HELICOPTER ACCESSIBILITY STUDY

Area 6/7

Date	25 July 2024
Report nr.	24-RA-011
Version	1.0

Intern gebruik

Colophon	
Report	24-RA-011
Version	1.0
Status	Final
Date	25 July 2024
Title	Helicopter accessibility area 6/7
Project number	13496.027.01
Client	DGWB
Project team MovingDot	Ander Okina, Alejandra Hertfelder, Michael Probyn, Basem Deeb, Mees van der Kooij, Sigmund Lentze
File name report	24-RA-011 Helicopter accessibility area 6-7.docx
Classification	Business confidential

Version control	Content	Date
0.1	Initial draft	1 May 2024
0.8	Concept report	29 May 2024
0.82	Update after final presentation (31/05/2024)	9 June 2024
1.0	Final version after processing all customer review comments	25 July 2024

Report authorisation	Name	Date
Created by	MovingDot project team	1 May 2024
Reviewed by	Sigmund Lentze	6 June 2024
Approved by	Henk Waltman	30 May 2024

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SAMENVATTING

Het Ministerie voor Infrastructuur en Waterstaat (IenW) onderzoekt de mogelijkheden voor de het aanwijzen van windenenergiegebieden in de Noordzee, met ruimte voor tenminste 23-26 GW. Het overgrote deel daarvan wordt gezocht in zoekgebied 6/7. Het voorliggende rapport beschrijft de mogelijke toepassing van "Point in Space" (PinS) helikopter procedures naar (toekomstige) platformen met een helideck in dat gebied. PinS procedures zijn "instrument" procedures - in tegenstelling tot volledig visuele procedures - waardoor er mogelijk preciezer, met minder ruimtebeslag, en onder meer weersomstandigheden veilig gevlogen kan worden.

De opgegeven onderzoeksvraag is tweeledig:

1) hoeveel ruimte is nodig voor zulke PinS naderings- en vertrekprocedures, waarbij ook de benodigde ruimte voor een veilige "One Engine Inoperative" (OEI) procedure wordt meegerekend, en
2) wat is de helikopterbereikbaarheid als deze procedures worden gebruikt?

Omdat tevens ruimte geboden moet worden voor veilige "One Engine Inoperative" (OEI) procedures rond het helideck, wordt de eerste vraag opgesplitst in tweede delen en bestaat het antwoord uit drie delen:

(1a) de hoeveelheid benodigde ruimte voor PinS,
(1b) dezelfde ruimte, aangevuld met OEI, en
(2) een schatting van de helikopterbereikbaarheid.

Om een bruikbaar resultaat te leveren is deze aanpak voor 3 mogelijke gebiedsindelingen van zoekgebied 6/7 onderzocht: combinatievariant 27, combinatievariant 0 en een uiterste theoretische gebiedsindeling, waarbij om ieder platform een obstakelvrije zone van 5 NM wordt vrijgehouden. "Combinatievariant 27" betreft een theoretische indeling van gebied 6/7 met een smalle open ruimte en met een beperkte ruimte voor helikoperbereikbaarheid voor alle potentiële platforms voor olie- en gas in het gebied. "Combinatievariant 0" betreft een theoretische indeling van gebied 6/7 waarin de ruimtelijke wensen van alle partijen gehonoreerd worden. Zie Figure 56 tot en met Figure 58 voor de drie theoretische gebiedsindelingen.

Tot slot, het is belangrijk op te merken dat instrument procedures met "obstakelvrije vlakken" gebaseerd zijn op de aanname dat deze vlakken vrij gehouden worden. De toepassing vereist daarom dat ook scheepvaart deze vlakken niet doorkruist op het moment dat de procedure gevlogen wordt. De detectie van scheepvaart is daarom een randvoorwaarde, terwijl systemen en procedures hiervoor nog in ontwikkeling zijn en op dit moment niet zondermeer beschikbaar zijn.

Ruimtebeslag – algemeen

De conclusie van het onderzoek is dat voor combinatievariant 27 de PinS procedure, inclusief OEI, ca. 41 km² ruimte vraagt in het gebied dat gepland is voor de windturbines. In onderstaande figuur (Figure 1 ***) is dat het oppervlakte van alle donkerroze gebieden ("Overlap between PinS and wind energy area") opgeteld.***

In de figuur is te zien hoe, voor alle mogelijke platformen in variant 27, de ruimte voor de PinS procedure zo in het gebied gepland is dat deze een minimaal ruimtebeslag vergt.

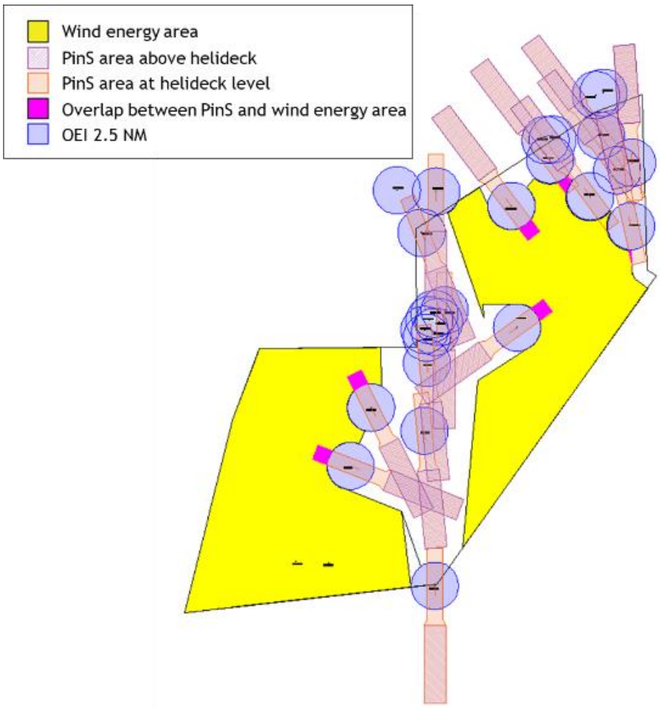


Figure 1: Combinatievariant 27 met ruimtebeslag PinS procedures

De genoemde 41 km^2 is hier overigens een gevolg van het ruimtebeslag voor een “missed approach”. Door hiervoor een ander (afwijkend) procedureontwerp te maken, wordt dit ruimtebeslag iets groter, maar past het beter in de vrije ruimte zoals ingetekend in combinatievariant 27. Dit is één van de mogelijke optimalisaties die bij de uitwerking kan leiden tot ruimtebesparing (zie Figure 2).

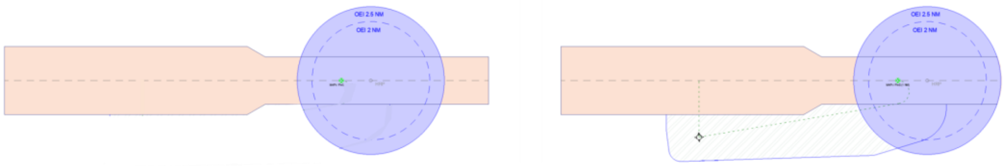


Figure 2: Links het ruimtebeslag van een PinS procedure voor één platform. Rechts met een alternatieve “missed approach” procedure

Daarentegen is in de figuur te zien dat de open ruimte in het midden van het gebied slechts gedeeltelijk nodig is - waardoor de procedure netto niet meer ruimte vraagt.

Voor de twee andere onderzochte gebiedsindelingen (combinatievariant 0 en met alleen 5 NM obstakelvrije zones) is er geen extra ruimtebeslag. Ook voor deze twee gebiedsindelingen is het ruimtebeslag in de vrije ruimte minder dan er beschikbaar is. Het rapport toont in separate tekeningen van het ruimtebeslag in deze twee gebiedsindelingen.

Aanvullende toelichting door IenW
Combinatievariant 27 is in de ruimtelijke analyse die IenW heeft uitgevoerd de variant waar de minste ruimte wordt gereserveerd voor specifiek helikopterbereikbaarheid (uitgezonderd twee prospects voor CCS in het zuidwesten van gebied 6.7). In andere combinatievarianten is er meer vrije ruimte voor helikopterbereikbaarheid gereserveerd, óf is voor 1 of meer prospects helemaal geen vrije ruimte voor helikopterbereikbaarheid. Dat betekent dat de PinS procedure ruimtelijk passend is in alle combinatievarianten waarin specifiek ruimte is gereserveerd voor helikopterbereikbaarheid.

Bereikbaarheid
De bereikbaarheid met PinS is afhankelijk van de vraag of de aanwezigheid van schepen in de gereserveerde ruimte tijdens het aan of afvliegen op een betrouwbare manier kan worden uitgesloten.

Het korte antwoord op de tweede deel van de onderzoeksvraag is dat de helikopterbereikbaarheid met de PinS procedure varieert van 91 tot 94 %. Het hangt af van keuzes in het detailontwerp (vooral de ligging van de PinS MAPt) en cloud-base limiet, en daarnaast varieert de bereikbaarheid per maand van het jaar. Omdat aangenomen is dat het helideck in een optimale oriëntatie op het platform ligt en er twee vliegrichtingen beschikbaar zijn, is de wind geen beperking.

Wat betreft de impact van scheepvaart (die langs de gegeven scheepvaartroutes vaart) op de procedure geldt dat de eisen voor de OEI niet samen gaan met schepen hoger dan 30 m en lager dan 300 m in het OEI gebied. Deze eis is onafhankelijk van de keuze voor PinS. Pas boven de 300 m zou scheepvaart impact hebben op de PinS procedure, als zulke scheepvaart al ooit zou voorkomen.

Zoals hierboven al vermeld, is het belangrijk op te merken dat het kunnen gebruiken van obstakelvlakken in procedures vereist dat schepen hiervan vrijblijven, bijvoorbeeld door de introductie van scheepsdetectie of ruime hoogte minima waarmee vrij wordt gebleven van scheepvaart. Op dit moment zijn er nog geen geaccepteerde systemen en procedures voor scheepsdetectie beschikbaar. Hoogteminima die boven alle mogelijke schepen gekozen zouden kunnen worden – tot bijvoorbeeld 700-800 ft - verlagen de bereikbaarheid met 10-15%.

In het rapport worden het ruimtebeslag en de helikopterbereikbaarheid in meer detail toegelicht. Voor het ruimtebeslag wordt tevens een indicatie gegeven van de flexibiliteit die in een later detailontwerp benut kan worden voor verdere optimalisatie.

Ruimtebeslag – in detail
Het ruimtebeslag is een gevolg van een groot aantal (ICAO) eisen, de lokale situatie en de specifieke operatie, en daarna van ontwerpmogelijkheden en -keuzes. Het horizontale ruimtebeslag (van bovenaf bezien) is opgebouwd uit meerdere eisen aan obstakelvrije ruimte. Dat zijn achtereenvolgens ICAO Annex 14 eisen voor take-off en landing (Obstacle Limitation Surfaces - OLS), de OEI eisen en de PinS procedure eisen.

In deze opdracht is het helideck vooraf gedefinieerd (o.a. op 30 m hoogte), zijn er 3 helikoptertypes beschouwd voor de helideck afmetingen, en wordt een “optimale” aanname gedaan van het vliegpad (klimhoek, daalhoek etc.) dat ruimte biedt voor onbelemmerde operaties, met een minimaal ruimtebeslag.

Tot slot is ook het extra ruimtebeslag door windturbine zog (turbine wake) beschouwd. Dat is echter nog niet goed bekend, noch voorgeschreven. Omdat richtlijnen en regelgeving ontbreken, is hiervoor een ‘educated guess’ gemaakt. Dat levert een extra 12 km^2 ruimtebeslag op, rond het lage gedeelte van de PinS procedure.

Ruimtebeslag horizontaal – in detail: Annex 14 Obstakelvrije vlakken (OLS)
Deze vlakken, die de helikopter tijdens het gebruik van de procedure beschermen, zijn opgebouwd uit een Obstacle Free Surface (OFS), een sectorsegment van 210˚, een naderings- en vertrekvlak, en een extra vlak voor visuele operaties bij het helideck (het Transitional Surface). De afmetingen en oriëntatie van deze vlakken worden in het rapport in meer detail beschreven. Onderstaande figuur toont de gecombineerde vlakken en het OFS t.o.v. het helideck.

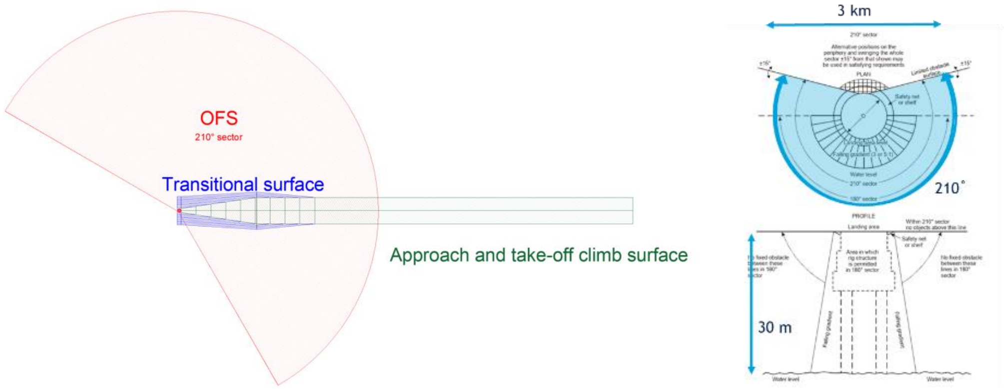


Figure 3: Obstakelvrije vlakken conform ICAO voorschriften

Het OFS is zo georiënteerd dat het onder alle windrichtingen gebruikt kan worden. Daarnaast zijn er bij voorkeur twee naderings- en vertrekvlakken, in (180˚) tegengestelde richtingen, zodat altijd tegen de wind in gevlogen kan worden.

Ruimtebeslag horizontaal – in detail: de afmetingen van de PinS procedure, OEI en turbine-zog
In onderstaande figuur zijn de afmetingen te zien van de PinS procedure, gecombineerd met de Annex 14 “OLS” vlakken. Dit is geschikt voor moderne helikopters (2030+) die met RNP 0.3 nauwkeurigheid kunnen vliegen.

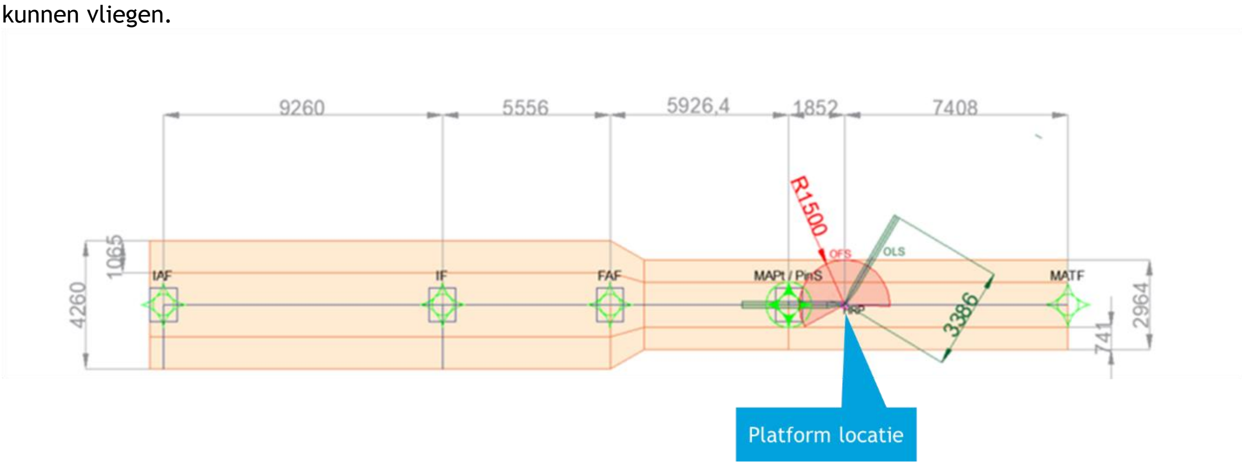


Figure 4: Horizontaal ruimtebeslag OFS en PinS

Aan deze afmetingen kunnen de OEI vlakken worden toegevoegd. Dan vereist de procedure onderstaande afmetingen. De straal van de OEI cirkel zou kleiner kunnen zijn (2 NM) dan hieronder is 2,5 NM aangenomen, conform de opgave van IenW.

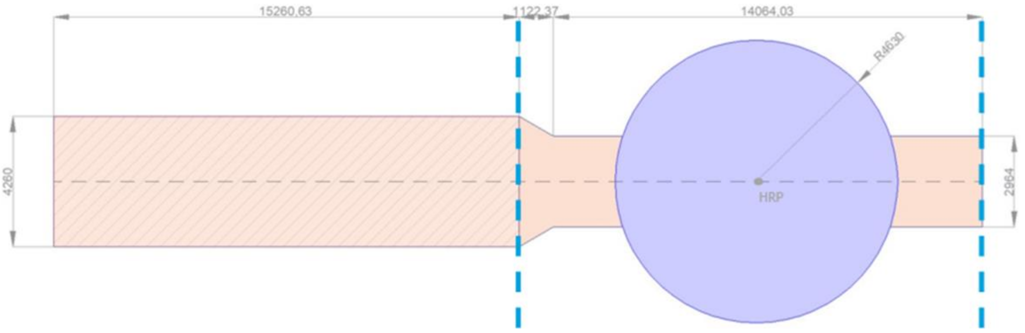


Figure 5: Globaal overzicht verschil in hoogtebeperkingen in ruimtebeslag OEI en PinS, verder van platform

In bovenstaande figuur is ook een verschil aangegeven links of rechts van de linker blauwe gestippelde lijn. Rechts van de lijn mogen er geen obstakels aanwezig zijn ter hoogte van het helideck, links ervan kunnen er hogere obstakels zijn. Dit zijn zogeheten beperkingen. De beperkingen worden hierna toegelicht.

Naast deze vlakken zou ook de invloed van het zog (de turbulentie) van de windturbines de operatie kunnen beperken. Als daarvoor extra ruimte moet worden meegenomen is nu de inschatting dat dit voor combinatievariant 27 tot een extra 12 km^2 ruimtebeslag rond het rechter deel zou kunnen leiden. Dit is echter een inschatting op een groot aantal aannames, gezien het ontbreken van breed geaccepteerde richtlijnen of specifieke regelgeving hiervoor.

Ruimtebeslag in hoogte

Het ruimtebeslag voor de PinS procedure biedt beperkt ruimte “onder” de procedure: het hoogte beslag van de procedure. Daarbij levert de nadering (de daling) grotere hoogtebeperkingen dan het vertrek (de klim).

Als de nadering beschouwd wordt, varieert het hoogtebeslag afhankelijk van de fase van de vlucht:

- Onder de initiële fase is er ruimte voor obstakels (bijvoorbeeld windturbines) tot 150 m.
- Onder de tussenfase is er ruimte tot 300 m.
- Onder de laatste fase en de afgebroken nadering is er geen ruimte.

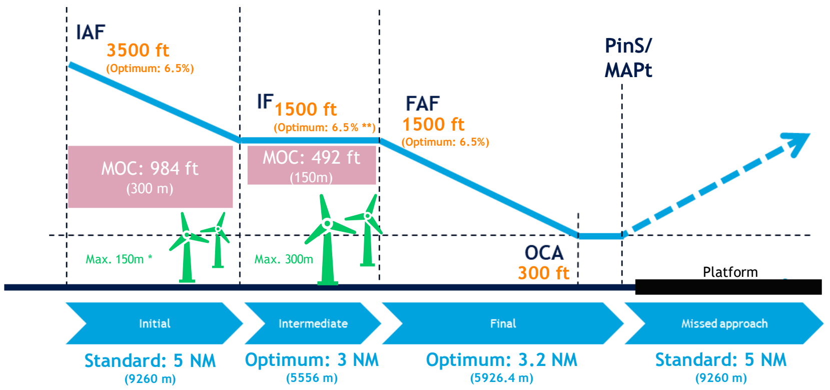


Figure 6: Vluchtfases nadering: initiele fase - tussenfase - laatste fase en afgebroken nadering

De initiële- en tussenfase samen zijn ca. 15 km lang (9.5 km + 5.5 km) en ca. 4,5 km breed. De finale fase en de afgebroken nadering beslaan samen ook ongeveer 15 km lengte, bij een breedte van ca. 3 km.

Er is ook gekeken naar verhoging van de tussenfase (naar 2.000 ft i.p.v. 1.500 ft) om daar meer ruimte voor windturbines te creëren. Met een tussenfase op 2.000 ft is onder de initiële fase dan ook ruimte voor obstakels tot 300 m. Er zijn daarbij echter aanzienlijke operationele nadelen, in het bijzonder het vergrote risico op ijsafzetting.

1 INTRODUCTION

1.1 Context

The Ministry of Infrastructure and Water Management (IenW) is preparing a Partial Revision (Partiële herziening, PH) of the North Sea Program 2022-2027 (Programma Noordzee) due to the need to designate new wind energy areas for the period after 2031. The task for the PH is to find space for at least 23-26 GW of wind energy. Three areas are being considered for this purpose.

The designation of wind energy areas is the first formal step in selecting locations for future wind farms. In a second formal step, *kavelbesluiten* are made. According to the Offshore Wind Energy Act (Wet Windenergie op Zee), *kavelbesluiten* can only be made in designated wind energy areas. Before designating wind energy areas, search areas are mapped and investigated.

Estimating the effects on helicopter accessibility of existing and potential future platforms is part of the investigations. It has become clear that the space requirements for the currently standard flight methods are substantial. To enhance the spatial efficiency of potential wind farming areas and achieve spatial gains in both mining and wind energy activities, it is valuable to explore alternative flight methods, particularly the PinS (Point-in-Space) approach/departure, and estimate the area needed for this. This information will be used in determining how much of search area 6/7 can be designated as a wind energy area and in considering whether to embark on a long-term project to implement the PinS approach/departure procedures for the period after 2030, in terms of reserving space. The information could also be instrumental in engaging different stakeholders such as mining and helicopter operators on this topic. This information will not automatically be translated into (spatial) policy but will serve as one of the inputs towards it.

1.2 Assignment

The aim of this assignment is to estimate the required space for a PinS approach/departure procedure for the expected prospects/mining platforms in and around search area 6/7. The objective is to answer the following two questions:

1. How much space (in km^2) is needed for safe helicopter accessibility around (potential) platforms in search area 6/7 if PinS procedures are applied in the future (including the requirements for OEI situations)?

2. What level of safe helicopter accessibility (if necessary, in the form of a range) can be achieved by reserving this space if flights are conducted using the PinS procedures?

1.3 Methodology

- **<u>Step 1:</u>** Estimate the space/area requirements for a PinS approach/departure for (at least) a selection of platforms in area 6/7, such that the range of total space requirements for helicopter accessibility through the PinS procedures in this area can be estimated.

  The aim is to provide indications of the total space needed in area 6/7 (in km^2) and to create different concept maps showing this space requirement. To that end, the following activities are carried out:

  - ICAO Annex 14 helideck surfaces – to safeguard the helideck against obstacles. The Annex 14 OLS purpose is to protect a volume of airspace to preserve the safety, accessibility (regularity) and efficiency of the helideck. These volumes of airspace around the helideck shall be kept free from obstacles to minimize the dangers presented by obstacles to a helicopter, by limiting the obstacles that are allowed in the vicinity of the helideck.

  - PANS-OPS protection areas for PinS procedures (routes). These areas are defined together with applicable obstacle clearance requirements for the achievement of safe and regular instrument flight operations, to safeguard a helicopter from collision with obstacles when flying in IMC. Such required protection areas are different depending on the specific instrument flight procedures (routes) and are designed for take-off from and landing on a specific helideck.

- Step 2. Estimate the space/area requirements for a PinS approach/departure if it is combined with the OEI obstacle free space requirement.
None of the previous set of standards (Annex 14 or PANS-OPS) currently address the issue of the protection of emergency procedures (designed by helicopter operators) such as one engine inoperative take-off. The aim of this second step is to integrate the results of step 1 (PinS approach/departure procedures) with the results of a separate study (carried out independently by To70) on the obstacle-free space needed for OEI (One Engine Inoperative). The objective is to provide an answer to the overall question of how much space is needed for accessibility with PinS, ensuring that OEI requirements, as mandated by law and regulations, are met. The space needed for OEI is included in the total area estimation (in km^2).

- Step 3: Estimate the average accessibility for helicopters that can be achieved with the integrated obstacle-free space from Step 2, considering:
  - Impact of the prevailing weather conditions in the area
  - Effect of the ICAO Annex 14 safety areas
  - Effect of the PinS procedures safety areas
  - Effect of the OEI required areas

1.4 Assumptions

1.4.1 General assumptions for the study

As agreed with the customer, the following assumptions are made for this project:

- The definition of a standard helideck is based on the parameters described in section 1.4.2.
- Two approach and take-off climb surfaces must be available per platform/prospect.
- Per platform/prospect, a single PinS approach/departure procedure is provided based on standard/optimum values provided in PANS-OPS (ICAO Doc. 8168 Vol. II).
- Simultaneous helicopter operations to platforms that are next to each other are not considered in the scope of this study. Therefore, overlapping protection areas (e.g. overlapping OEI areas or PinS areas) do not pose a risk for the helicopter operations.
- The OEI surface is provided at helideck level and must be free of obstacles when the helicopter is operating to/from that specific platform.

1.4.2 Parameters defining the helideck

For the assessment of the required obstacle limitation surfaces (OLS), it is necessary to establish the type of heliport and its physical dimensions. The physical dimensions are related to the maximum length of the helicopter intended to operate to/from the helideck.

For the time being the type of platform, helideck and helicopter type are not yet known. Therefore, the study of the ICAO Annex 14 surfaces is performed bases on the following assumptions:

- Heliport type: helideck (offshore facilities, see definitions above)
- Assumption: TLOF = FATO = D
- D-value: 20 m. Chosen based on the biggest helicopter out of the most used helicopter types in offshore projects (NL, GE, BE)
- Helideck elevation: 30 m[1]

	AW139	NH90	H175
D-value (metres)	16.63	19.58	18.06
Perimeter 'D' Marking	17	20	18
Rotor diameter (metres)	13.80	16.3	14.80

Note: the definition of the platform and its helideck (physical dimensions) has no impact on the design and implementation of PinS procedures. This information is only required for the provision of the OLS conform ICAO Annex 14.

[1] As provided by the customer via email (13/05/2024).

2 ESTIMATION OF THE AREA REQUIREMENTS FOR PINS APPROACH/DEPARTURE

This chapter includes the definition of the required ICAO Annex 14 surfaces (OLS) and the standard definition of the PinS procedures (approach and departure) to be considered later in the accessibility study.

2.1 ICAO Annex 14 Vol. II required surfaces

The purpose of the **Obstacle Limitation Surfaces (OLS)** is to define the airspace around the different helicopter landing sites that needs to be maintained free from obstacles so as to permit the intended operations at the helicopter landing site to be conducted safely.

The heliports considered in this study are defined as helidecks[2], following ICAO's definitions [**Error! Reference source not found.**]. The following OLS must be maintained free of obstacles:

- Obstacle Free Sector (OFS)
- Approach surface
- Take-off climb surface
- Transitional surface, if PinS procedures with proceed visually are to be provided to/from the helideck

The dimensions of the OLS are determined by the type of helicopter operating on the helideck (longest helicopter expected to operate). For the time being, there is no helicopter operator assigned for these platforms and, therefore, the assumptions described in section 1.4 will be used.

Other assumptions required for the determination of the OLS are listed below:

- **Day and night operations.** In order to maintain the options as open as possible for the future operation, these calculations are made based on the use of the helideck during day and night, since different and more stringent criteria apply for night operations.
- **Performance Class.** In hostile environments (such as offshore platforms, conform the definition of ICAO Annex 6 [**Error! Reference source not found.**]), only operations in accordance with performance class 1 and 2 (PC1 and PC2) are allowed. This information shall be provided by the helicopter operator, but since there is no helicopter operator yet, it is assumed that they will operate as PC1 (based on the input received from other helicopter operators in the Netherlands, Belgium and in Germany for similar studies in the North Sea area).
- **Slope design category.** For PC1, slope design category A is assumed. Note that all other slope design categories (B and C) are less limiting and even so, the values included in Table 1 are just minimum values and not operational values.

[2] **Helideck.** A heliport located on a fixed or floating offshore facility such as an exploration and/or production unit used for the exploitation of oil or gas.

*Table 1 - ICAO Annex 14 Vol II [**Error! Reference source not found.**] - OLS parameters*

Surface and dimensions	Slope design category A
Approach and take-off climb surface:	
Length of inner edge	Width of safety area
Location of inner edge	Safety area boundary
Divergence:	
Night use	15%
Total section:	
Length	3 386 m
Slope	4.5% (1:22.2)
Outer width	10 rotor diameters overall width for night operations
Transitional surface:	
Slope	50% (1:2)
Height	45 m

2.1.1 Obstacle Free Sector / Surface (OFS)

The **obstacle free surface** is a complex set of surfaces meant to protect operations to and from helidecks, in the surrounding of the FATO, applicable in all types of operations. These surfaces cannot be penetrated by any obstacles, in order to make the design compliant and safe for usage by helicopters.

The OFS consists of two surfaces (see Figure 7): one above and one below helideck level. The horizontal surface above helideck level is intended to protect the approach and departure path of the helicopter; while the surface below helideck level extends downwards and outwards sloping from the edge of the FATO to protect loss of elevation in case of an engine failure.

The horizontal OFS depends on the physical characteristics of the platform as it extends 210° (minimum) from the edge of the helideck where the OFS chevron is marked (opposite side of the area meant for helicopter operations), as shown in Figure 8. Therefore, the position and the orientation of the platform influences the provision of the horizontal OFS.

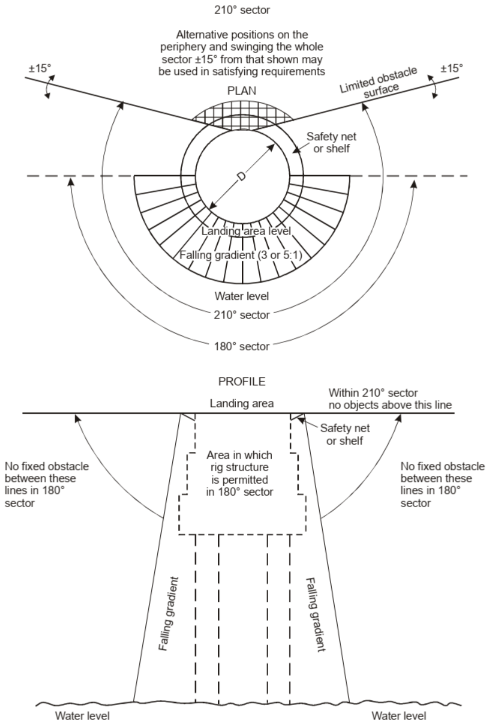


Figure 7 - Helideck obstacle-free sector [Ref 1]

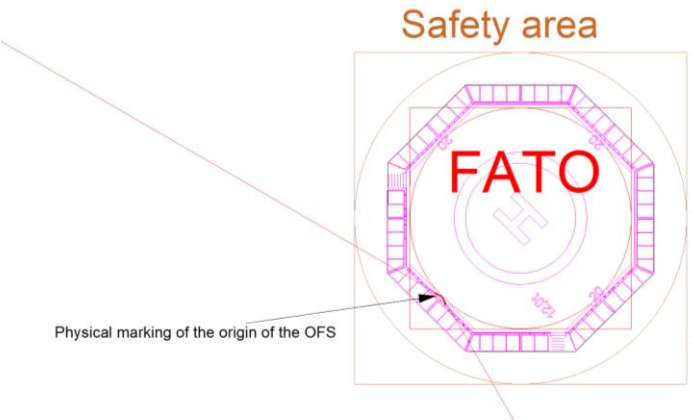


Figure 8 – Physical marking of the origin of the OFS

The 210-degree surface does not have a fixed radius although it is dependent on the required distance to a safe elevation by the worst performing helicopter with one engine inoperative. The parameters to compute the required distance to a safe altitude are defined in each helicopter flight manual. In this case, due to the lack of guidance on national regulation level, and based on previous studies performed in Germany, Netherlands and Belgium, a radius of 1.5 km is used in the definition of the 210-degree surface. This distance would allow helicopter operators to maneuver within the 210-degree sector to align themselves with the wind direction and land (or take-off) in a safe manner.

In the cases where there is not enough space available for the full OFS to be provided, a reduced OFS could also be provided with the size of available space[3]. This would in turn result in operational constraints for the operator. This could be an interesting option for helidecks that are located in an obstacle-rich environment, such as in a windfarm.

For the horizontal surface, the area required for the case where a radius of 1.5 km is required is approximately 4.2 km^2.

Note: given the scope of this study (where one-engine inoperative protection areas of 2.5 NM are considered in the overall picture), a reduced OFS is not further explored as the OFS will not be the most limiting factor or area.

[3] With the reduced OFS being an operating limitation for the helicopter operation. According to EASA AMC1 SPA.HOFO.115 [**Error! Reference source not found.**]: *If these sectors/surfaces are infringed, even on a temporary basis, and/or if an adjacent installation or vessel infringes the obstacle-protected surfaces related to the landing area, an assessment should be made to determine whether it is necessary to impose operating limitations and/or restrictions to mitigate any non-compliance with the criteria.*

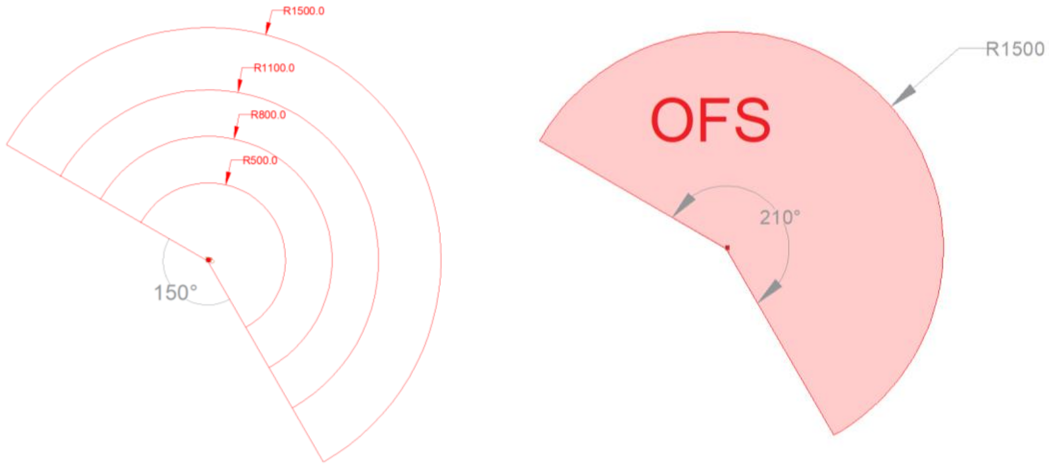


Figure 9 – 210-degree sector defined for different radius between 500 and 1500 m (for illustration purposes)

The second surface extends 180°, from the edge of the FATO downwards to sea-level, with a slope of 5-to-1 for performance class 1 operations. With the helideck height of 30 m, the surface extends 6 m away from the helideck, and the surface cannot be penetrated by any obstacle. Due to the inherent design of the platform, and due to the lack of obstacles in that area, this surface is expected to never penetrated by any obstacle.

2.1.2 Approach and take-off climb surface

In order to safeguard a helicopter during its approach to the helideck and in its climb after take-off, an **approach surface and a take-off climb surface** through which no obstacle is permitted to project is established for each approach and take-off climb path designated to/from the helideck.

ICAO Annex 14 Vol. II **[Error! Reference source not found.]** defines the approach and take-off surfaces as inclined planes, starting at the edge of the safety area (or safety net, in the case of a helideck), and extending up to an altitude of 152 m above the elevation of the Final Approach and Take-off Area (FATO). The surface splays towards the outside until reaching a maximum width, dependent on the design rotor diameter, and then continues until reaching an altitude of 152 m. The parameters for the construction of the surface are gathered in Table 1, while Table 2 shows the values that apply in this case.

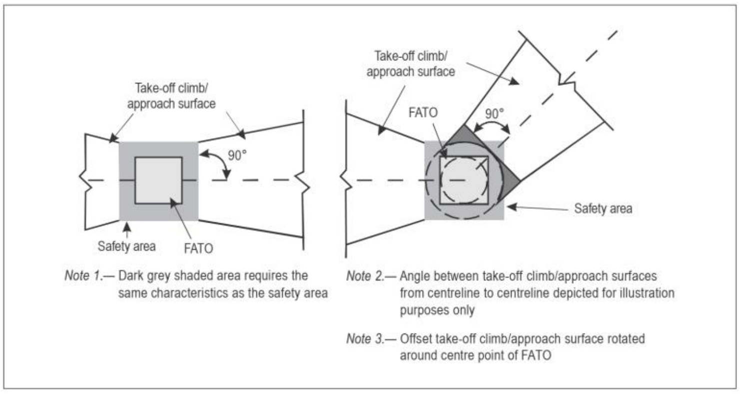


Figure 10 - Construction of take-off climb and approach surfaces [Ref 1]

Additionally, when the obstacle environment is complex, turns may be provided in the approach and take-off surfaces. There are however strict requirements for the turn radius, straight segment, and arc lengths of the turns, as well as a limitation for a single turn in a route. These are summarized in Figure 11.

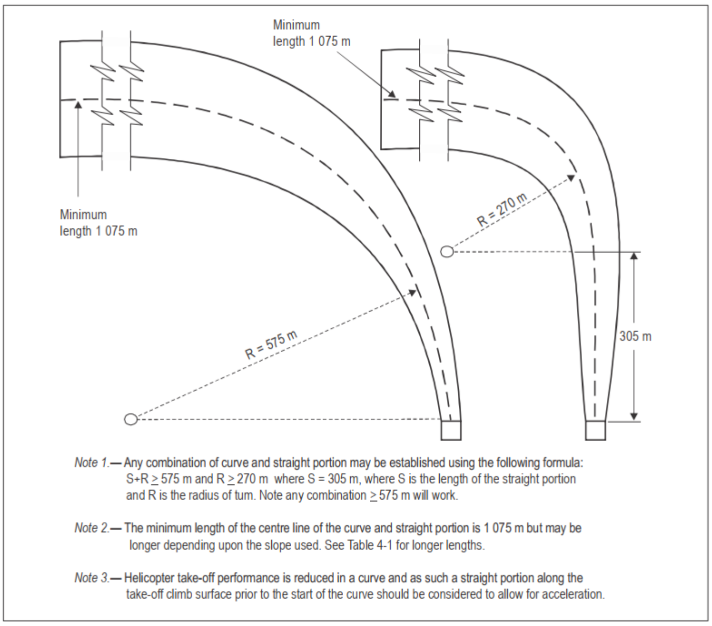


Figure 11 - Requirements for turn dimensions on approach and take-off routes [Ref 1]

Based on ICAO Annex 14 Vol. II [Ref 1] parameters, the approach and take-off climb surfaces have the same dimensions. The following values will be used to construct the surface associated to the routes defined for each of the three scenarios:

Table 2 - Values for the construction of approach and take-off surfaces

Parameter	Design values
Initial width (inner edge)	30 m (assumption)
Location of inner edge	15 m from helideck centre
Divergence	15% (night operation)
Initial elevation	30 m
Final elevation (height)	182 m (152 m)
Length	3386 m

Slope	4.50%
Design Rotor Diameter	20 m (up to NH-90)
Final width	200 m (10 x RD)

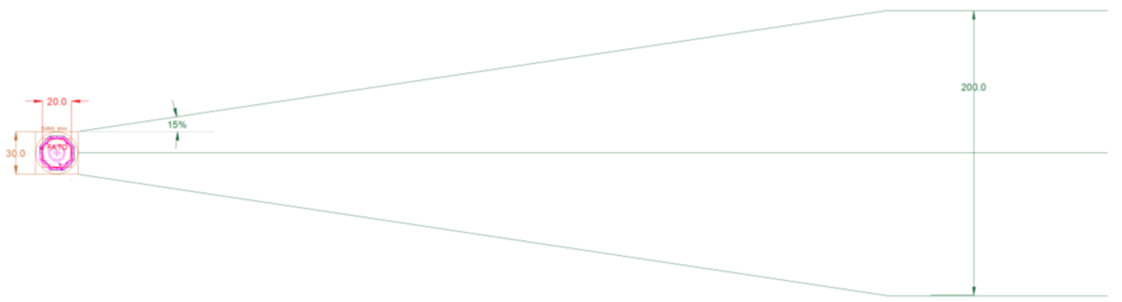


Figure 12 – Depiction of the initial segment of the approach and take-off climb surface

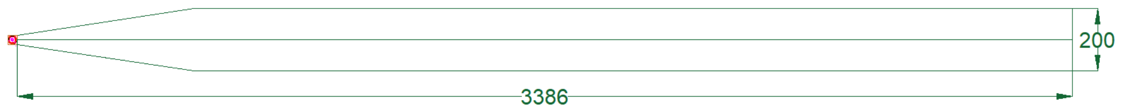


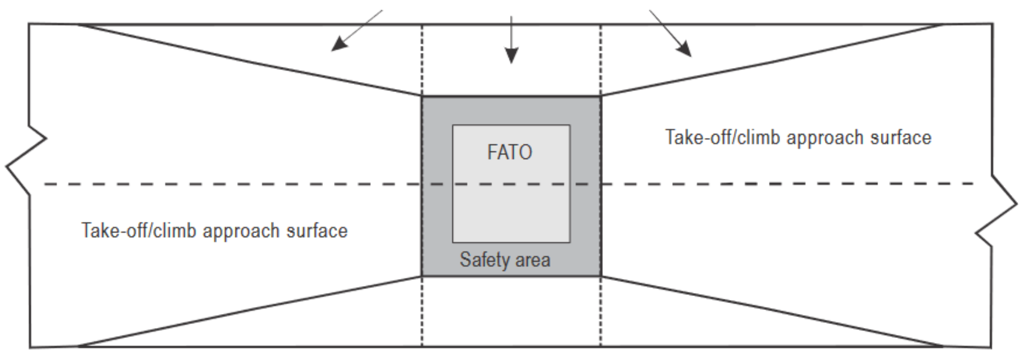
Figure 13 – Lateral dimension of the approach and take-off climb surface

For the approach and take-off climb surface, the area required for each of the surfaces is approximately 0.7 km^2. See section 2.1.4 for further details about the definition of the second approach and take-off climb surface and the total required area.

2.1.3 Transitional surface

A FATO with a PinS approach/departure procedure with proceed visually instruction may be used in conditions that are below those required for VFR flight. Consequently, seeing and avoiding obstacles that are outside the OLS whilst manoeuvring to maintain the required flight path add to the workload of the pilot. For the safety of a helicopter which becomes displaced from the centre line while executing a PinS approach/departure procedure with proceed visually instruction, a **transitional surface** should be provided, although not a necessity for heliports which will only be used in VMC.

A complex surface along the side of the safety area and part of the side of the approach/take-off climb surface, that slopes upwards and outwards to a predetermined height of 45 m (150 ft) with 50% slope (see Figure 14). This surface is required to facilitate PinS procedures.



Note 1.— For single take-off/climb approach surface. Transition surface extends to far side of safety area.
Note 2.— PANS-OPS, Doc 8168, Volume II, Part IV, details procedure design criteria.
Note 3.— This figure shows a square FATO for illustration purposes only. For a circular FATO, the transitional surface lower and upper edges would also be circular.

Figure 14 - Transitional surface for a FATO with a PinS approach procedure [Ref 1]

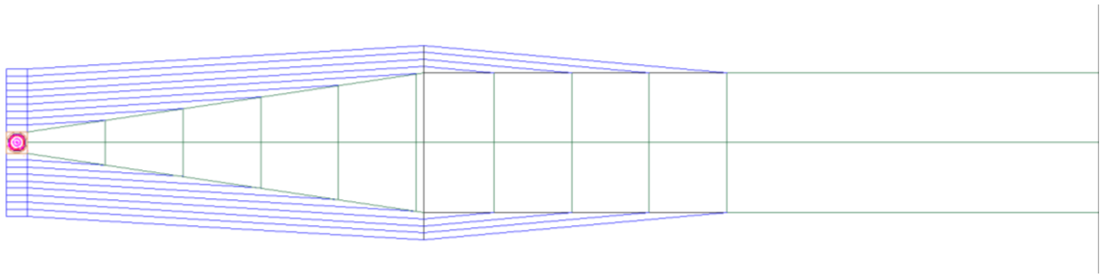


Figure 15 - Lateral definition of the transitional surface

2.1.4 Combination of all ICAO Annex 14 required surfaces

With all the provisions from the previous sections about the OFS, approach and take-off climb- and transitional surfaces, the combination of the three ICAO Annex 14 surfaces is depicted in Figure 16.

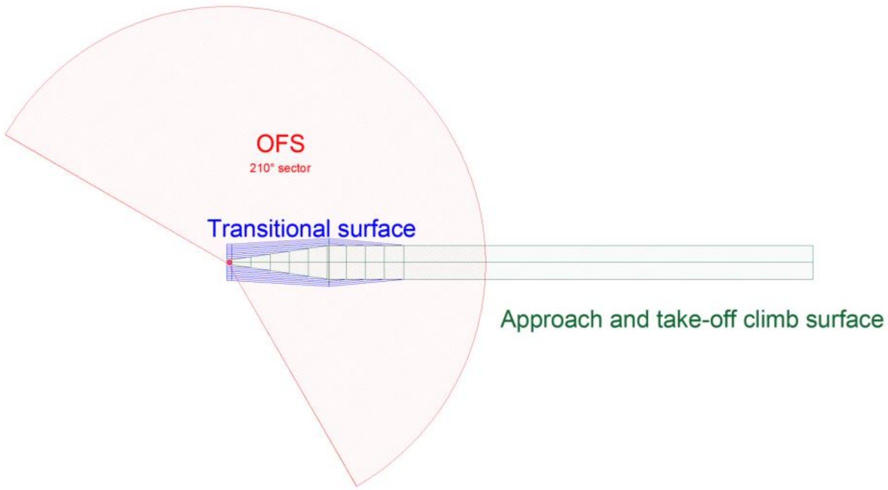


Figure 16 – Combination of all required ICAO Annex 14 surfaces for a generic case (single route)

Flexibility in the provision of ICAO Annex 14 helideck surfaces

- The orientation of the platform and the chevron marking on the helideck itself will determine the orientation of the OFS.
- For illustration purposes, the orientation of the platform, the OFS and the approach and take-off climb surfaces used in the previous images have been chosen randomly.
- A second approach and take-off climb surface[4] shall be provided in order to meet the recommendation of providing two approach and take-off climb directions to access the helideck.
- When only one approach and take-off climb surface is provided, an aeronautical study shall be carried out to ensure the safety of the helicopter operations.
- As an example, two approach and take-off climb surfaces are shown in Figure 17. They have been oriented in opposite directions as this represents the most optimimum orientation of such surfaces in order to increase the helideck accessibility for different wind conditions.
- Any other orientation of these surfaces is allowed within the 210-degree sector, but the accessibility and wind conditions should be considered as input for the optimization of their orientation.
- There is no requirement in terms of the minimum/maximum angle between two approach and take-off climb surfaces.

An advice of the orientation of the platform and the required approach and take-off climb surfaces is provided in the last step (Chapter 4) based on, among other factors, predominant wind conditions in the area.

[4] It is recommended to provide at least two approach and take-off climb surfaces to avoid downwind conditions, minimize crosswind conditions and permit for a balked landing.

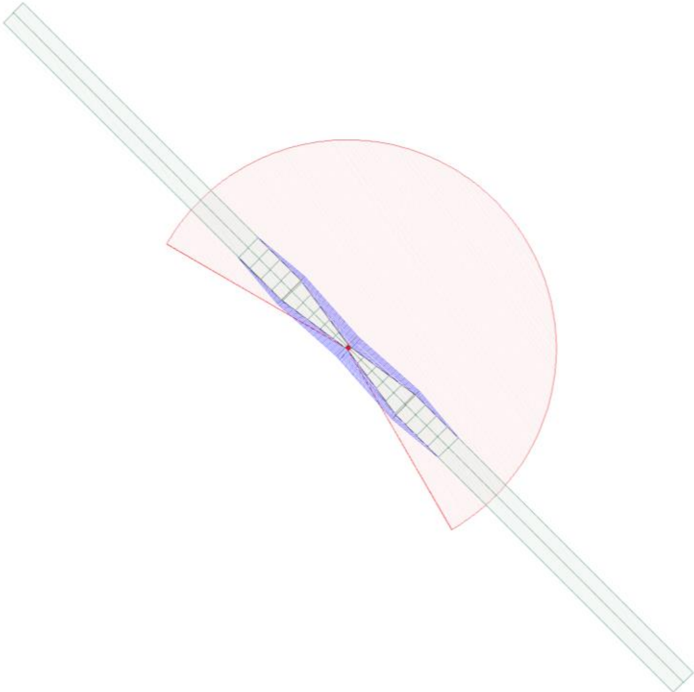


Figure 17 – Combination of all required ICAO Annex 14 surfaces for a generic case (two routes)

2.2 PinS approach and departure procedures

This section describes the required area based on PANS-OPS protection areas [Ref 3] that are needed for the implementation of PinS procedures, including approach, missed approach and departure flight phases.

<u>Remarks:</u>

1. For this first step, a generic PinS procedure is designed based on standard and optimum parameters (where available).
2. It is advised that PinS procedures are designed in collaboration with the helicopter operator(s) that will use the procedures regularly and tailored for their specific operation and helicopter type, given the flexibility they offer.
3. Where possible, the optimization of these procedures (and their corresponding protection areas) is considered in step 3 of the assignment (Chapter 4).
4. PinS criteria are relatively new and still under development. It is to be expected that by 2030 new criteria and possibilities will be included in future PANS-OPS amendments.

Note: Further details about the PinS procedures (approach and departure) should be discussed with the helicopter operator and the PinS procedures should be designed tailor made for a specific helicopter and operation type.

2.2.1 General PANS-OPS items

An instrument approach[5] may be divided into as many as four approach segments: initial, intermediate, final, and missed approach:

- **Initial segment:** The initial approach segment begins at an initial approach fix (IAF) and usually ends where it joins the intermediate approach segment.
- **Intermediate segment:** This segment begins at the intermediate fix (IF) and ends at the final approach fix (FAF). Its purpose is to align the helicopter with the final approach course.
- **Final segment:** The final approach segment begins either at a designated final approach fix (FAF) or at a point where you are established on the final approach course, and ends at the missed approach point (MAPt)
- **Missed approach segment:** The missed approach segment begins at the missed approach point (MAPt) and ends at a designated point, such as an initial approach or enroute fix.

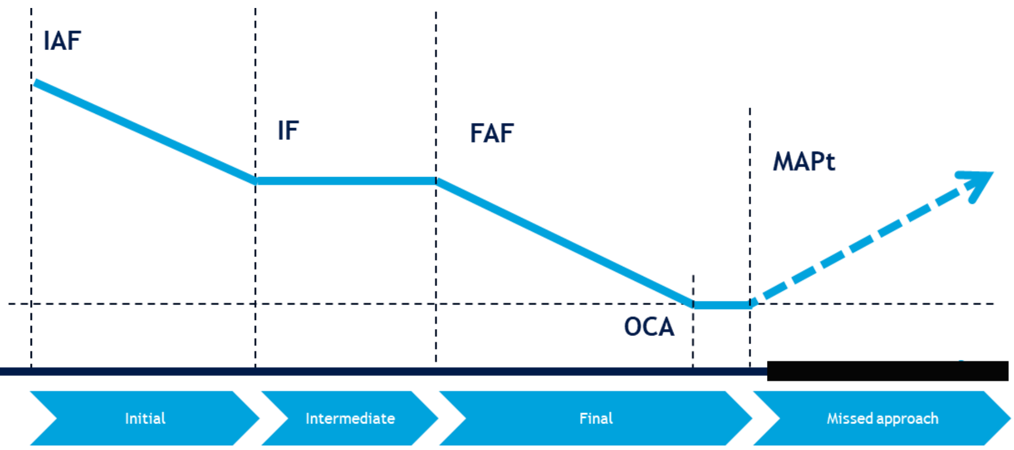


Figure 18 - Standard flight phases of an instrument approach procedure

[5] These flight phases do not exist as such for departure procedures since they are specific for instrument approach procedures.

<u>Procedure altitude and maximum obstacle elevation per flight phase in the IFR segment</u>

This section describes the maximum elevation for obstacles that can be placed on each of the segments defining the IFR part of the PinS procedure (see definitions in section 2.2.2).

At the request of the customer, a standard profile for a maximum procedure altitude of 1500 ft and 2000 ft is provided in this section, with deeper insight in the maximum obstacle elevation allowed per segment in an instrument approach.

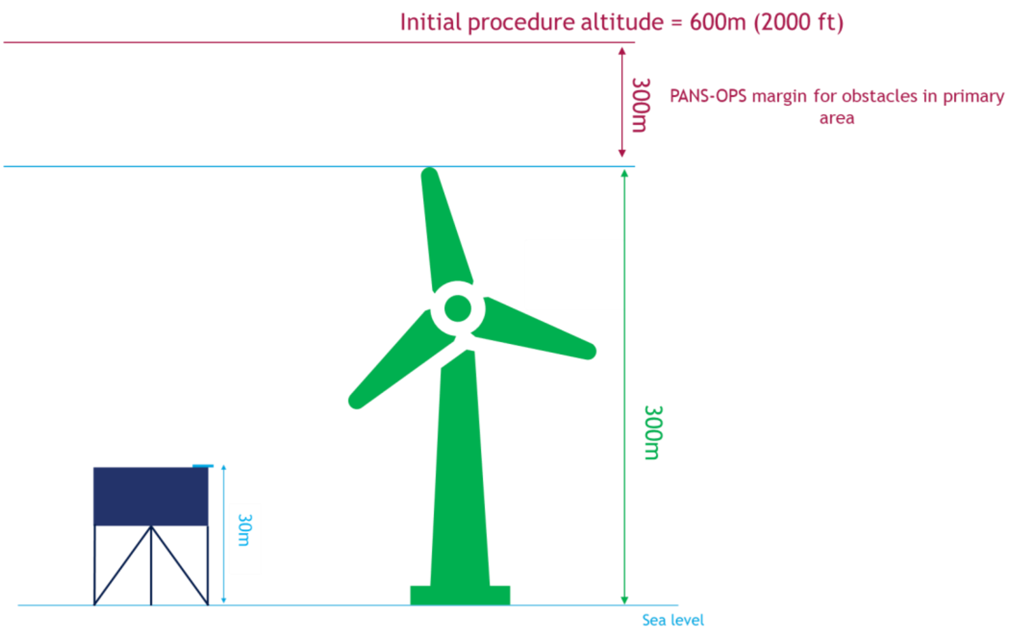
The results included in this section must be taken as indicative values and, therefore, shall not be considered as definitive values since these will depend on the exact definition of the PinS route and other constraints such as airspace (maximum altitude to avoid entering (or not) controlled airspace) or icing conditions for the helicopter operator. These variables are typically discussed with the helicopter operator in the early stages of a full design project and, therefore, cannot be determined in this study.

Initial approach segment

The Minimum Obstacle Clearance (MOC) that is applicable in the primary area of the initial segment is 300 m. This means the following:

- For the helicopter to remain at or above **<u>1500 ft</u>** (which is expected to be desirable compared to 2000 ft to avoid icing conditions over the North Sea) the maximum elevation of the wind turbines or any other obstacle in the initial segment shall be 150 m (150 + 300 = 450 m = 1500 ft).

- For the helicopter to remain at or above **<u>2000 ft</u>**, the maximum elevation of the wind turbines or any other obstacle in the initial segment shall be 300 m (300 + 300 = 600 m = 2000 ft).

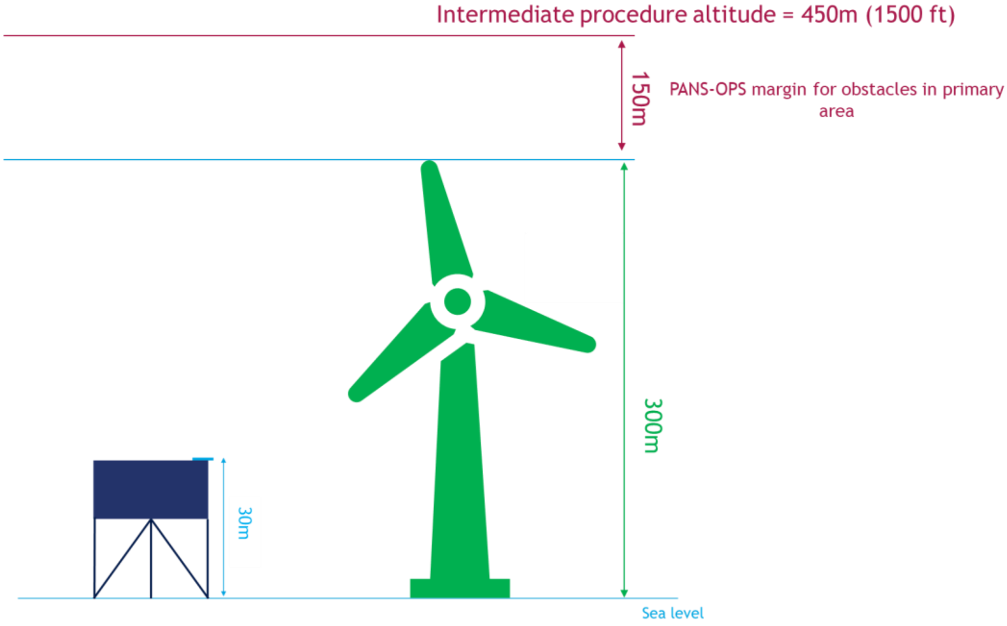


Intermediate approach segment

The Minimum Obstacle Clearance (MOC) that is applicable in the primary area of the intermediate segment is 150 m, which means:

- Wind turbines up to 300 m could be placed in the intermediate segment under the primary or secondary area of the approach as long as the required procedure altitude for this segment is **1500 ft** or above. If a different altitude would be required (below 1500 ft), then the elevation of the windturbines should be reduced accordingly.

- For an intermediate altitude of **2000 ft**, the maximum elevation of obstacles would then be 460 m (450 + 150 = 600 m = 2000 ft).

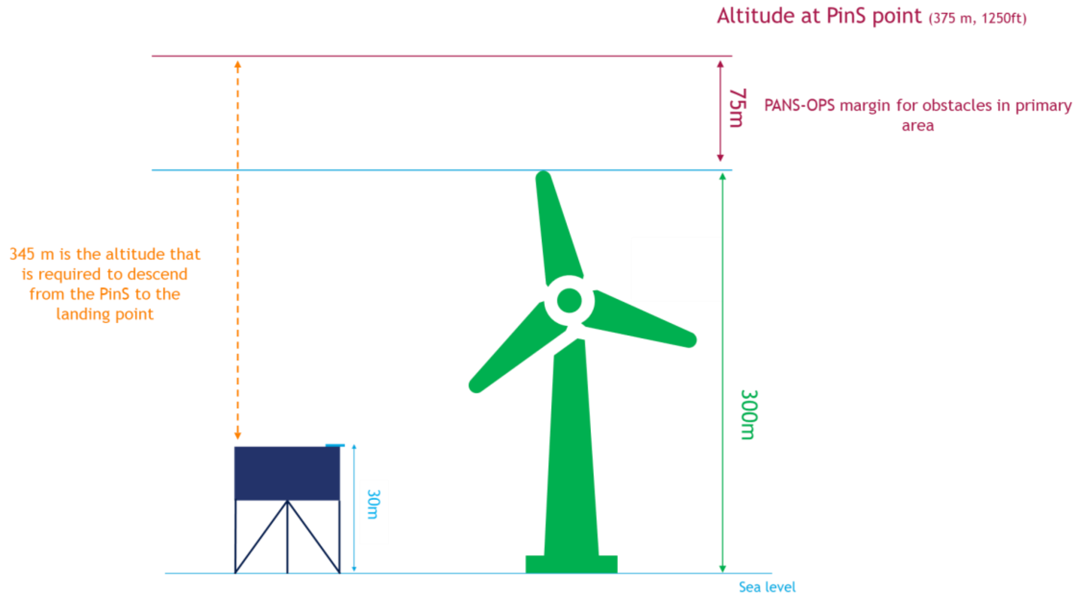


Final approach segment

The Minimum Obstacle Clearance (MOC) that is applicable in the primary area of the final segment is 75 m. That means that for windturbines of up to 300 m, the minimum altitude up to the PinS (or MAPt) would be 1250 ft, which, in turn, would result in the following visual segments (from the PinS to the helideck):

- By defining a steep descent profile (descent gradient of 10%[6]), the segment length required in the visual segment to allow for this descent would be 1.9 NM.
- For smaller visual segments (1 NM or less), the descent gradient required if windturbines of 300 m would be placed under the primary protection areas would be 20%, which is not feasible for almost all the helicopter operators.
- The determination of the altitude at the PinS point and the length of the visual segment shall therefore be carried out in an iterative way, also considering the potential heights of windturbines located within the final and visual segments.
- If possible, in order to optimize the PinS procedures and make use of the flexibility they can offer, it is preferred that no obstacles are placed between the FAF and the landing site. This way the lateral and vertical profile would be optimized.

[6] In the final segment, the recommended maximum descent gradient is 10% and the optimum is 6.5% [Ref 3]



2.2.2 General PinS items

PinS (Point-in-Space) procedures are based on GNSS (satellite navigation) and are designed to be used by helicopters only. This concept relies on the possibility for the pilot to conduct flight under IMC (Instrument Meteorological Conditions, i.e. low visibility) to and from a PinS and not directly to and from a heliport, supporting IFR procedures on instrument and non-instrument landing locations. Two types of PinS procedures are possible: PinS departures and PinS approaches.

- For departure procedures, the pilot proceeds using visual references from the FATO to a Point in Space called the IDF (Initial Departure Fix). This part of the operation is the visual flight phase. PinS procedures are built based on visual criteria and are defined according to ICAO Doc 8168 Vol.II. Two types of visual flight phase are possible:

    - "proceed visually" procedure - performed under IFR following a published visual flight procedure. Does not require VMC. The pilot climbs towards the IDF to or above the authorized altitude (IDF MCA) and navigates by visual reference to the earth's surface; the visibility shall be sufficient to see and avoid obstacles.
    - "proceed VFR" procedure - performed under VFR and requires VMC.

  The instrument flight phase starts once the pilot has passed the IDF at or above a certain altitude (MCA: Minimum Crossing Altitude).

- For approach procedures, the pilot conducts the flight under IFR from the Initial Approach Fix (IAF) to a Point-in-Space (PinS), which is considered as a missed approach point (MAPt). This part of the operation is the instrument flight phase. Then,
    - if appropriate visual references are obtained, the pilot proceeds using visual references from the PinS to the FATO. This part of the operation is the visual flight phase;
    - if appropriate visual references are not obtained, the pilot performs an instrument missed approach procedures. This operation is part of the instrument flight phase.

  Two types of PinS approach procedures are possible:

- PinS “proceed visually” approach - performed under IFR and relies on a published visual flight procedure. VMC not required; it is only required to see the heliport or landing location or visual references associated with it.
- PinS “proceed VFR” approach - performed under VFR and requires VMC.

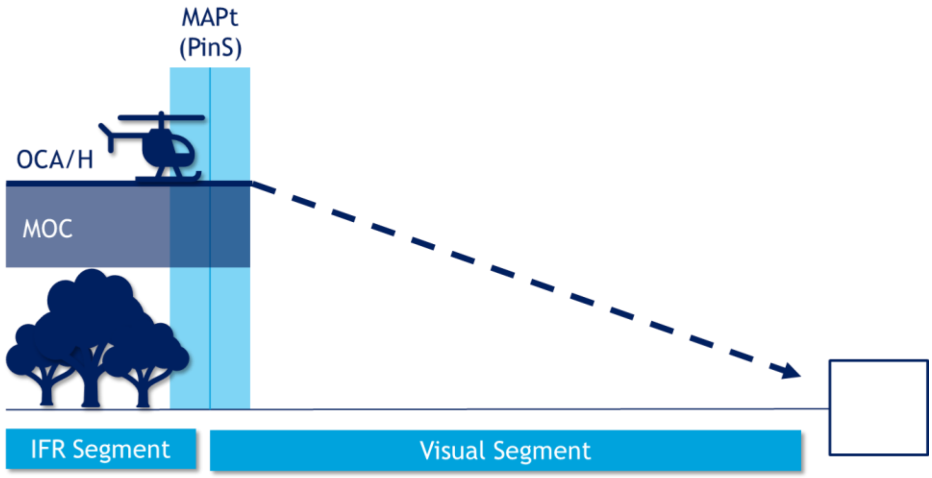


Figure 19 - Generic PinS approach procedure

2.2.3 PinS approach procedure

As shown in Figure 19, the PinS approach procedure is divided into two different segments: the IFR segment and the visual segment. For each of these segments the different variables and possibilities are analysed in the paragraphs below.

IFR Segment

Navigation Specification. The Navigation Specification details the specific requirements for the helicopter's avionics and the flight crew's management of the helicopter to meet a navigation performance. There are currently eleven navigation specifications but for the specific case of the combination of helicopters and approach procedures only two are available: RNP 0.3[7] and RNP APCH. These navigation specifications have a different impact on the required area to be protected against obstacles and they are only applicable for the IFR segment of the PinS procedure (from the IAF to the MAPt and for the missed approach procedure, but not for the visual segment defined between the MAPt and the landing site).

Protection areas. Since these specifications have different onboard requirements, they also require different design criteria for the design of the instrument approach procedure and, therefore, require different protection areas. In order to estimate the required area for each of these navigation specifications a generic PinS approach procedure has been designed, based on optimum or standard PANS-OPS values (see

[7] Customer agreed that RNP 0.3 capability may be assumed for 2030+

Table 3). Where optimum values are not provided in PANS-OPS, values based on best practices for offshore operations in other countries have been used as a reference.

Table 3 - Definition of the standard approach procedure (IFR segment)

	Waypoints	Length	Navigation specification
Initial Approach Segment	IAF – IF	5 NM (Standard)	RNP APCH or RNP 0.3
Intermediate Approach Segment	IF – FAF	3 NM (Optimum)	RNP APCH or RNP 0.3
Final Approach Segment	FAF – MAPt	3.2 NM (Optimum)	RNP 0.3

For this standard PinS approach procedure, a representation has been made to show the difference in the protection area required for each of the navigation specifications available for helicopter operations:

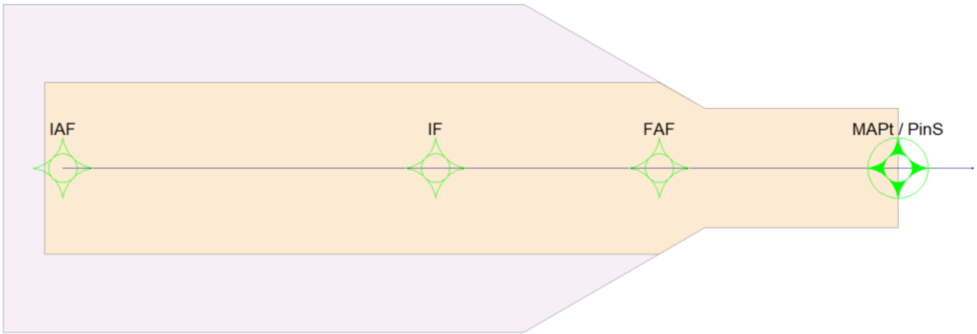


Figure 20 - Depiction of the area required for a PinS approach (IFR segment) based on RNP 0.3 (shown in orange) and RNP APCH (additional area shown in pink)

Required area. It is noticeable in Figure 20 that the protection area required for approaches based on RNP 0.3 (approximately **85 km²**) is smaller than for the RNP APCH specification (approximately 145 km²).

MovingDot recommendation

- Define the PinS procedures based on RNP 0.3 all phases to reduce the area free of obstacle required around the PinS approaches.

  Note that the IFR segment for a PinS approach procedure is the same irrespective of the type of visual segment that is selected (Proceed VFR or Proceed visually).

Type of approach (LNAV or LPV)

The type of approach to be designed and implemented only has an influence on the accessibility of the helideck. LNAV minima are typically higher than LPV minima, and the lowest possible value of the two is 250 ft.

The type of approach (LNAV or LPV) has no impact on the required area that needs to be free of obstacles, as the protection areas associated to the LPV minima are not smaller than those of the LNAV minima.

MovingDot recommendation

- Define the PinS approaches based on LPV if the helicopter operator is equipped and certified for LPV procedures. Otherwise define both (LNAV and LPV) and let the helicopter operator decide which one they will fly (similar to the fixed wing procedures published in the AIP where RNP APCH have three different minima available).

Missed approach procedure

For this initial step a generic missed approach procedure has been designed. The missed approach procedure is very flexible and highly variable from one landing site to another, as it depends on many factors such as the airspace constraints, obstacles, helicopter performance and payload, etc. Therefore a generic straight missed approach procedure following the optimum helicopter routing in case of a go-around is considered at this stage of the study.

Table 4 - Definition of the standard missed approach procedure (IFR segment)

	Waypoints	Length	Navigation specification
Missed Approach Segment	MAPt - MATF	5 NM (Standard)	RNP APCH or RNP 0.3

Note that the altitude gain for a standard missed approach procedure in a distance of 5 NM is 1200 ft (based on the nominal missed approach climb gradient of 4.2%), which means that if the OCA is not at sea level (which will not be), at the end of the missed approach the helicopter would be at an altitude safe enough to either try again another approach (from the MATF to the landing site, if the weather conditions allow that, or to fly over the platform and go back to the origin following the departure route).

The total area required to protect from obstacles the missed approach procedure is approximately 28 km^2, which makes the total PinS IFR area (for an RNP 0.3 procedure based on standard parameters and straight missed approach) 113 km^2.

Note that this area can be used for departure procedures (as long as the PinS-point of the departure route is coincident with the PinS-point of the approach route) and this will reduce the additional area required to protect a PinS departure procedure.

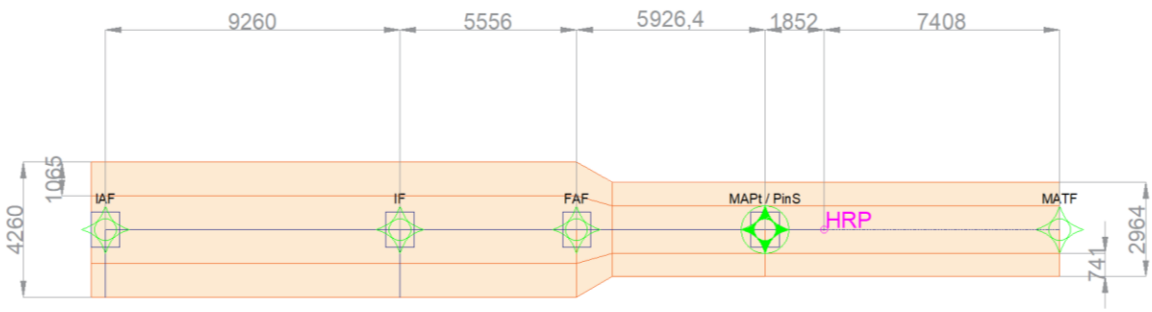


Figure 21 - IFR segment of the PinS approach procedure (dimensions provided in meters)

During the project, questions arose whether the required space for the Missed Approach could be less if the helicopter would make a turn in that manoeuvre. As an example, and for illustration purposes only, a turning missed approach is shown in Figure 22. This type of missed approach procedure is possible but requires an additional area free of obstacles of approximately 40 km^2 per PinS approach procedure.

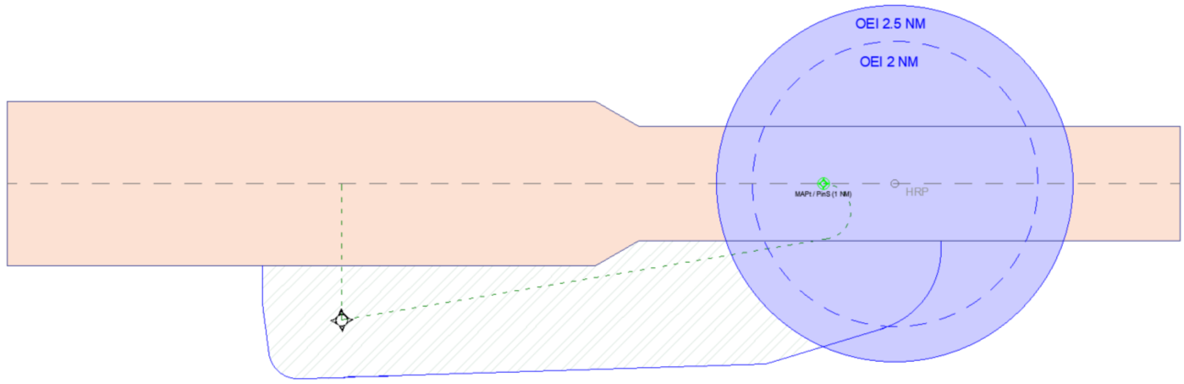


Figure 22 - Example of a turning missed approach and required additional area (depicted in green)

Vertical representation of the IFR segment

The following image shows a vertical representation of the IFR segment including all flight phases (from the initial approach up to the missed approach) and a typical profile for an altitude of 1500 ft at the intermediate and final segments.

Note that based on other experiences of helicopter pilots flying in the North Sea, this altitude is normally preferred to avoid entering icing conditions during the flight. However, this is not fixed and a different altitude (lower or higher) can be chosen in the detail design phase of the PinS procedures.

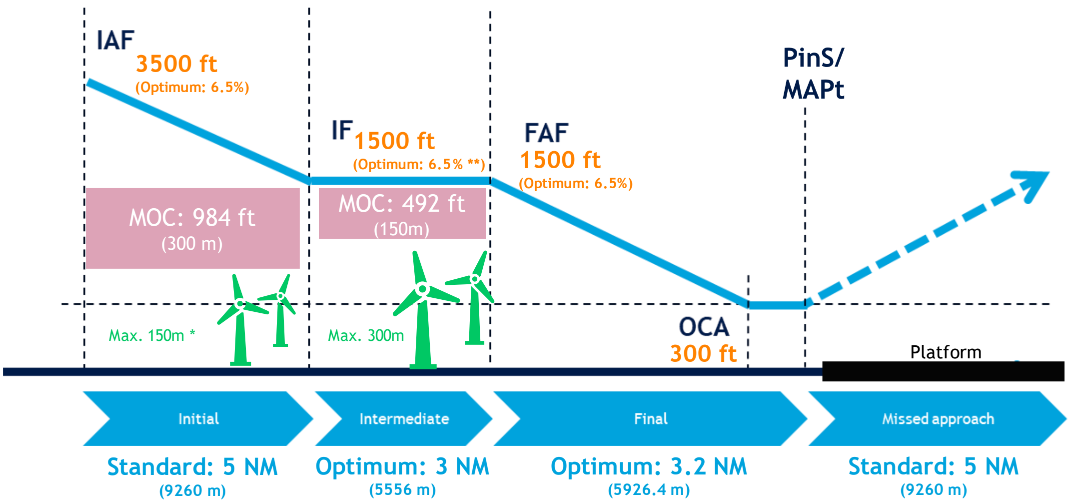


Figure 23 - Vertical representation of the standard IFR segment for a straight-in PinS approach (1500 ft)

**The limitation in the initial segment (between IAF and IF) of obstacle heights below 150 m is due to the altitude required at the IF (1500 ft) and only applicable in the primary area. Heights above 150 m could be considered but need to be assessed on a case-by-case basis (they cannot be generically assessed).*

*** Because the intermediate approach segment is used to prepare the helicopter speed and configuration for entry into the final approach segment, this segment should be flat. Should a descent be required, then the optimum value defined in PANS-OPS is 6.5%.*

Other profiles could be based on an altitude of 2000 ft at the beginning of the intermediate segment so that higher wind turbines could be placed under the initial segment as well, since an altitude of 2000 ft allows for obstacles in the initial approach segment up to 300 m. This might be preferred from an obstacle point of view but it should be checked with the helicopter operator that altitudes above 1500 ft can be safely used over in offshore operations over the North Sea.

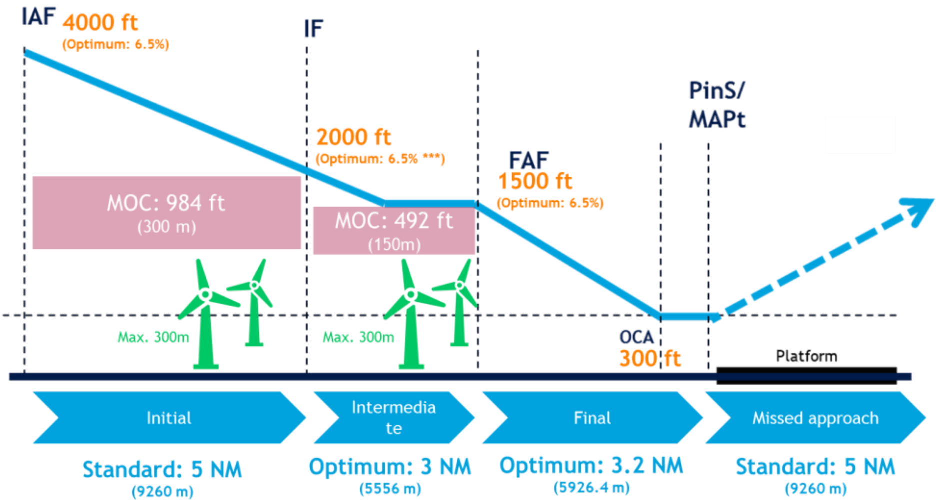


Figure 24 - Vertical representation of the standard IFR segment for a straight-in PinS approach (2000 ft)

**** Optimum gradient used to descend from 2000 ft to 1500 ft. Afterwards, a level segment is provided to prepare the helicopter speed and configuration for entry into the final approach segment.*

Visual Segment

Once the helicopter pilot arrives to the PinS (or MAPt), the visual segment starts. As already explained in section 2.2.2, two types of visual segments can be designed: proceed VFR or proceed visually.

- **Proceed VFR** design is incredibly flexible but can only be executed in visual meteorological conditions (VMC). In this type of approach, the pilot is responsible for obstacle clearance in the visual segment (after the MAPt or PinS point) and, therefore, no additional protection areas for the visual segment are required.

- **Proceed visually** design is less flexible but does not require VMC. Pilot must have sufficient visual reference at MAPt to reach landing location.

  This type of procedure has an additional requirement for the landing location: they have to be ICAO Annex 14 vol. II compliant (which means that the transitional surface needs to be provided and kept free of obstacles), no obstacles can penetrate the protection area associated with the visual segment and that the minimum distance between the landing site (helideck reference point) and the PinS-point shall be 1 km.

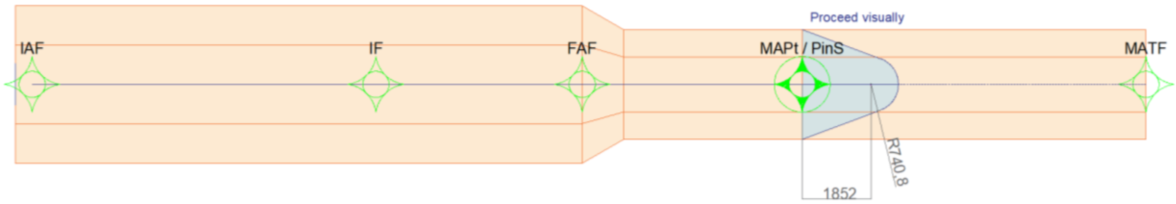


Figure 25 - Protection areas associated to the PinS approach (IFR segment and visual segment) for a proceed visually procedure

Note that:

- When a proceed visually procedure is not feasible, a proceed VFR probably is.
- The protection area associated with the visual segment of a *proceed visually* PinS approach (shown in blue in Figure 25) is not limiting as it falls within the protection areas associated to the IFR segment of the PinS approach.

Flexibility in the design of PinS procedures

- The different approach segments that form the IFR part of the PinS procedure (from the IAF to the MAPt) have been designed in the generic approach as straight-in segments. When required, different types of turns can be provided in each of the segments to fit the procedure within the available area free of obstacles or to avoid certain areas.
- Generic turns cannot be provided in this assignment as they depend on the altitude and helicopter performance, among other requirements such as airspace and obstacle constraints.
- For Proceed VFR, the following options are possible:
  - No maximum or minimum length prescribed for the visual segment
  - No maximum track change at the PinS point

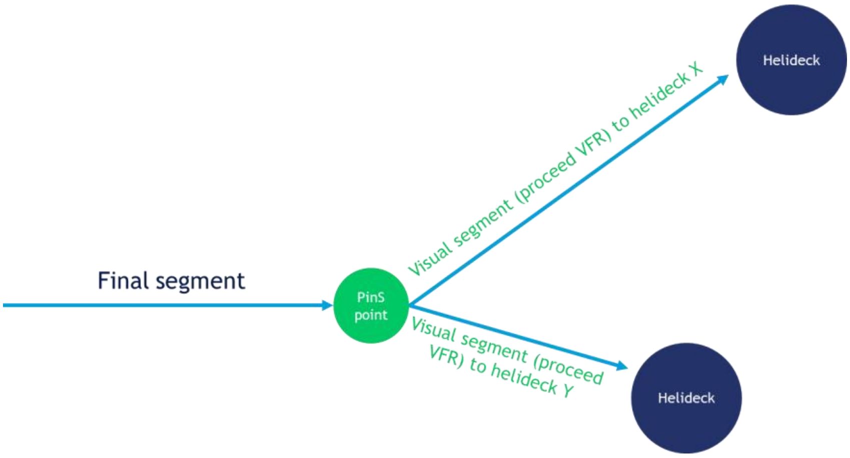


Figure 26 - Options in Proceed VFR to connect multiple platforms for a single IFR segment (from initial to final)

- For Proceed visually, the following alternatives are possible in the determination of the PinS approaches:
  - Direct VS, which connects the PinS to the landing location with a straight segment.
    - Variable length, dependent on the maximum helicopter speed in the final approach segment (between 0.54 NM and 1.62 NM).
    - Maximum course change allowed at the PinS point is 30°
  - Manoeuvring VS, which allows the pilot to visually maneuver around the heliport or landing location to land from a direction other than directly from the PinS point.

- Variable length, dependent on the maximum helicopter speed in the final approach segment (minimum 0.54 NM).
- Variable definition of the procedure, depending on the OCA (approach minima) and helicopter type.
- Additional area required to be protected against obstacles but contained within final/missed approach associated protection areas.

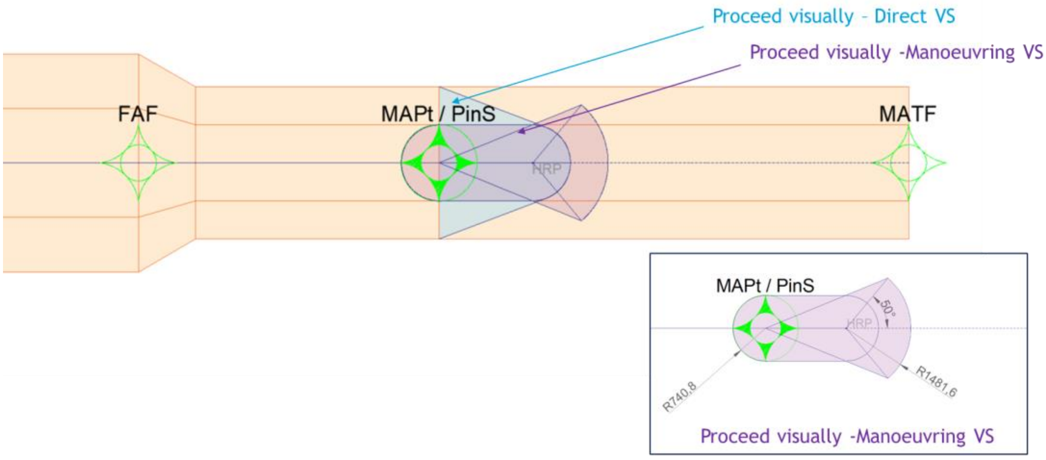


Figure 27 - Manoeuvring VS procedure option for the proceed visually approach

- The vertical profiles shown in Figure 23 and Figure 24 make use of the standard definition of the PinS approach provided for this study. For both types of PinS approach procedures (proceed visually and proceed VFR) there are many other optimization options to modify the segment of the different lengths (initial, intermediate and final) if that would be required due to the presence of obstacles below these segments.
  - For example, the initial approach segment could be reduced from 5 to 4 NM and the intermediate segment could be increased from 3 to 4 NM in order to have a longer intermediate segment that allows higher obstacles underneath.
  - These options shall be discussed in the detail design phase with the helicopter operator, as they might have an impact on their operations.

MovingDot recommendation

- Do not decide yet between proceed visually vs. proceed VFR as the additional protection area required for proceed visually PinS procedures is not limiting and falls within the final/missed approach protection areas.
- In case proceed visually would be preferred, do not decide yet between direct VS or manoeuvring VS since the additional area for manoeuvring VS procedures is not limiting and falls within the final/missed approach protection areas.

2.3 Combination of ICAO Annex 14 and PANS-OPS surfaces for a standard platform

The result of the combination of the different ICAO Annex 14 and PANS-OPS surfaces can be seen in the following picture:

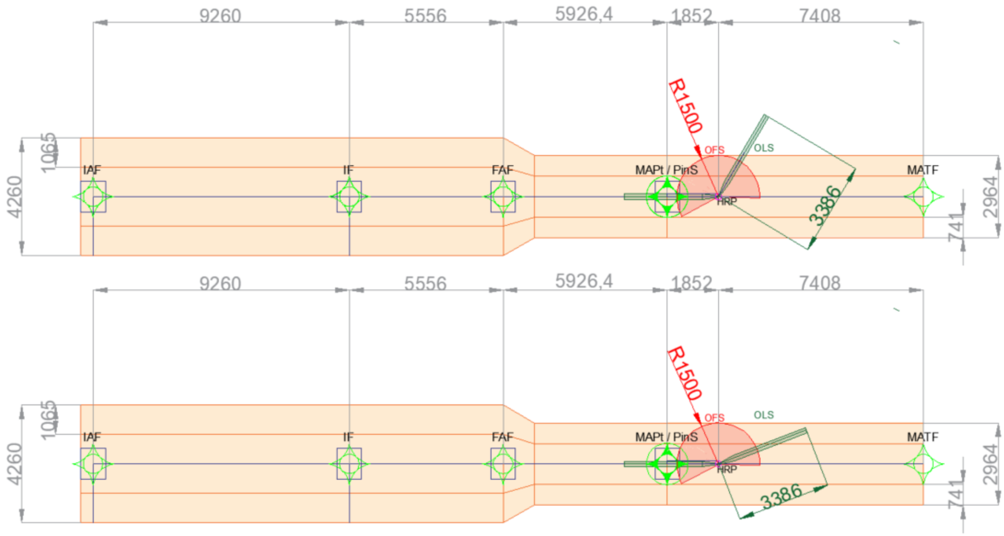


Figure 28 - Depiction of a standard PinS approach procedure with some examples of OFS and OLS

- The orientation of the OFS (depicted in red) is not yet determined but given its characteristics and dimensions, it falls within the PinS protection areas, which means that any orientation of the platform and its corresponding OFS will be enclosed and shielded by the PinS areas.
- The orientation of the approach and take-off climb surfaces (depicted in green) is not yet determined. As an example, two different orientations (chosen randomly) are shown in Figure 28 and these demonstrate that these routes can be oriented both to fall within the protection areas of the PinS procedures and that an additional area is required when one of the routes does not fall entirely within the protection area of the PinS procedures.
- Given the recommendation to orient the approach and take-off climb surfaces as opposite as possible (to limit the effect of the wind near the platform) and the flexibility still available in choosing the orientation of each platform and the PinS procedures, the rest of the study considers the two surfaces as falling within the protection areas of the PinS procedures.
- Therefore, it can be concluded that the most limiting area is the area defined to protect the PinS procedures.

MovingDot recommendation

- In order to provide as much flexibility as possible in the future design of PinS procedures, it is recommended that the segment defined between the FAF and the MATF (end and missed approach segments) be horizontal at the helideck height.
- In this case, any provision of OFS and associated OLS is enclosed and shielded by the PinS protection areas and, therefore, no additional surface needs to be provided free of obstacles.

A combination of the lateral and vertical representation of the different ICAO Annex 14 and PinS procedure surfaces is shown in Figure 29.

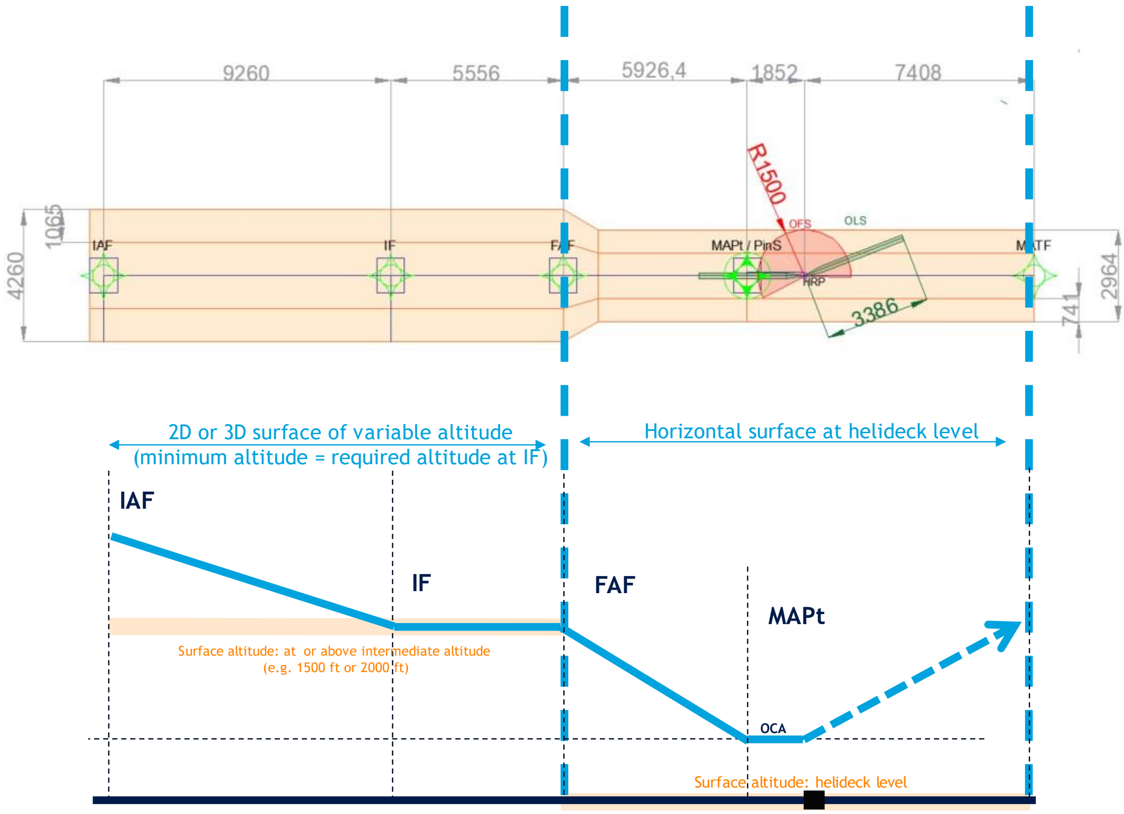
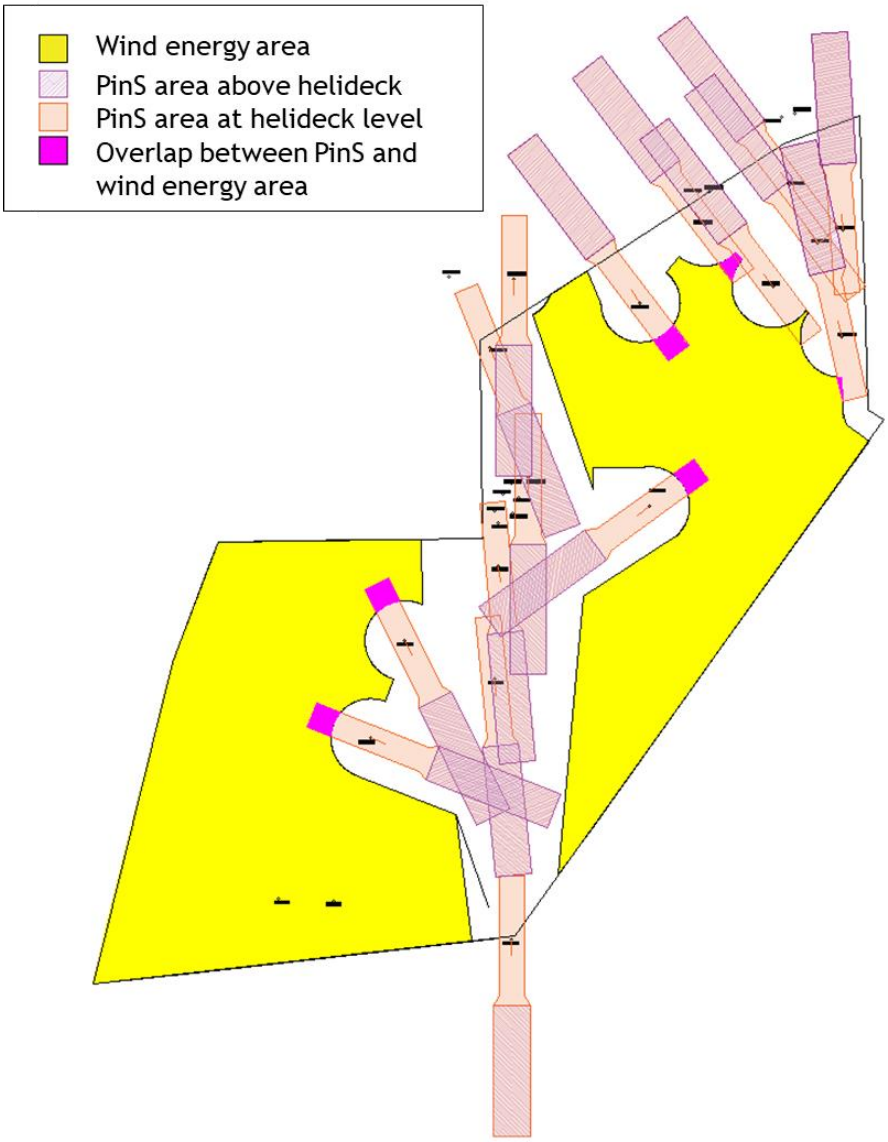


Figure 29 - Lateral and vertical representation of the required surfaces (ICAO Annex 14 and PANS-OPS)

2.4 Projection of the required surfaces for the different scenarios

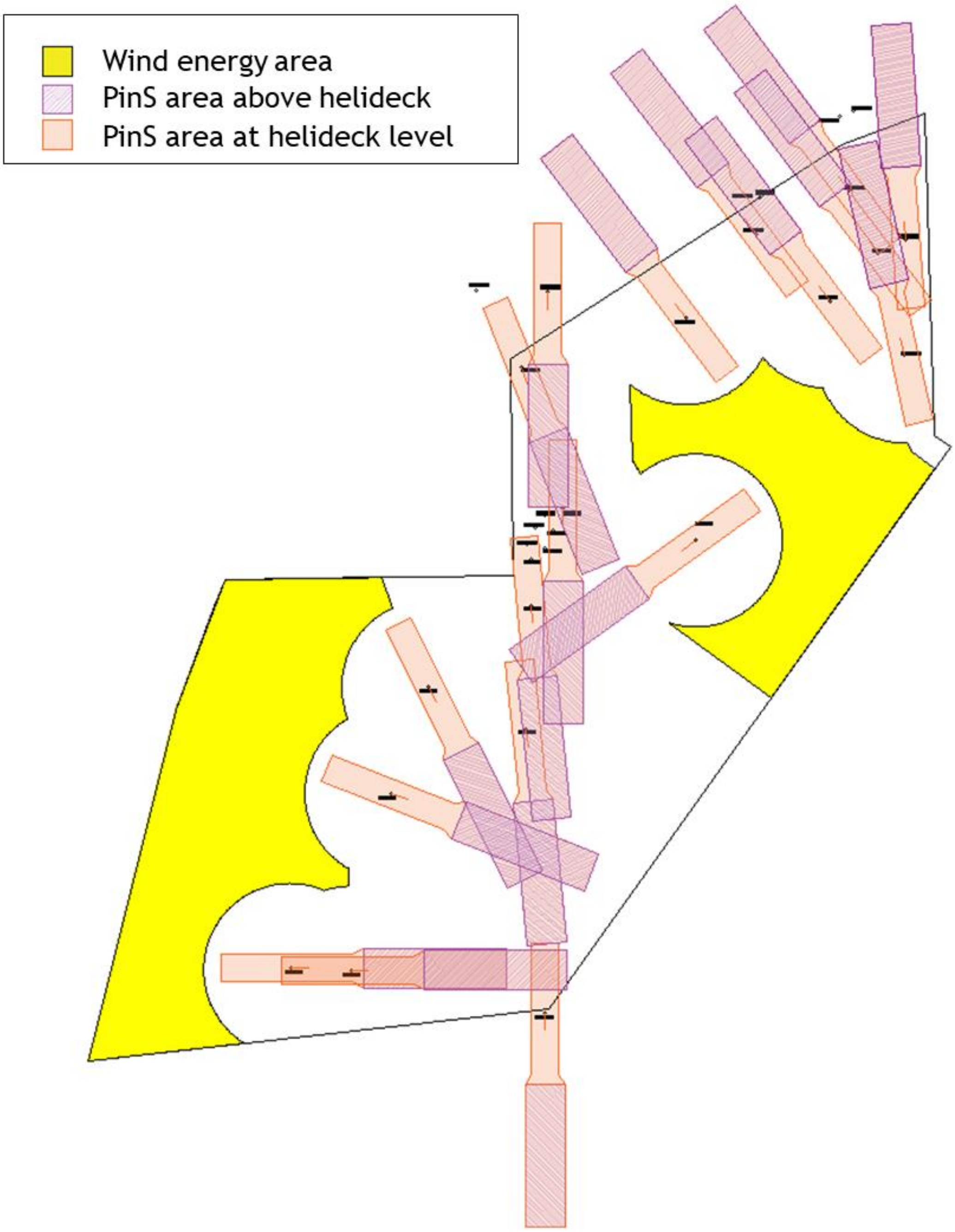
2.4.1 Combinatievariant 27



Key takeaways combinatievariant 27

- Most of the PinS procedures would fit within the available open space.
- The orientation of the PinS procedures has been chosen in a way that reduces the overlap with the wind energy area. There is still some space available to optimize these routes (at least for the IFR segment) but that is to be considered in the detail design stages.
- A small portion of additional surface would be required from the area reserved for wind turbines of this scenario (41 km^2) to protect a standard straight-in missed approach procedure, although the drawing shows enough free space not used by the PinS procedures to gain this surface back.
- Other types of missed approach procedures can be designed in the detail design phase, in coordination with the helicopter operator and tailored for a specific helicopter type(s) to reduce even further this additional area required.

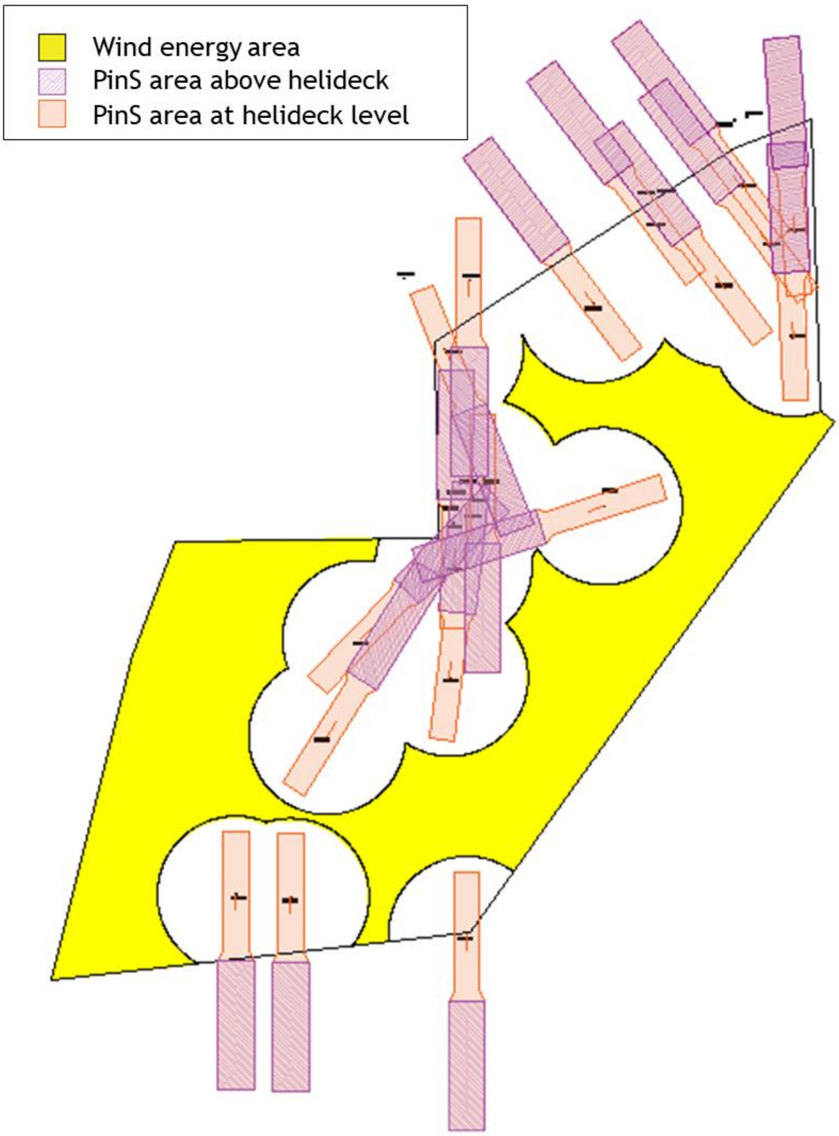
2.4.2 Combinatievariant 0



Key takeaways combinatievariant 0

- Most of the PinS procedures would fit within the available open space.
- The orientation of the PinS procedures has been chosen in a way that reduces the overlap with the wind energy area. There is still some space available to optimize these routes (at least for the IFR segment) but that is to be considered in the detail design stages.

2.4.3 Scenario based on 5NM areas around each platform



Key takeaways 5NM scenario

- Most of the PinS procedures would fit within the available open space.
- The orientation of the PinS procedures has been chosen in a way that reduces the overlap with the wind energy area. There is still some space available to optimize these routes (at least for the IFR segment) but that is to be considered in the detail design stages.

3 ESTIMATION OF THE AREA REQUIREMENTS FOR ONE-ENGINE-INOPERATIVE PROCEDURES

3.1 General OEI items

One-Engine-Inoperative (OEI) procedures are the responsibility of the helicopter operator. However, given the obstacle-rich environment expected in the area 6/7 (with wind turbines around the platforms), IenW and RWS would like to make some reservations in the area around the platforms (and helidecks) in order to protect these future operations.

It is expected that these OEI areas are defined in the form of circles centred on the helideck reference point (geometric centre of the helideck) with a predefined radius. These areas should allow helicopter operators to define their OEI procedures within the available airspace around the helidecks.

The input for this part of the study is currently being investigated in a separate assignment carried out by an external company. Since both studies are being carried out in parallel, it was decided during the kick-off meeting that a first estimation can be made with a circle whose radius is 2.5 NM (section 3.2).

Afterwards, a second iteration is made to include a second scenario based on a radius of 2.0 NM in the overall assessment of the space required for PinS and OEI procedures (section 03.3).

3.2 Standard case (2.5 NM)

The standard case considered in this study is based on a circle centred on the helideck reference point with a radius of 2.5 NM (4630 m). This results in the following geometry and required area around each of the platforms of 68 km^2.

Figure 30 - Illustration of the OEI required area compared to the dimensions of the platform (pink dot in the centre of the image)

For illustration purposes, Figure 31 shows how this OEI area compares to the available space for each of the scenarios.

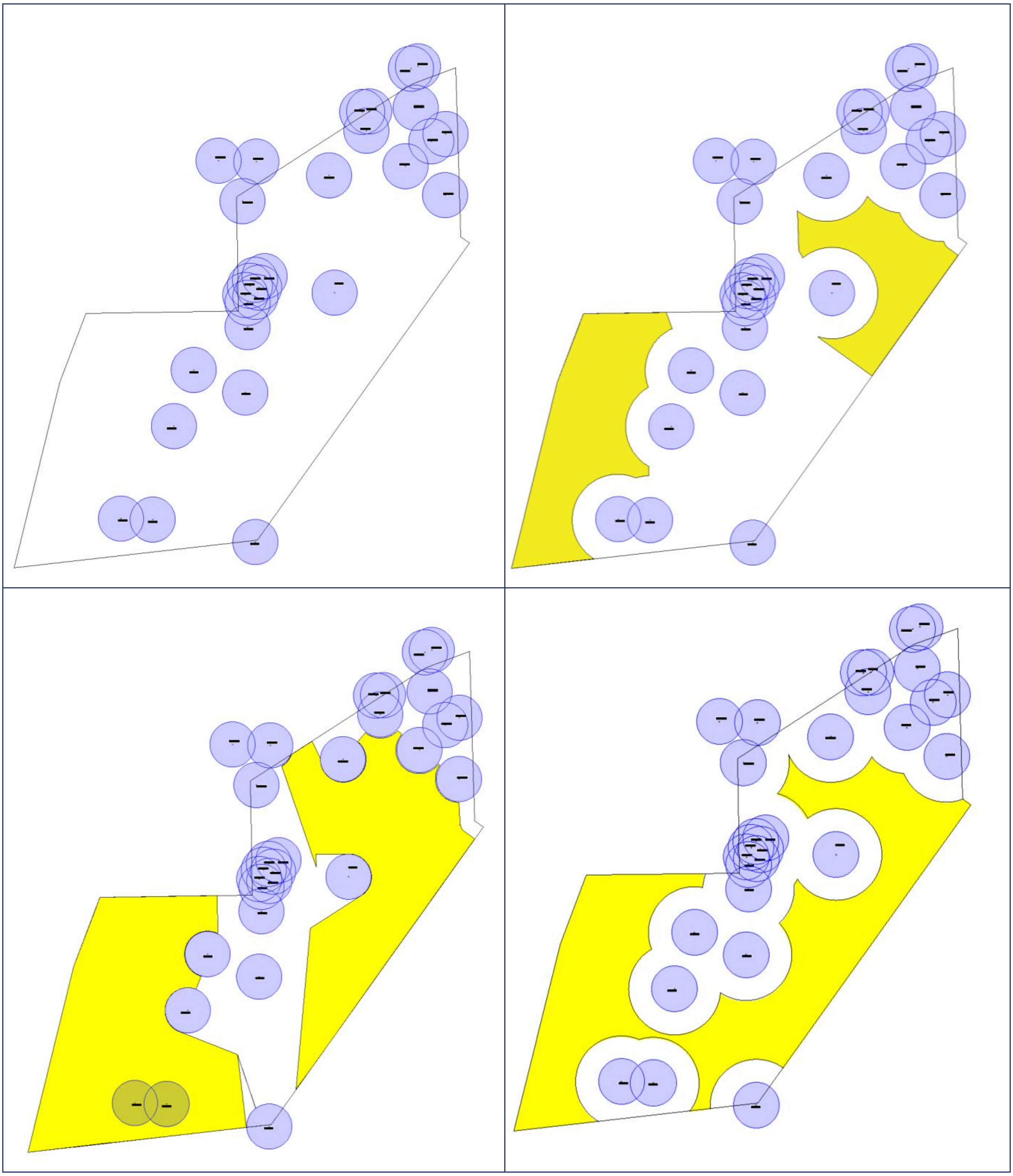


Figure 31 - Representation of the OEI area (based on a radius of 2.5 NM) required around each platform (top left), for combinatievariant 0 (top right), combinatievariant 27 (bottom left) and for the 5 NM scenario around the platforms (bottom right)

It must also be noted that the OFS and OLS fall within this area and therefore, if this area is provided free of obstacles (horizontally, at the same height as the helideck elevation), the required OFS and OLS are automatically enclosed and shielded, and no additional area is required for ICAO Annex 14 surfaces in particular.

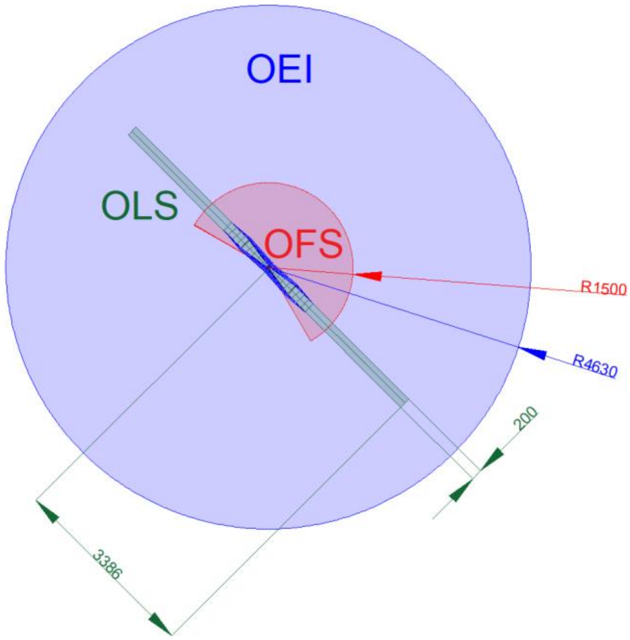


Figure 32 - Dimensions of the OEI and ICAO Annex 14 surfaces (2.5 NM)

Key takeaway:

- The OEI, if provided horizontally at helideck level, is the most restrictive area to protect the surroundings of the platform.

- Given the dimensions required for the different surfaces (Figure 32), any future rotation of the platform different from the standard orientation considered in this study will remain protected against obstacles (including the OFS and the approach and take-off climb surfaces). No additional area needs to be considered when the rotation of the platform is defined.

  Note that this will only be valid as long as the platform dimensions do not exceed the maximum dimensions considered for this study, as defined in section 1.4.

3.3 Other cases (2.0 NM)

In case of a circle centered on the helideck reference point with a radius of 2.0 NM (3704 m), it results in the following geometry and a required area around each of the platforms of 44 km^2.

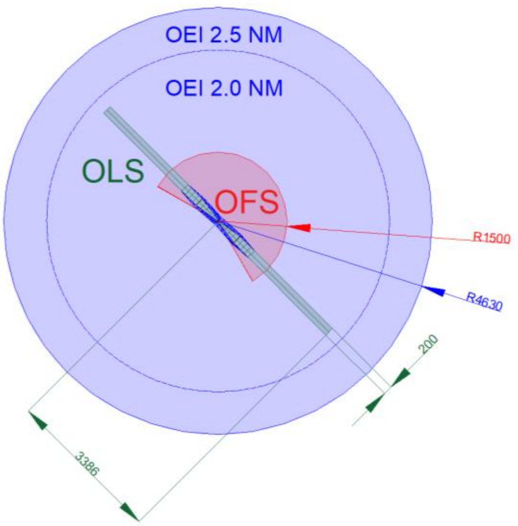


Figure 33 - Dimensions of the OEI and ICAO Annex 14 surfaces (2.5 NM and 2.0 NM)

Key takeaway:

- Given the length of the approach and take-off climb surfaces (3.4 km from HRP), a smaller OEI area (2 NM or 3704 m) would still be possible to be provided and will shield the Annex 14 surfaces.

4 ACCESSIBILITY STUDY

4.1 Summary of required areas

The following table summarises all the required areas that are analysed in this study, including helideck protection areas (ICAO Annex 14), PinS procedures (ICAO Doc. 8168 Vol. II) and OEI areas.

Table 5 - Summary of all the individual areas analysed in this study

Type	Parameters	Estimated area	Reference in this report
OFS	Radius: 1.5 km 210° D-value: 20 m	4.2 km^2	§2.1.1
Approach and take-off climb surface	Two approach and take-off climb areas Table 2	1.4 km^2	§2.1.2
PinS approach / departure	Standard/optimum PANS-OPS parameters	113 km^2	§2.2.3
OEI	2.5 NM	68 km^2	§3.2
	2 NM	44 km^2	§3.3

However, these estimated areas are not to be added together to obtain the total estimation of the required area around the platforms that needs to be free of obstacles, since:

- Some of these areas are overlapping (see examples shown in Figure 34) and, therefore, by adding them all together a bigger than necessary area will be reserved.

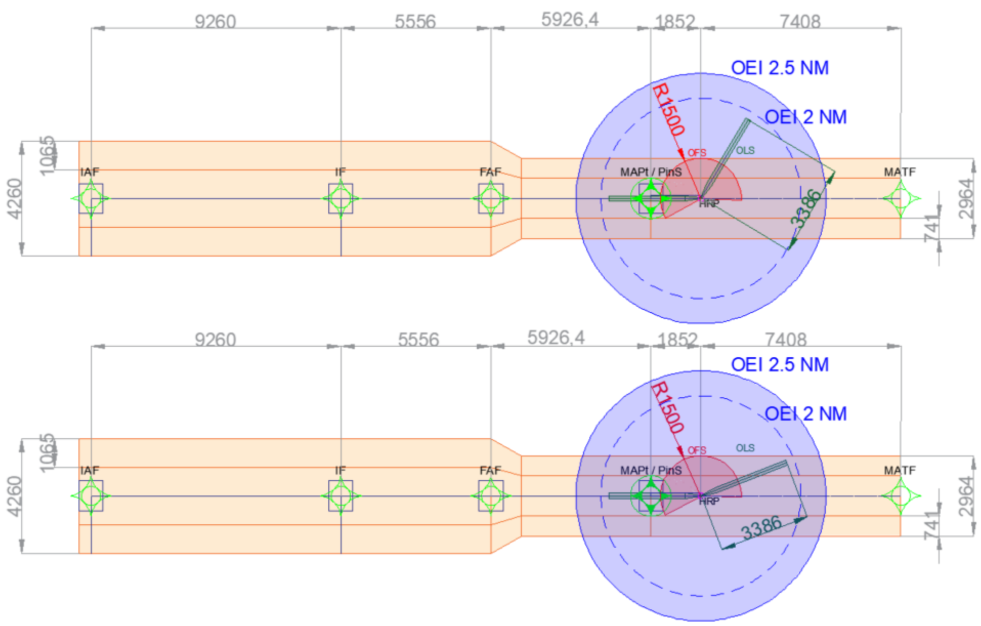


Figure 34 - Depiction of a standard PinS approach procedure with some examples of OFS and OLS and the two scenarios considered for OEI (2.5 and 2 NM)

- Disregarding the overlap between all protection areas and considering only the total amount of surface that would be required based on the most limiting protection areas (as indicated in Figure 35), the total area required is 151 km^2 (which is less than the addition of all the individual areas indicated in Table 5) for the case of an OEI of 2.5 NM and a total area of 132 km^2 for an OEI of 2 NM.

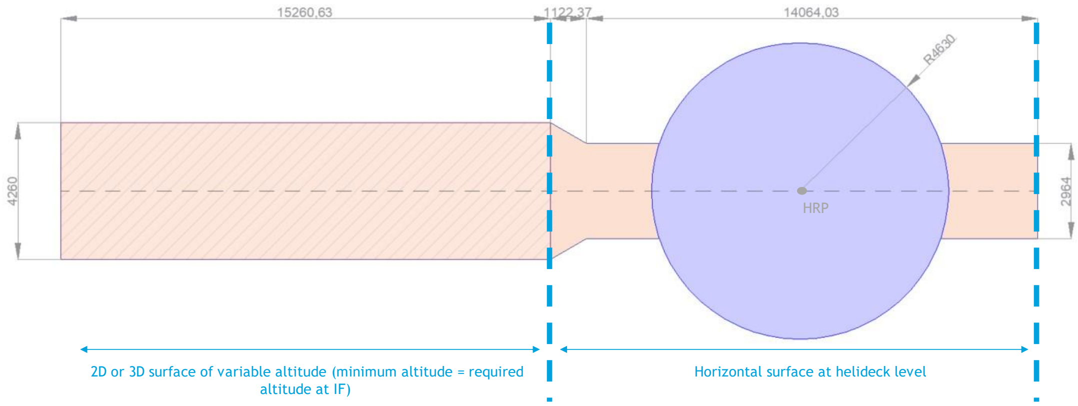


Figure 35 – Total area required based on the combination of PinS and OEI procedures

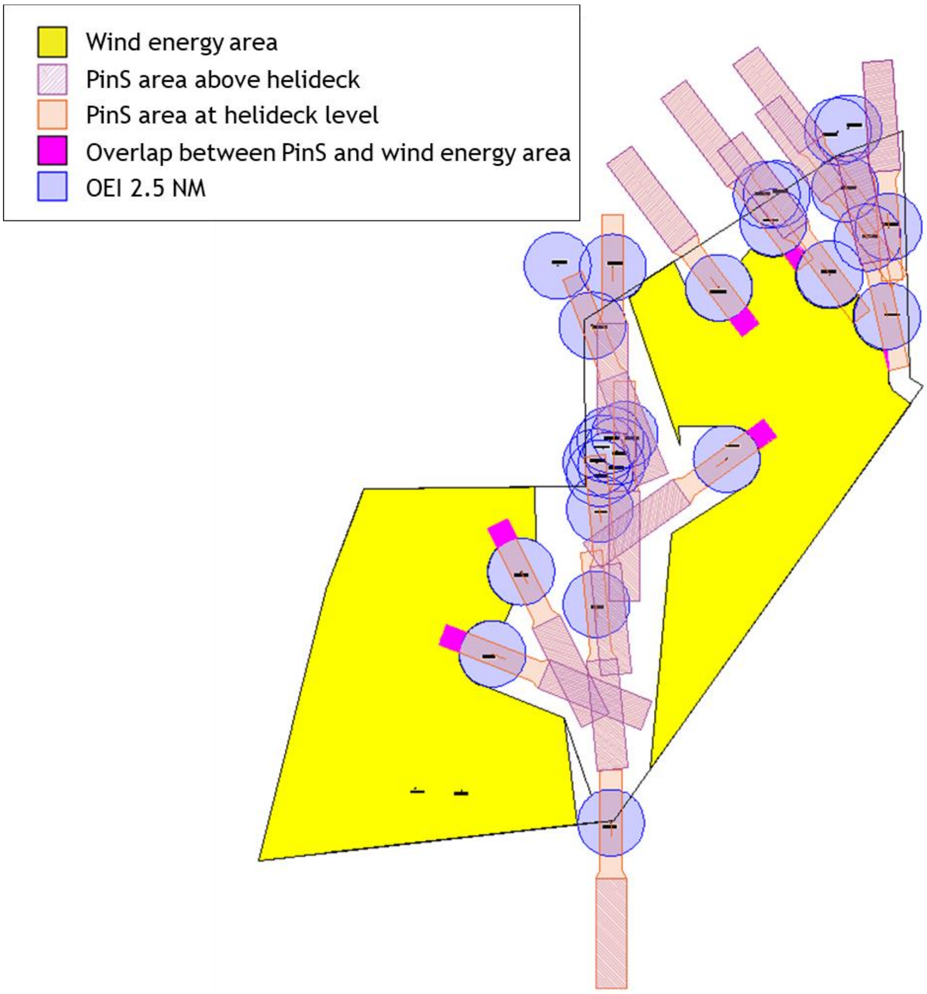
- Note that the part indicated on the left hand side of Figure 35 is not to be provided at helideck level and, therefore, obstacles can be placed under this part of the PinS approach provided that the procedure altitudes and obstacle elevations are carefully analysed during the detail design phase of the PinS procedures.

The following sections analyse per scenario the combination of all required protection areas (ICAO Annex 14, PinS and OEI) as proposed by the customer, answering the first question of this assignment: *How much space is needed for helicopter accessibility around (potential platforms) in search area 6/7 if PinS procedures are applied in the future (including the requirements for OEI situations)?*

4.1.1 Combinatievariant 27

When adding all required protection areas together (thus, adding the required OEI area to the areas analysed in section 2.4.1), it can be seen that the addition of the OEI surface (whether it is for 2.5 NM or less) does not add any km^2 to the total estimation of area required in the first scenario, *combinatievariant 27*.

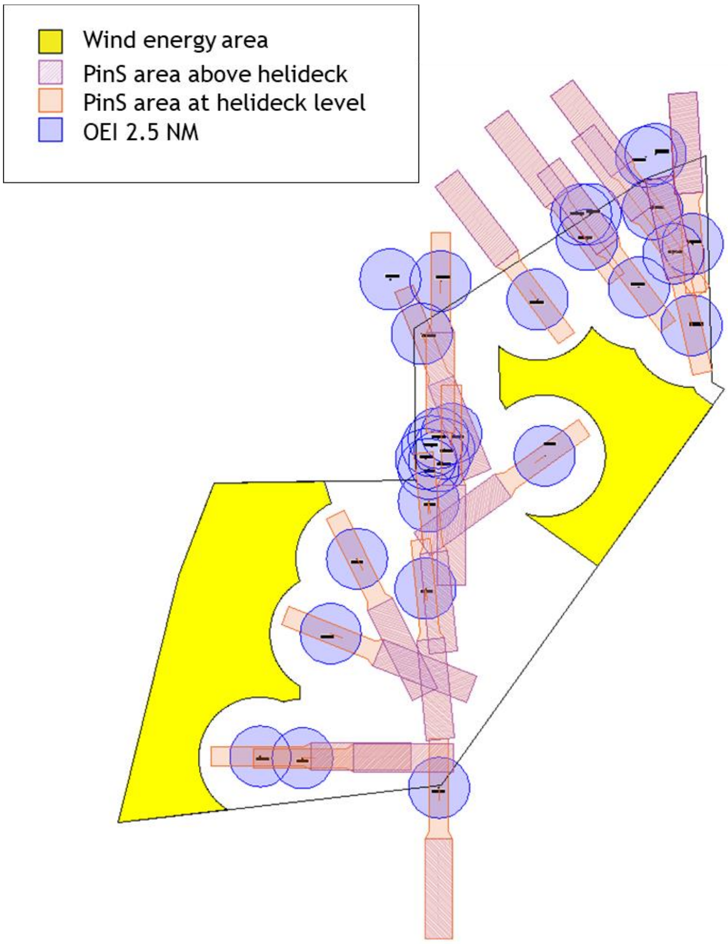
The required **additional area of approximately 41km²** that resulted from the combination of ICAO Annex 14 and PinS protection areas is, however, still needed, but it is not increased by the addition of the OEI area.



4.1.2 Combinatievariant 0

When adding all required protection areas together (thus, adding the required OEI area to the areas analysed in section 2.4.2), it can be seen that the addition of the OEI surface (whether it is for 2.5 NM or less) does not add any km^2 to the total estimation of area required in the second scenario, *combinatievariant 0*.

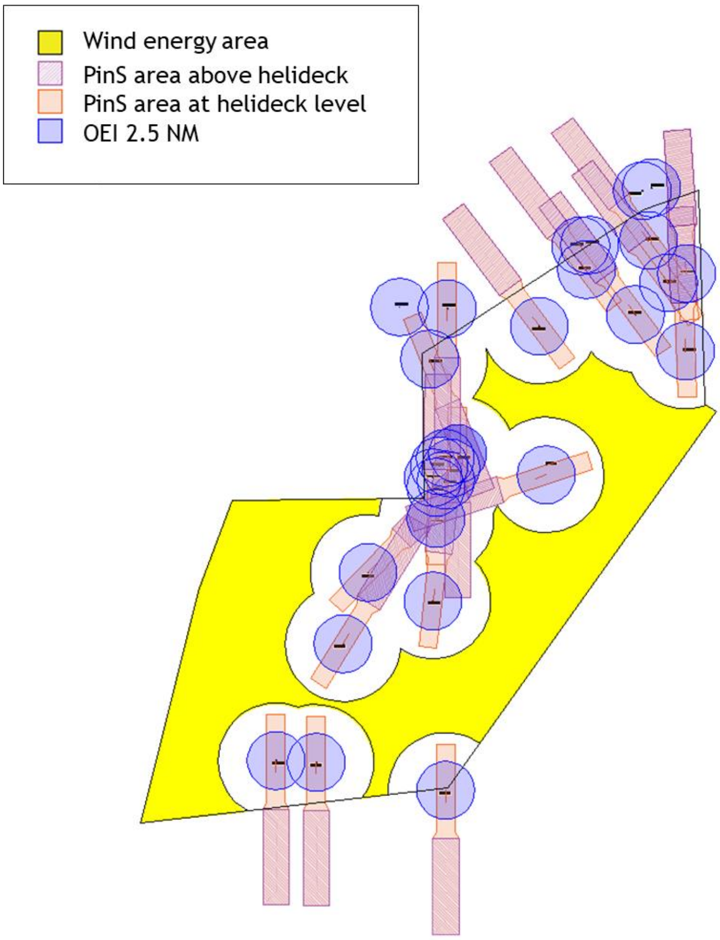
Therefore, this scenario requires **no additional area** free of obstacles (wind turbines) as long as the PinS procedures and associated protection areas are designed within the open space, as shown in the figure below.



4.1.3 Scenario based on 5NM areas around each platform

When adding all required protection areas together (thus, adding the required OEI area to the areas analysed in section 2.4.3), it can be seen that the addition of the OEI surface (whether it is for 2.5 NM or less) does not add any km^2 to the total estimation of area required in the second scenario, defined based on providing a circular area of 5 NM around each platform.

Therefore, this scenario requires **no additional area** free of obstacles (wind turbines) as long as the PinS procedures and associated protection areas are designed within the open space, as shown in the figure below.



4.2 Influence of wake turbulence

Before analysing the subsequent aspects of this study (such as weather conditions or accessibility of the platforms), it is necessary to check whether the protection areas considered so far would (or would not) include the safety distance that needs to be left between the helicopter and the wind turbines to reduce the effect of the wake turbulence on helicopter operations.

To date, there is no European regulation that dictates the minimum distance between wind turbines and helicopters. As a reference, there are several studies carried out both in the UK and in the Netherlands that define this distance based on the rotor diameter of wind turbines, with results ranging from 0 to 9 times the rotor diameter.

For this study, as a preliminary analysis and without knowing the exact location and orientation of both the platforms and the wind turbines, the following assumptions based on expert judgment are used:

- Wind turbine rotor diameter (RD): 280 m
- Safe distance (laterally) to be applied: 5xRD[8]
- Safe distance (vertically) to be applied: 500 ft[8] (150 m)

There are also no clear guidelines referring to the edge from which this lateral distance of 5RD should be applied. Helicopter flying a PinS procedure can find themselves anywhere within the primary protection area (although the adherence to the nominal trajectory is quite frequent, there might be cases where they are laterally displaced form the nominal trajectory due to flight errors or weather conditions). Therefore, it is decided that the safe margin of 5RD should be applied to the edge of the primary area.

When applying this safe margin to overcome the influence of wake turbulence on helicopter operations, two considerations can be made:

- In the initial and intermediate flight phases, there is no need to apply additional lateral or vertical clearance since the PANS-OPS obstacle safe margin applied in the determination of the initial and intermediate procedure altitude (MOC) is at least 500 ft, which means that if a wind turbine would be placed in one of these segments the vertical clearance of 500 ft required in CAP 764 is ensured. Since the vertical clearance is ensured, the lateral clearance is no longer needed.

- In the final and missed approach segment (where there should be no obstacles higher than the helideck), the vertical clearance is no longer applicable and, therefore, the lateral clearance of 5RD must be applied on each side of the primary area (see Figure 36). This results in the following additional areas required:
    - On each side of the trajectory (area #1 in Figure 36): 8.6 km^2
    - After the end of the missed approach (area #2 in Figure 36): 6 km^2

[8] These are also the values proposed in the British regulation on the Policy and Guidelines on Wind Turbines (CAP 764)

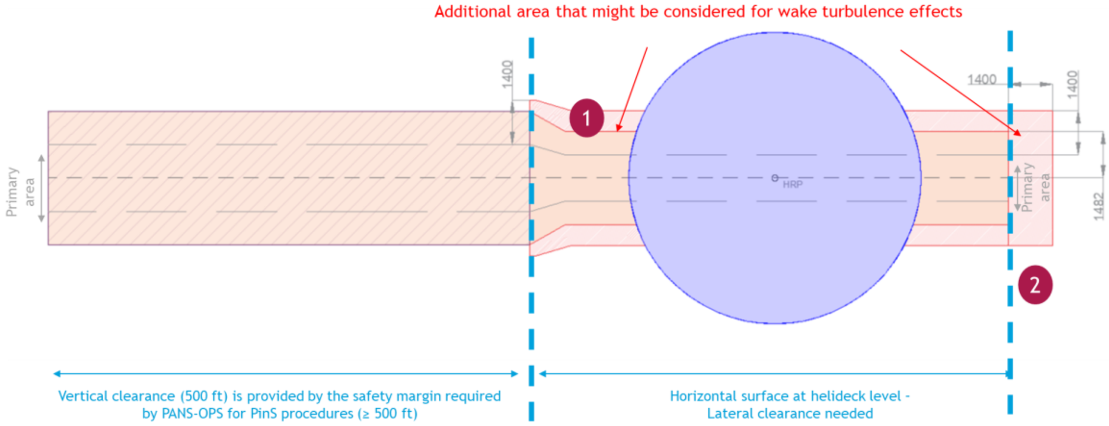


Figure 36 - Effect of wake turbulence and additional margins needed

This additional area means:

- In the first scenario (*combinatievariant 27*) an additional 12 km^2 per missed approach procedure penetrating in the wind turbine area would be required to reduce the effect of the wind turbines, as shown in Figure 37.

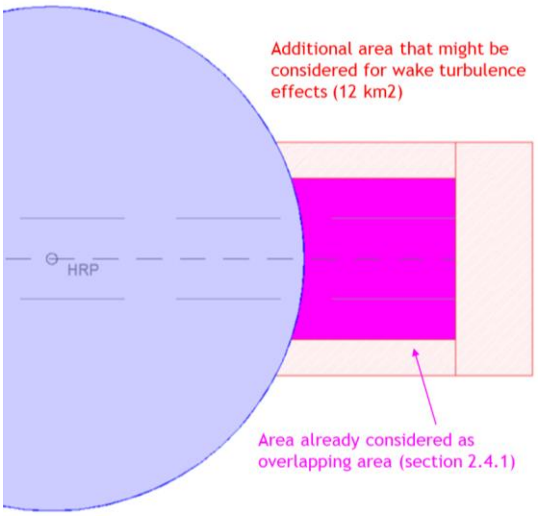


Figure 37 - Additional area to be considered for wake turbulence effects

- In the other two scenarios (*combinatievariant* 0 and the 5NM around each platform) no additional area is required to protect the helicopter operations from the effect of wake turbulences, as the additional safe margins (5RD) can be provided within the available open space.

4.3 Meteorological assessment

Meteorology is a crucial factor in defining how accessible a helideck will be, since visibility, wind and cloud base conditions need to be above specific thresholds for a helicopter to be able to fly. This section analyses the current requirements and applicable regulations for the three identified parameters under different types of operations (VFR, offshore operations -shuttling-, ARA and PinS procedures). Based on historical data around the area 6/7, an indication of how often these flyable conditions are met is also provided.

To gather historical meteorological data, an open-source database was consulted [Ref 4], which contains meteorological information gathered from different sources for aeronautical stations across the world. This includes data for the Netherlands, sourced from the KNMI stations, from all aeronautical stations including offshore helidecks. The closest meteorological station around area 6/7 is chosen as data source, given its proximity to the area EHFD.

For the purpose of this analysis, data from January 2021 through May 2024 was collected, containing a total of over three years of weather data with half-hourly reports from all stations. The selection of the weather dataset was not stipulated beforehand, however, the data was assessed to be representative of the location of the platform/prospects.

4.3.1 Regulatory requirements

Regarding the applicable meteorology regulations and requirements for offshore operations, EASA AIROPS Part SPA.HOFO [Ref 5] contains guidance for offshore operations.

Shuttling operations

Requirement EASA AIROPS Part SPA.HOFO130 [Ref 5] specifies weather required for the operations when flying between offshore locations located in class G airspace (uncontrolled airspace) where the overwater sector is less than 10 NM[9]. In that case, VFR flights may be conducted when the limits are at, or better than, the minima presented in Table 6.

Note: AIROPS Part SPA.HOFO requirements only apply to flights between offshore stations, and do not encompass the flights to and from the land-base. These operations are also referred to as shuttling operations.

Table 6 - Minima for flying between offshore locations located in class G airspace (EASA Part SPA.HOFO)

	Day		Night	
	Height*	Visibility	Height*	Visibility
Single pilot	300 ft	3 km	500 ft	5 km
Two pilots	300 ft	2 km**	500 ft	5 km***

** The cloud base shall allow flight at the specified height to be below and clear of cloud.*
*** Helicopters may be operated in flight visibility down to 800 m, provided the destination or an intermediate structure is continuously visible.*
**** Helicopters may be operated in flight visibility down to 1500 m, provided the destination or an intermediate structure is continuously visible.*

IMC/VMC

Apart from the specific minima for helicopter offshore operations presented above, it is important to consider the required meteorological conditions for the different types of navigation: visual or instrument. These conditions will have to be met when flying to and from the land helicopter base.

Offshore helicopter operations can be conducted in normal visibility conditions, Visual Meteorological Conditions (VMC), or in low visibility conditions, often referred to as Instrument Meteorological Conditions (IMC):

- When operating in VMC, the type of operation is performed under Visual Flight Rules (VFR) and is known as visual navigation.
    - In this case, the pilot must be able to operate with visual reference to the ground and using the "see and avoid" principle.
- When operating in IMC, the type of operation is performed under Instrument Flight Rules (IFR).
    - In this case, and specifically for helicopter offshore operations, there are two types of instrument procedures: Airborne Radar Approach (ARA) or Point-in-Space (PinS) procedures. Both can be operated in day and nighttime, with different corresponding meteorological condition requirements.

To determine whether IMC or VMC are prevailing, it is necessary to analyse the meteorological parameters: visibility and distance from cloud (or cloud-base). The corresponding flight minima are published in the Dutch eAIP [Ref 6] and are summarised in Table 7:

Table 7 - Visual Meteorological conditions and VFR criteria (ENR 1.2 Visual Flight Rules)

Altitude band	Airspace Class	Flight Visibility	Distance from cloud
At and above FL100	A B C D E F G	8km	1500m horizontally 300m vertically
Below FL100 and above 3000ft AMSL, or 1000ft above terrain, whichever is the higher	A B C D E F G	5km	1500m horizontally
At and below 3000ft AMSL, or 1000ft above terrain, whichever is the higher	A B C D E	5km	300m vertically
	F G	5km*	Clear of cloud and with the surface in sight

**In class G airspace at and below 3000 ft AMSL applies a flight visibility reduced to not less than:*

a) 1500 m for flights operating:
- *at speeds of 140 kt or less to give adequate opportunity to observe other traffic or any obstacles in time to avoid collision; or*
- *in circumstances in which the probability of encounters with other traffic would normally be low.*

b) 800m for military helicopters, police aircraft and helicopter flights on behalf of trauma teams, at speeds that will give adequate opportunity to observe other traffic or any obstacle in time to avoid collision.

Weather limitations and requirements

Overall, Table 8 describes the required visibility and cloud-base minima for different types of offshore operations:

Table 8 - Summary of visibility and cloud-base conditions for different kinds of operation

Navigation	Procedure	Visibility	Cloud-base
Visual	VFR – Class G	5km (1.5km possible*)	1500ft**
	Offshore ops day (shuttling)	2km	300ft
	Offshore ops night (shuttling)	5km	500ft
Instrument	ARA day	1.4km***	200ft****
	ARA night	1.4km***	300ft****
	PinS case 1A	3km	200ft
	PinS case 1B	1.8km	200ft
	PinS case 1C	1km	200ft
	PinS case 2A	3km	250ft
	PinS case 2B	1.8km	250ft
	PinS case 2C	1km	250ft
	PinS case 3A	3km	300ft
	PinS case 3B	1.8km	300ft
	PinS case 3C	1km	300ft

** Visibility requirement up to 1500m for operations in class G airspace and below 3000 ft AMSL are possible but not expected to happen in helicopter offshore wind operations. Therefore, the rest of the accessibility study is performed using 5km only.*

*** VFR operations in uncontrolled airspace (Class G) are only required to be clear of the clouds. This means that the cloud-base should be at least the flight altitude. A usual flight altitude for operations into offshore platforms would be 1500 ft, which is the value used for this analysis.*

**** ARA procedures require that the decision point to continue the landing to be located at least 1.4 km away from the helideck. At this point, the helideck must be in sight, meaning a visibility of at least 1.4 km is required.*

***** In ARA procedures, the Minimum Descent Height (MDH) is either 50 ft above the helideck (150 ft elevation in the case of the studied platforms, assuming a 30m (100 ft) platform elevation), or 200 ft by day and 300 ft by night, whichever is higher.*

PinS procedures have complex protection surfaces associated to the flight tracks, in order to ensure obstacle protection. The visibility and cloud-base requirements are a function of the obstacle environment, type of operation, type of helicopter and other factors. To provide an overview of these accessibility values and be able to compare those with the other types of operations, the following cases have been included in Table 8:

- **PinS case 1**, based on a theoretical minima of 200 ft (not yet possible due to the LPV limitations) and:
  - **1A:** Visibility requirement based on a distance between the PinS point and the HRP of 3km (maximum distance allowed)
  - **1B:** Visibility requirement based on a distance between the PinS point and the HRP of 1.8km (optimum distance allowed)
  - **1C:** Visibility requirement based on a distance between the PinS point and the HRP of 1km (minimum distance allowed)

- **PinS case 2**, based on a the currently possible minima of 250 ft and:
    - **2A: V**isibility requirement based on a distance between the PinS point and the HRP of 3km (maximum distance allowed)
    - **2B: V**isibility requirement based on a distance between the PinS point and the HRP of 1.8km (optimum distance allowed)
    - **2C: V**isibility requirement based on a distance between the PinS point and the HRP of 1km (minimum distance allowed)

- **PinS case 3**, based on a minima of 300 ft and:
    - **3A: V**isibility requirement based on a distance between the PinS point and the HRP of 3km (maximum distance allowed)
    - **3B: V**isibility requirement based on a distance between the PinS point and the HRP of 1.8km (optimum distance allowed)
    - **3C: V**isibility requirement based on a distance between the PinS point and the HRP of 1km (minimum distance allowed)

Note that PinS procedures do not make a distinction between day and night operations.

4.3.2 Visibility conditions

This section shows the assessment of the visibility conditions and the statistical outcomes.

Figure 38 shows the visibility data distribution of the analysed weather station for the period of January 2021 through May 2024. The data collected shows visibility values for 24h a day, as well as filtered for the daytime period (7:00 to 20:00). Most of the time, both during the day and during the overall 24h period, visibility is above the required minima for visual navigation (5km).

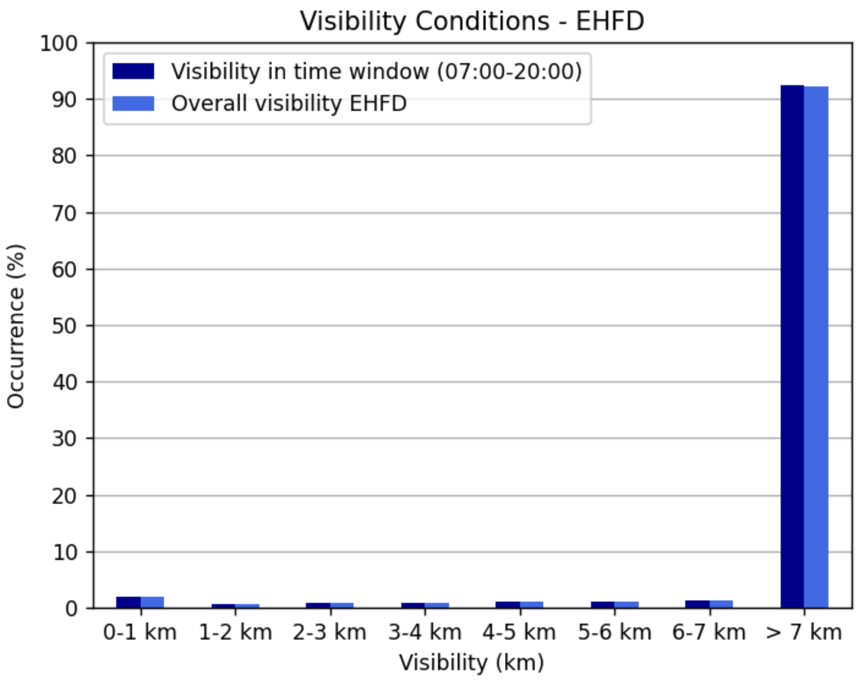


Figure 38 - Visibility conditions registered at EHFD station (Jan 2021 - May 2024)

Looking at the visibility conditions by month (using the same data sample), a clear trend can be identified as to when lower visibility conditions occur during the year, with February, March and May showing the worst conditions. In all months, except the ones with the worst conditions, 5 km or more visibility is achieved over 90% of the time (see Figure 39). While the months with the worst conditions, 5 km or more visibility is achieved over 80% of the time.

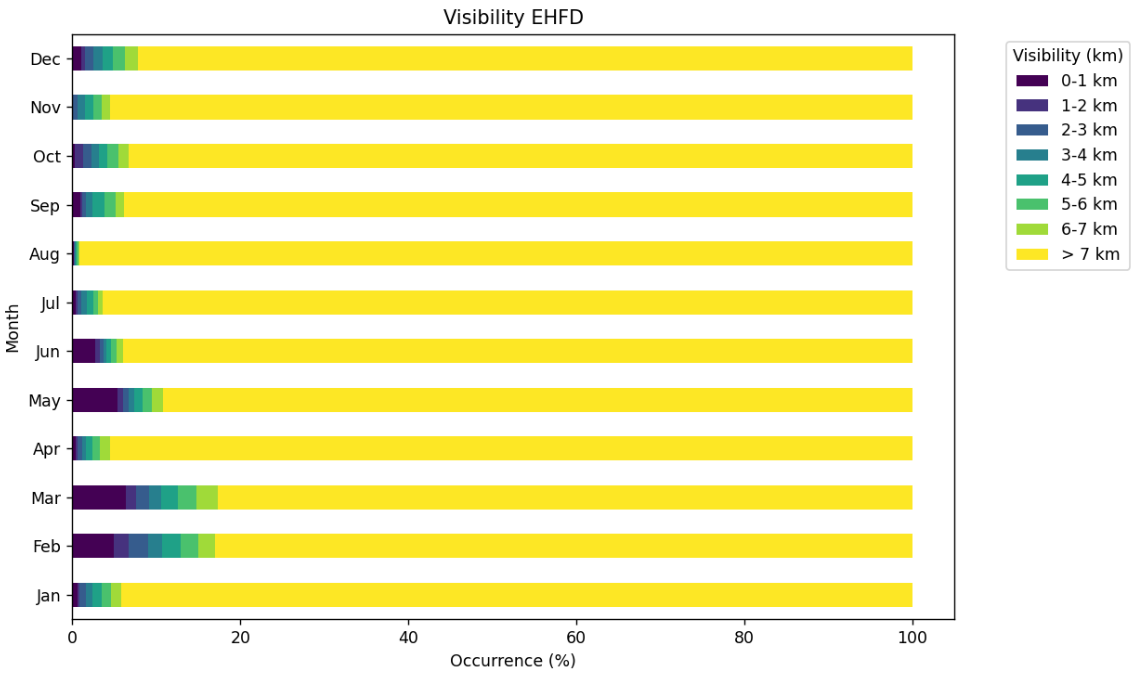


Figure 39 - Distribution of the visibility conditions per month registered at EHFD station (Jan 2021 - May 2024)

Looking at more detailed information, the graph below (Figure 40) shows how often the visibility is above the different minima identified in Table 8.

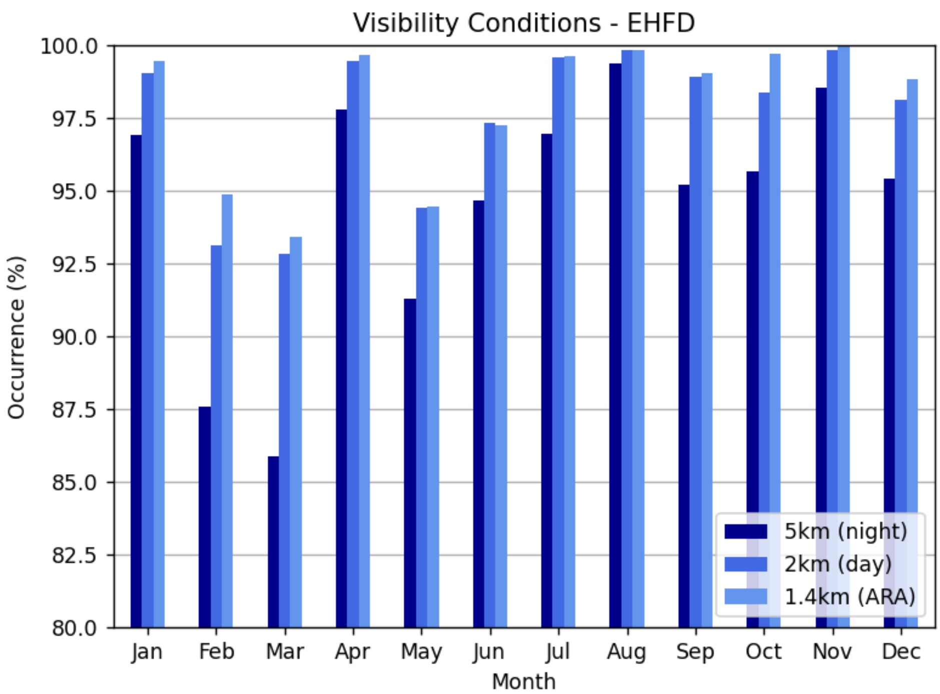


Figure 40 - Visibility conditions registered at EHFD station above EASA minima for day and night operations (Jan 2021 - May 2024)

When considering visibility only, the following can be concluded:

- Visibility conditions are good in general, falling below the 2 km limit (for daytime operations) about 3% of the time, and below 5km limit (for nighttime or VFR operations) 6% of the time, on average.
- Operations in the daytime can be carried out 97% of the time.
- Operations in the nighttime can be carried out 94% of the time.
- Visibility conditions fall below ARA minima (1.4km) between 1-7% of the time, meaning ARA procedures can be flown over 90-99% of the time.
- The months of February, March and May seem to be the ones with worst visibility.
- In the worst months, the 2 km visibility is not reached up to 7% of the time, meaning daytime operations are possible around 90% of the time.
- In the worst months, the 5 km visibility is not reached up to 5-14% of the time, meaning nighttime operations are possible 86-95% of the time.
- For operations in Class G airspace below 3000 ft (as indicated in Table 7), a minimum visibility of 5 km is required. However, due to the remote nature of offshore operations, an exception for 1500m of visibility could apply (see first remark in Table 7).
- Visibility is higher than 1500m over 97% of the time in the studied wind station, meaning operations are possible under visual flight conditions 97% of the time only considering visibility.

4.3.3 Cloud-base conditions

The cloud-base altitude is also relevant for the operations to offshore platforms and other visual and instrument navigation, as both have limits specified in the regulations.

In the case of helicopter offshore operations, a minimum cloud-base altitude of 300 ft is required by day, and 500 ft by night, as specified in the EASA AIROPS Part SPA.HOFO regulation [Ref 5] (see Table 6).

For general visual operations under VFR in uncontrolled airspace, the cloud-base should be higher than the flight altitude, which is assumed to be 1500ft in this case. For ARA instrument procedures, the cloud-base elevation limit is 295 ft by day, and 300 ft by night, based on the Minimum Descent Height (MDH) defined in the EASA AIROPS regulation.

The graphs below (Figure 41) show the distribution of cloud-base altitude data, based on the assumed flight altitude of 1500 ft, for the platform for which the information is available, showing also the 200, 300 and 500 ft limits required for different operations. If the flight altitude is intended to be higher than 1500 ft, then the cloud base should be higher as well. Figure 41 also shows that the occurrence of the cloud base higher than 2000 ft decreases. Therefore, the higher flight altitude, the smaller the occurrence of cloud base higher than the flight altitude.

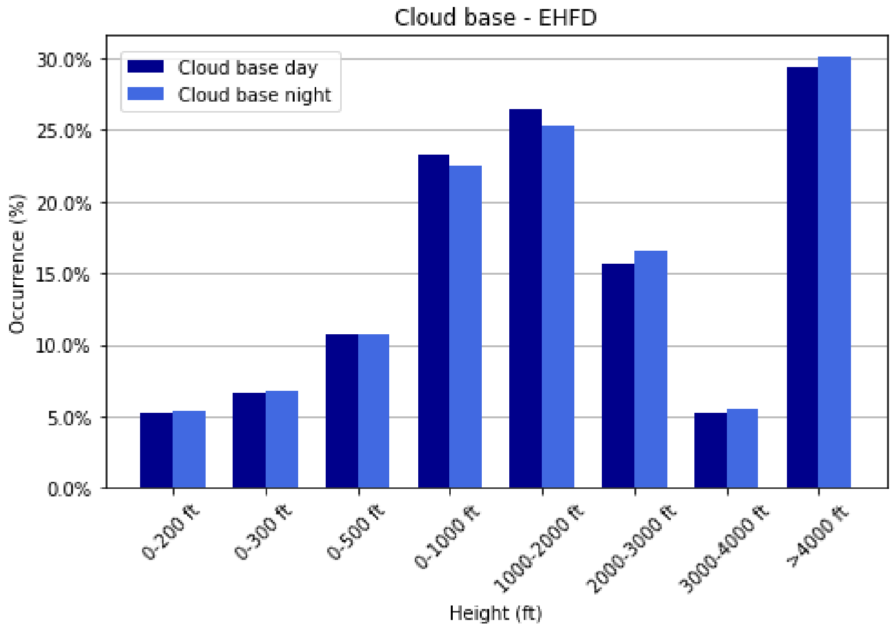


Figure 41 - Cloud-base conditions registered at EHFD station (Jan 2021 - May 2024)

From the graphs in Figure 41, when considering cloud-base conditions only, the following can be concluded about offshore helicopter operations:

- The cloud-base drops below 300 ft around 7% of the time and below 500 ft about 11% of the time. This means that flights might not be able to operate during the day up to 7% of the time (less than 300 ft of cloud-base), and up to 11% during the night (less than 500ft of cloud-base) between offshore platforms.
- The cloud-base is less than 200 ft 5% of the time, meaning ARA based approaches could be performed over 95% of the time.
- In a typical operating altitude of 1500 ft, the cloud-base will allow the operation (cloud-base higher than 1500ft) under visual flight conditions around 66% of the time.

4.3.4 Wind conditions

Wind conditions, mostly the tailwind component of the wind, are critical for the take-off and landing phases of the flight. Helicopters have prescribed performance limits within which they need to perform their landings and take-offs. These performance limits are specific to a helicopter type, operator and type of operation, and therefore it is not possible to set a general regulatory limit on acceptable wind.

In the regulations, there are however some specified limits for offshore operations. EASA AIROPS Part SPA.HOFO [Ref 5] requirement 135 limits operations to/from helidecks to winds lower than 60kt.

EASA Part SPA.HOFO.135 Wind limitations for operations to offshore locations Operation to an offshore location shall only be performed when the wind speed at the helideck is reported to be not more than 60 knots including gusts.

The following graph (Figure 42) contains the results of the wind analysis for the platform (EHFD) that was specified as relevant for the area 6/7. A wind-rose was produced for the weather station, which displays the predominant wind directions and wind speeds, allowing to estimate of the potential impact on the helicopter operations.

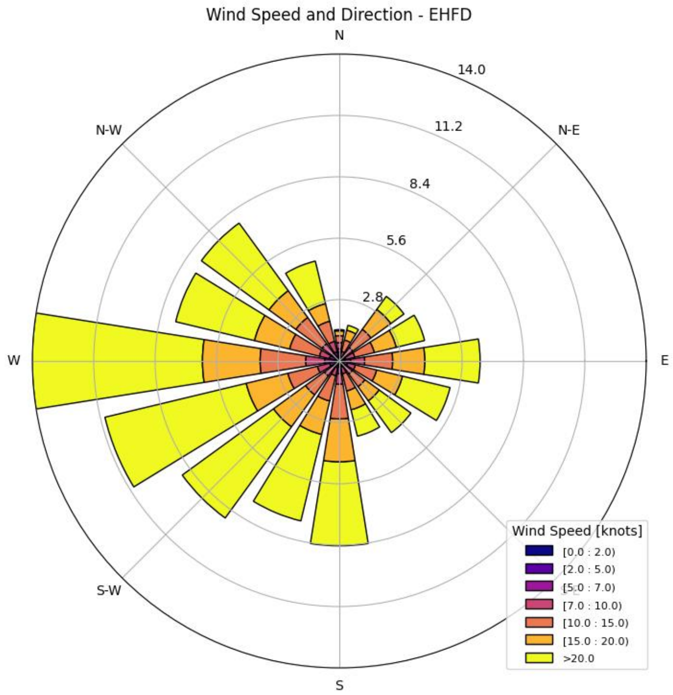


Figure 42 - Windrose plot for EHFD station (Jan 2021 - May 2024)

The prevailing wind direction is of specific importance when determining the orientation of the platform and he helideck, as it will define the orientation of the OFS and the space available for the provision of the approach and take-off climb surfaces.

It is recommended to position the approach and take-off climb surface/corridor at 0° (facing North) to minimize the impact of wind during the helicopter approach. This minimises the risk of tailwind affecting the helicopter during the approach phase, although it will result in a tailwind during takeoff. To address this, it is advised to establish an additional approach corridor in the opposite direction at 180° (facing South). This setup will help mitigate the impact of the tailwind in the take-off and approach phases. However, visibility, cloud cover, and other meteorological conditions still need to be considered.

Figure 43 shows the proposed corridor direction (0°-180°). By defining these corridors (approach and take-off climb surfaces), the orientation of the platform and its associated OFS is also affected: the corridors need to be provided within the area that the OFS covers, to make the operation of the helicopters possible to take-off and approach (they will use the available space within the OFS to maneuver the helicopter considering wind conditions and land in an approach procedure). Figure 43 also shows how the OFS and the orientation of the platform could be provided to consider wind conditions as much as possible while allowing safe operations to/from the helideck. In particular, this orientation is used to not make the helicopters experience tailwind in the approach phase of the flight.

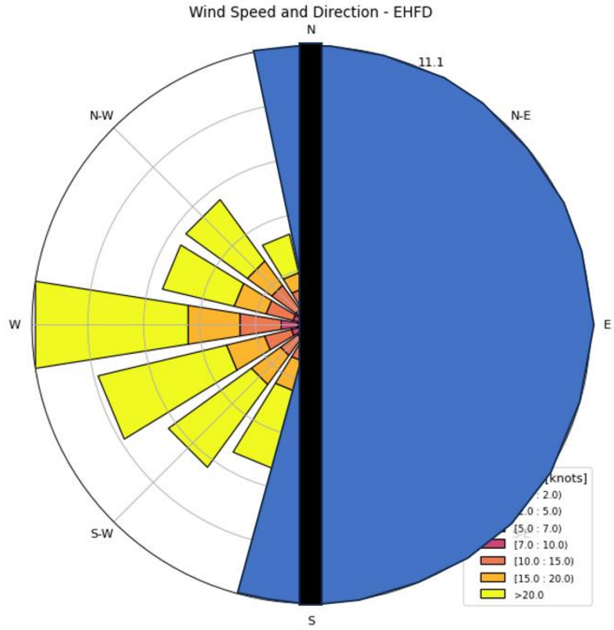


Figure 43 - Windrose with corridor direction

When considering wind conditions only, the following can be concluded:

- The prevailing wind direction is mostly from the west and south-west direction.
- Wind speeds of over 60 knots were only recorded on three occasions per weather station in the entire period that was analysed, meaning that the limit specified in the EASA AIROPS Part SPA.HOFO [Ref 5] is rarely reached.

4.3.5 Impact of meteorological assessment

The analyses in the preceding sections present the impact different meteorological conditions have on operations individually. However, it is important to analyse the overall situation, namely all meteorological conditions combined, in order to estimate the true accessibility figures for the helidecks.

The impact of wind conditions is harder to measure, since they are related to the specific helicopter performance and crew comfort, meaning there are no hard (regulatory) limits such as for the other weather conditions. In this case, an assumption is made that tailwinds of 10kt and higher along the approach corridor do not allow the operation of the helicopter. This issue is mitigated by providing two approach corridors in -as much as possible- opposite directions, which virtually removes the impact of wind in the accessibility, by allowing the approach and take-off procedures to be performed without tailwind, due to the choice of two different directions. This would affect the orientation of the platform, since the OFS should include the two corridors (approach and take-off climb surfaces) and should provide an obstacle free sector of 210° around the platform. The OFS and the orientation of the platform should be done such as to make the helicopters experience tailwind as less as possible.

The accessibility to the platforms based on the requirements provided in Table 8 has been studied. Those conditions include the requirements for all sorts of different operations to and from the offshore platforms. The accessibility of the helideck is in the range of 86% and 91% for instrument and visual conditions specific to offshore operations. Under normal VMC conditions in Class G airspace, the accessibility is reduced to about 62%, mainly due to the required cloud-base. Cloud-base is over 1500 ft only about 65% of the time, which restricts the possibilities for VFR flights.

Accessibility values can vary by time of the year, due to different seasonal meteorological conditions. Table 9 contains the accessibility figures per month considering all types of flight operations from Table 8**Error! Reference source not found.**. From this table, it can be derived that accessibility figures do not change significantly throughout the months. However, it can be observed that summer months provide the best accessibility figures overall.

Table 9 - Accessibility figures for different types of operation, per month based on weather station EHFD

	Visibility	Cloud-base	Average accessibility	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
VFR	5km	1500ft	61.7%	53.4%	60.9%	59.5%	73.2%	57.7%	62.1%	64.5%	67.1%	69.1%	64.1%	54.2%	55.0%
Offshore day (shuttling)	2km	300ft	91.2%	92.0%	84.3%	84.2%	95.5%	84.6%	90.8%	92.7%	96.9%	95.3%	93.3%	96.0%	91.1%
Offshore night (shuttling)	5km	500ft	86.5%	86.6%	78.7%	78.6%	92.6%	79.1%	87.4%	88.7%	94.6%	91.6%	87.3%	91.3%	84.0%
ARA day	1.4km	200ft	94.7%	96.5%	88.4%	88.0%	97.8%	90.6%	93.8%	96.0%	98.4%	97.6%	97.7%	98.8%	95.6%
ARA night	1.4km	300ft	91.3%	92.0%	84.4%	84.2%	95.5%	84.6%	90.8%	92.7%	96.9%	95.3%	94.1%	96.1%	91.1%
PinS 1A (1.62NM/200ft)	3km	200ft	94.1%	96.0%	86.8%	87.3%	97.4%	90.4%	93.7%	95.9%	98.3%	97.2%	96.0%	98.4%	95.0%
PinS 1B (1NM/200ft)	1.8km	200ft	94.7%	96.5%	88.3%	87.9%	97.7%	90.6%	93.8%	96.0%	98.4%	97.5%	97.2%	98.8%	95.6%
PinS 1C (0.54NM/200ft)	1km	200ft	94.7%	96.5%	88.4%	88.0%	97.8%	90.6%	93.8%	96.0%	98.4%	97.6%	97.9%	98.8%	95.6%
PinS 2A (1.62NM/250ft)	3km	250ft	92.8%	94.3%	85.4%	85.8%	96.5%	88.2%	92.4%	94.4%	97.6%	96.4%	94.7%	97.3%	93.0%
PinS 2B (1NM/250ft)	1.8km	250ft	93.2%	94.6%	86.6%	86.3%	96.8%	88.4%	92.5%	94.6%	97.7%	96.7%	95.8%	97.7%	93.6%
PinS 2C (0.54NM/250ft)	1km	250ft	93.3%	94.6%	86.8%	86.4%	96.8%	88.4%	92.5%	94.6%	97.7%	96.7%	96.5%	97.7%	93.6%
PinS 3A (1.62NM/300ft)	3km	300ft	90.8%	91.8%	83.4%	83.8%	95.2%	84.4%	90.8%	92.6%	96.8%	95.0%	92.5%	95.7%	90.6%
PinS 3B (1NM/300ft)	1.8km	300ft	91.2%	92.0%	84.4%	84.2%	95.5%	84.6%	90.8%	92.7%	96.9%	95.3%	93.5%	96.1%	91.1%
PinS 3C (0.54NM/300ft)	1km	300ft	91.3%	92.0%	84.5%	84.2%	95.5%	84.6%	90.8%	92.7%	96.9%	95.3%	94.2%	96.1%	91.1%

From the table above it can be seen that PinS procedures have a great potential in terms of accessibility of the helidecks, as purely based on weather conditions they offer accessibility figures of over 90%. Based on the individual information collected from the EHFD weather station, the ceiling (cloud-base) is the most limiting factor and that is the reason why PinS and ARA procedures show similar values for the same cloud-base conditions but different horizontal visibility requirements.

4.4 Optimization options

4.4.1 Orientation of the platform

The orientation of the platform, although seemingly a trivial question due to its circular shape in most cases, is of extreme importance as its orientation (and the physical position of the chevron marking) will determine how the 210˚sector needs to be provided and the position of the obstacles around the helideck (as there cannot be any obstacles higher than the helideck level in that 210˚sector).

Section 4.3.4 provides one of the options for the orientation of such a platform and the OFS (having the main axis at 90°), taking into account only the prevailing wind conditions in the area. This orientation is recommended to facilitate the final manoeuvring into the platform in case of an approach, and the initial manoeuvring from the platform in case of a departure, given that it maximises orientations outside of tailwind conditions. There are, however, other options available (see Figure 44).

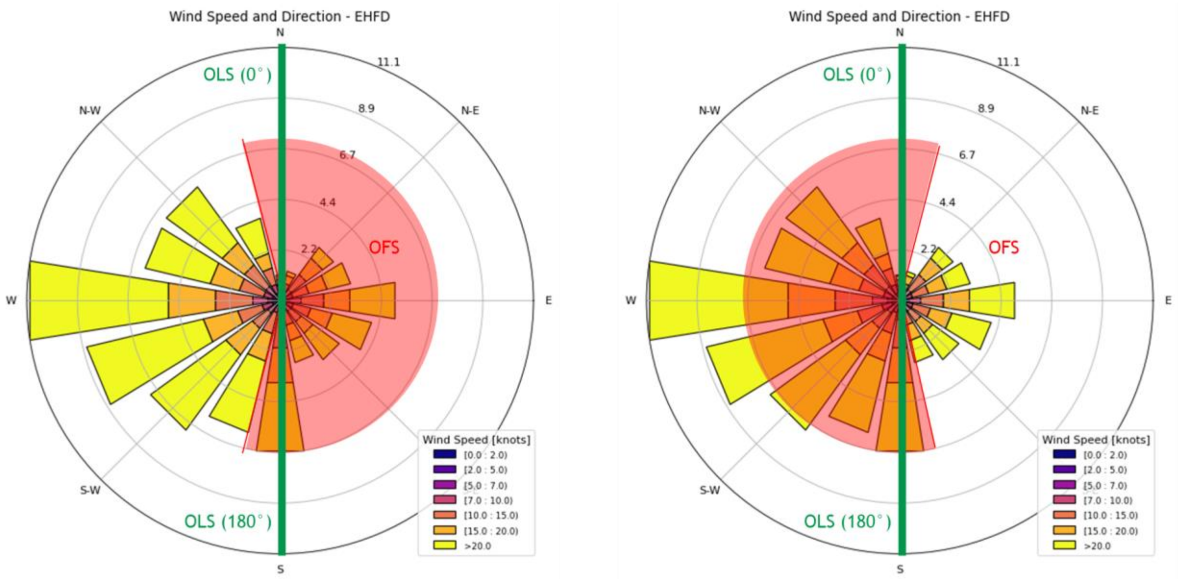


Figure 44 – Examples of two OFS and platform orientations for the provision of the same approach and take-off climb surfaces

However, it is possible that this orientation will not be chosen at a later stage due to other (non-aviation) factors that are not known at this point in time. It should be noted that the orientation of the platform has not been fixed by this study, as a generic orientation has been chosen. It is recommended that the final choice of this orientation be made, as much as possible, on the basis of the prevailing meteorological conditions in this area in the interest of facilitating helicopter operations.

4.4.2 Variability in the location of the PinS point

The PinS point has been chosen at a distance of 1 NM from the HRP, as a standard value that is possible for any PinS approach and departure procedure. This distance (1852 m) would also determine the visibility requirement for the PinS approach in case of a straight-in segment.

It is recommended that during the design phases of the PinS procedures the location of the PinS point is optimized based on the final approach speed of the helicopter type, the final obstacle environment around the platform and the type of PinS procedure that is chosen. Ranges from 0.54 up to 1.62 NM are possible (see Figure 45).

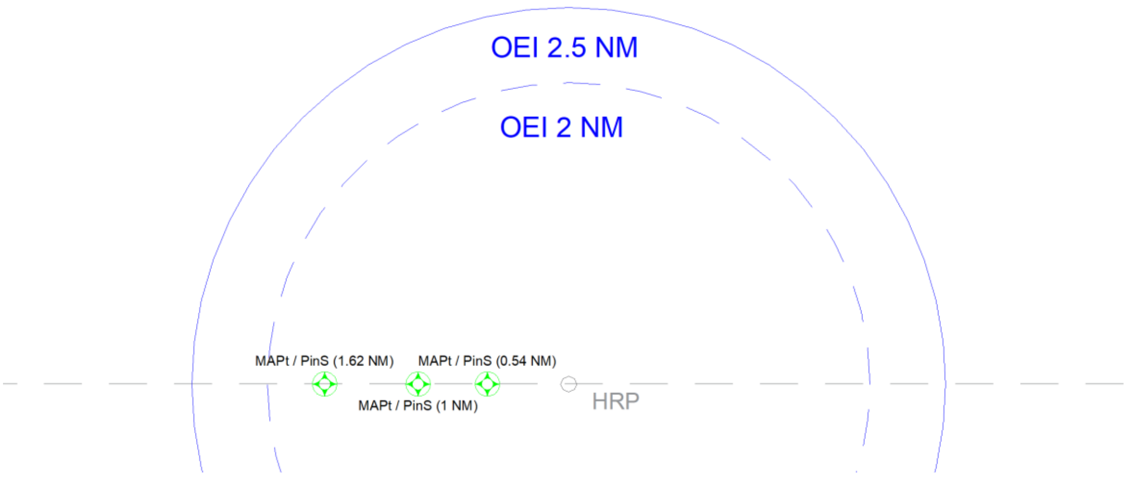


Figure 45 - Possible locations of the PinS point

It must be noted that all these options for the location of the PinS point fall within the OEI areas of 2.5 and 2 NM, which means that if the OEI area is provided free of obstacles, there will be no obstacles within the visual segment of the approach and, therefore, it will be easier for the pilot to perform a PinS approach even in the case of a proceed VFR procedure (where no obstacle protection is provided as it is based on the see and avoid principle).

To have an idea about the influence of the location of the PinS point on the helideck accessibility, Table 9 shows the different percentages of accessibility that can be expected for different combinations of horizontal visibility (which is directly dependent on the location of the PinS) and cloud base. It must be noted that from these two parameters, as concluded in the meteorological assessment, the cloud base is more restrictive and limiting than the visibility conditions and, therefore, it is preferred to optimize the minima required in the procedure (related to the cloud base) than the position of the PinS point, although an iterative process will be required to determine the minima based on the location of the PinS point.

4.5 Impact of shipping routes around area 6/7

There are several shipping routes defined around area 6/7 with different intensities in terms of number of movements per year. These routes will probably have an influence on the area 6/7 and in particular the helicopter operations to/from the different platforms. As an indication of the location of these routes, Figure 46 shows these planned routes and clearways with the expected intensity in terms of ships making use of them over a period of time of one year.

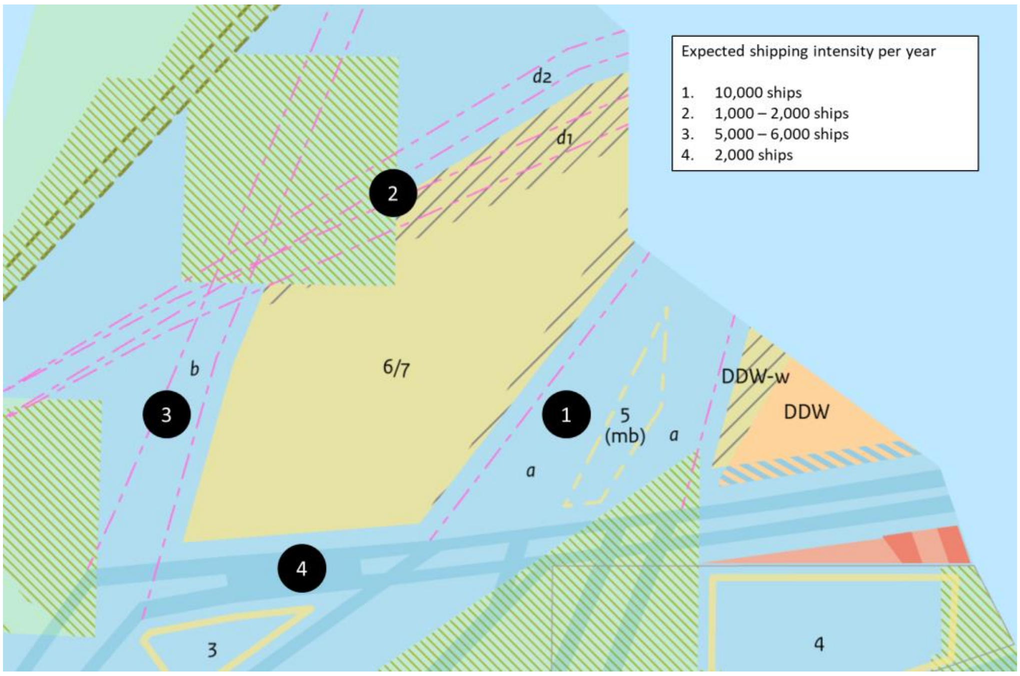


Figure 46 - Indication of the potential shipping routes and clearways. Background image: Zoekgebiedenkaart voor windenergie en scheepvaart, NRD Partiële Herziening Programma Noordzee 2022-2027

The impact of these routes is assessed in sections 4.5.1 through 4.5.3 for each of the three scenarios considered in this study. It must be noted that only the shipping routes outside of the area 6/7 are analysed as the shipping inside the area will depend on the final scenario that is chosen for area 6/7 and are, for the time being, not defined.

Note: for the time being vessel detection is not available for helicopter operators. Therefore, offshore PinS procedures with real time (or near real time) vessel detection shall be developed when the technology and required corresponding procedures are in place in order to assess the real figures of accessibility and the impact of the shipping routes on PinS procedures.

4.5.1 Combinatievariant 27

In this variant, the impact of the routes can be observed in two clearly differentiated areas: in the north, coinciding with route #2, and in the south/southeast, coinciding with routes #1 and #4. These two areas are analysed in detail in the following paragraphs.

<u>Northern situation</u>

The impact of the shipping routes on the north part of *combinatievariant 27* is really limited for PinS procedures, as in most of the cases they penetrate other protection areas that are more limiting such as the OEI area (for the 2.5 NM case)[10].

- For platforms 24, 25 and 30 (located in the northwest corner of the area 6/7, see Figure 47), the OEI protection area is more restrictive than the areas associated to the PinS procedures and, therefore, it is expected that shipping routes have no impact on PinS procedures. Whenever helicopter operations are taking place to/from one of these platforms, the OEI area (provided at helideck level) shall be free of obstacles (including ships) which shields the required protection area and obstacle limitation for PinS procedures. If ships lower than 30m are around the area, they do not penetrate the OEI or the PinS areas, so they do not have an impact on the accessibility of any of these platforms.
- For platforms 17, 21, 22 and 23, the interaction between the PinS procedures and the shipping routes has no effect on the accessibility of the helideck provided that the height of the ships will not exceed 300 m (which is a reasonable assumption) and that the procedure altitude will be at least 1500 ft up to the final approach segment (which is expected to be the case).
- For platforms 18, 26, 27, 28 and 29 (located in the northeast corner of the area 6/7, see Figure 47), the same conclusions as for the northwest corner area apply, since the OEI area is the most limiting and restrictive surface.

It can be concluded that the impact of the shipping routes, in particular shipping route #2, on the northern part of the area 6/7 is very limited and in most of the cases restricted to the OEI surface and not the PinS procedure. It is not required to have different sets of minima for PinS approaches depending on the presence or absence of ships in route #2, as in none of the cases the PinS protection areas result in the most limiting surface.

The reduction of the OEI area to 2.0 NM might only reduce the impact on platform 30 (located in the northwest corner outside the area 6/7), as in that case the OEI area will not cross the shipping route. However, this situation will still be dependent on the exact location of the ship in that route (as it is not expected that ships will follow exactly the shipping route) and since the platform is located outside area 6/7, other orientations of PinS procedures avoiding any overlap with the shipping route can still be provided. Note that for platforms outside the area 6/7 no PinS procedure and associated areas has been provided as there is no need to account for additional area that requires to be free of obstacles.

[10] Provided that the 2.5NM area associated to the OEI is free of vessels, which is a requirement for the safe operation in the platforms, the PinS procedures are also clear of the vessels. At a distance of 2.5NM, the helicopter flying a PinS approach is a 1000ft (300m) following the optimum descent gradient of 6.5%. Given a minimum obstacle clearance (MOC) of 75m, any ship lower than 225m beyond the 2.5NM distance will not be a limiting factor for the minima of the procedure.

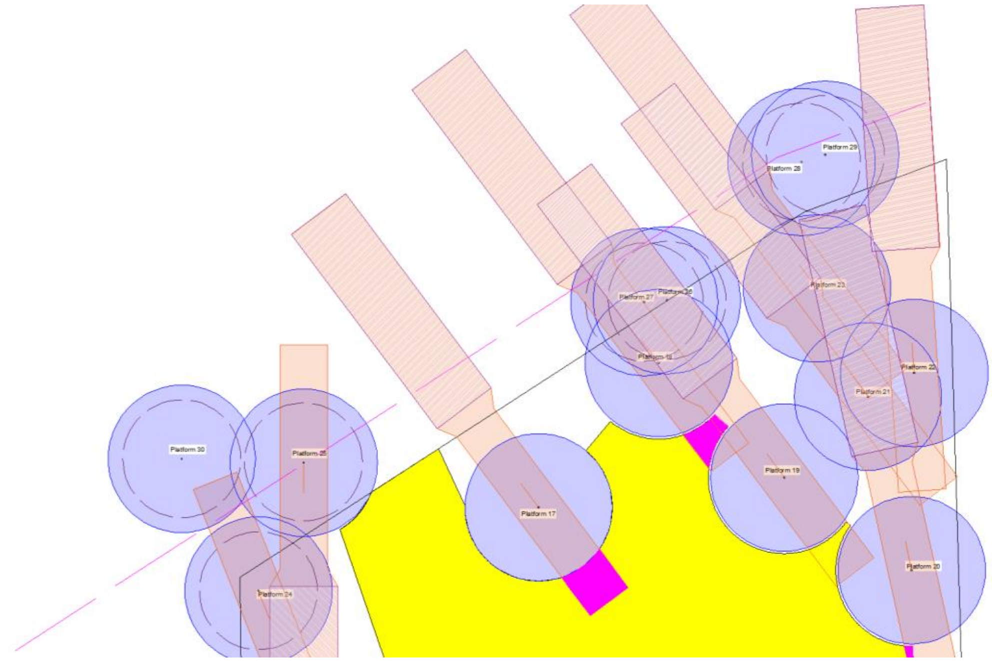


Figure 47 - Interaction of shipping route #2 and PinS procedures for the northern platforms in combinatievariant 27

Southern situation

The impact of the shipping routes on the south part of *combinatievariant 27* is limited to a single platform, #3. For this platform, as many others located in the northern part of area 6/7, the impact is limited to the OEI area (either with 2.5 or 2 NM radius), and, therefore, has no impact on the PinS procedures.

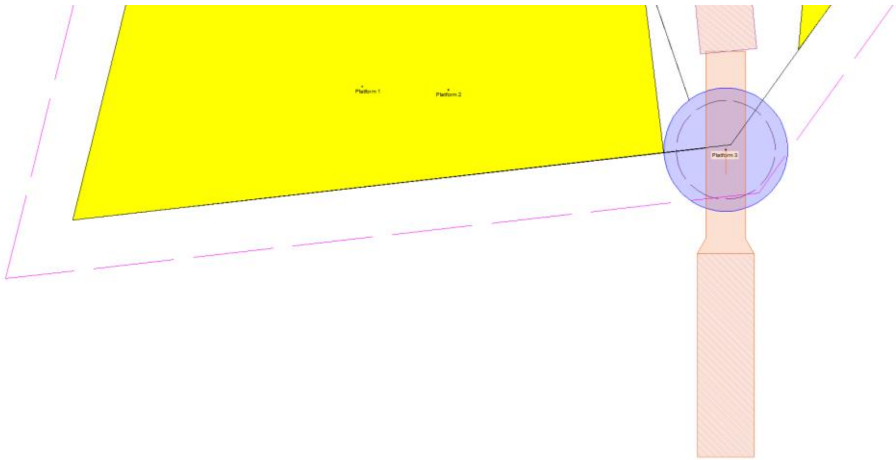


Figure 48 - Interaction of shipping routes #1 and #3 and PinS procedures for the southeast platform (#3) in combinatievariant 27

Overall conclusion combinatievariant 27

Based on the previous analysis for the different platforms and shipping routes, it can be concluded that shipping routes have no impact on PinS procedures as long as the following assumptions are valid:

- The OEI area (either 2.5 or 2 NM) is provided at helideck level and needs to be free of obstacles when a platform is in use
- Ships' highest points remain below 300 m height and the procedure altitude defined in the PinS approach (up to the final approach segment) is at or above 1500 ft.

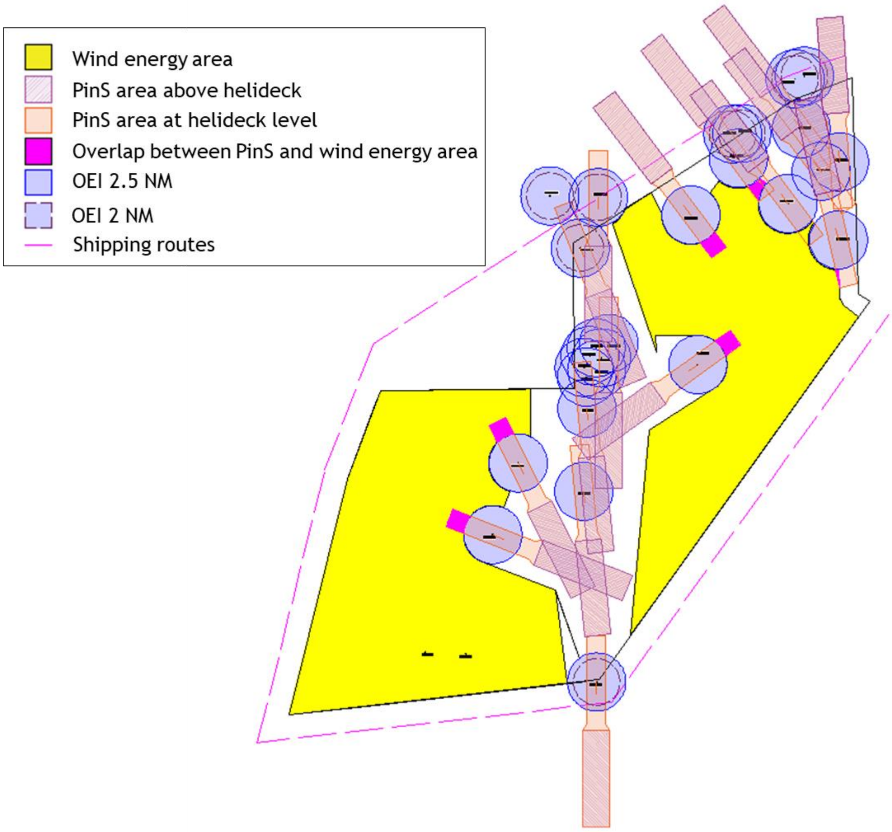


Figure 49 - Overall interaction of shipping routes and combinatievariant 27

4.5.2 Combinatievariant 0

Northern situation

This situation is no different than for the first variant and, therefore, the same conclusions can be applied.

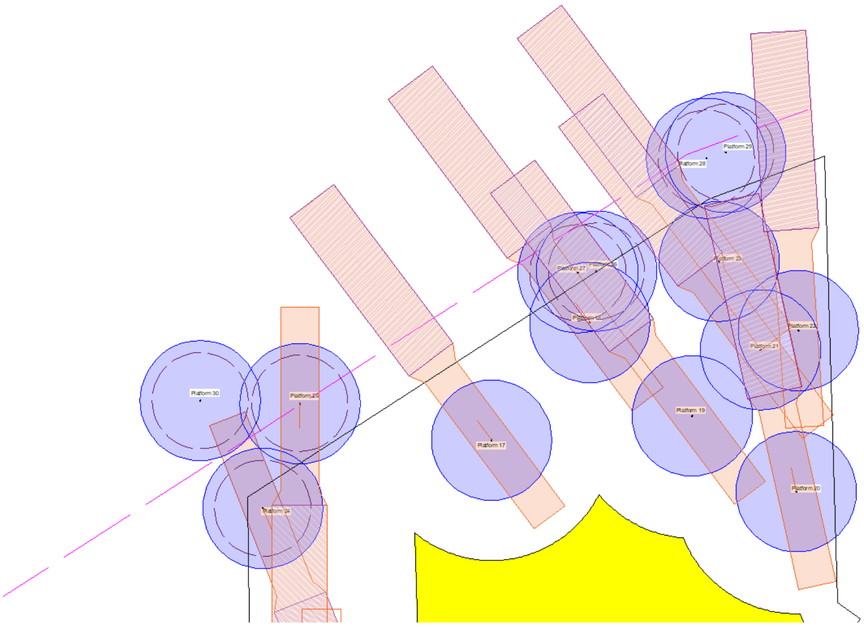


Figure 50- Interaction of shipping route #2 and PinS procedures for the northern platforms in combinatievariant 0

Southern situation

This situation is no different than for the first variant and, therefore, the same conclusions can be applied.

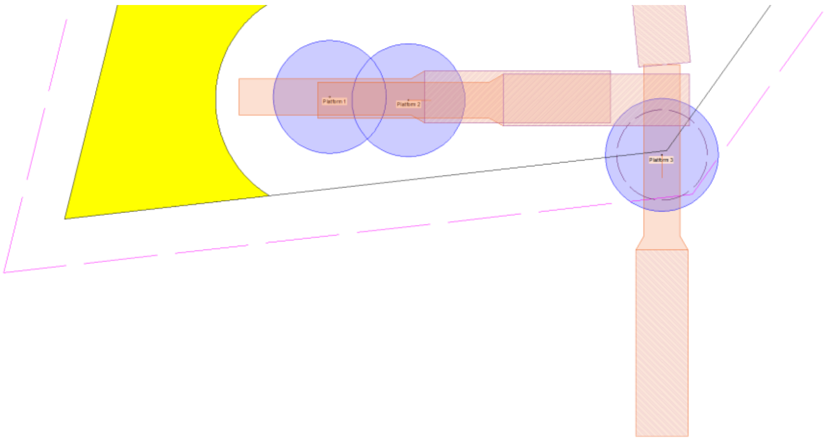


Figure 51 - Interaction of shipping routes #1 and #3 and PinS procedures for the southeast platform (#3) in combinatievariant 0

Overall conclusion combinatievariant 0

Based on the previous analysis for the different platforms and shipping routes, it can be concluded that shipping routes have no impact on PinS procedures as long as the following assumptions are valid:

- The OEI area (either 2.5 or 2 NM) is provided at helideck level and needs to be free of obstacles when a platform is in use.
- Ships' highest points remain below 300 m height and the procedure altitude defined in the PinS approach (up to the final approach segment) is at or above 1500 ft.

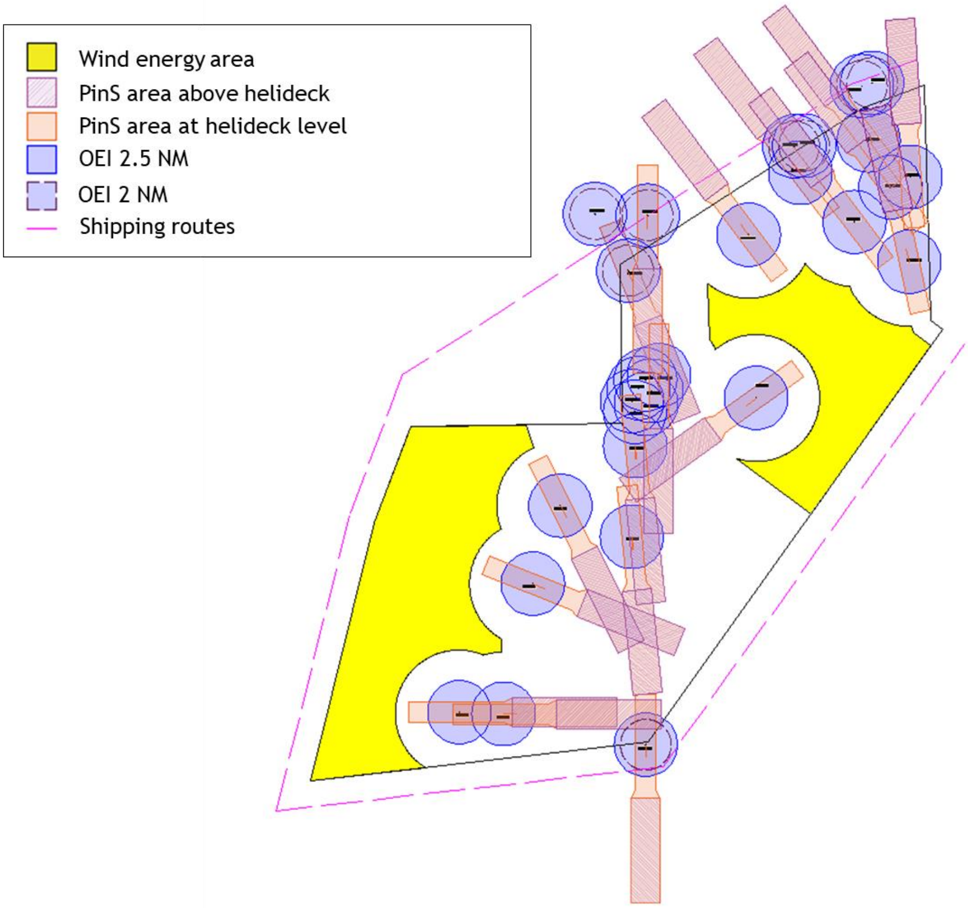


Figure 52 - Overall interaction of shipping routes and combinatievariant 0

4.5.3 Spatial layout based on 5NM areas around each platform (spatial layout 3)

Northern situation

This situation is no different than for the first and second variant and, therefore, the same conclusions can be applied.

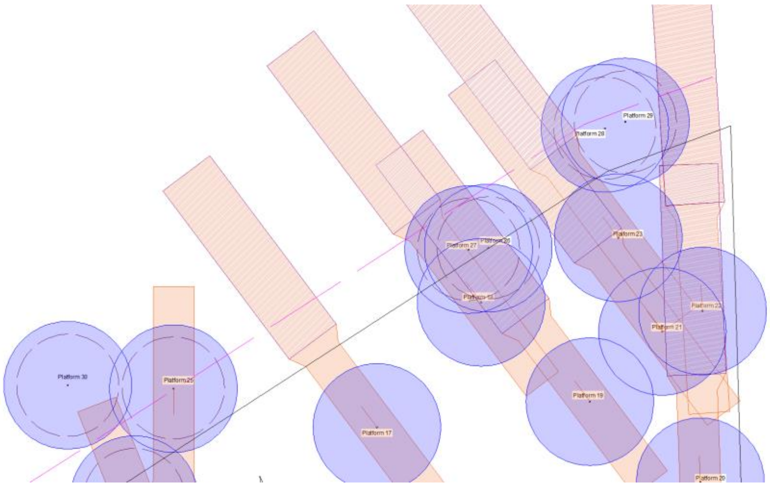


Figure 53 - Interaction of shipping route #2 and PinS procedures for the northern platforms in scenario 3

Southern situation

For platform #3 (located in the southeast corner of the area) the situation is no different than for the first and second variant and, therefore, the same conclusions can be applied.

For platforms #1 and #2 the definition of the PinS procedures cannot be provided from the east (as it is the case in the previous two scenarios), due to the limitations in the open space available around these two platforms. Therefore, the only manner in which helicopters could access these two platforms in particular is from the south, crossing the shipping route #4 (which has a low intensity compared to other shipping routes).

In this case, the interaction between the PinS procedures and the shipping route would take place before the final segment in the case of a standard PinS procedure. In this case, depending on the procedure altitude determined for the initial and intermediate segments, the impact of the shipping routes might be disregarded as long as the height of the ships operating there is less than 300 m.

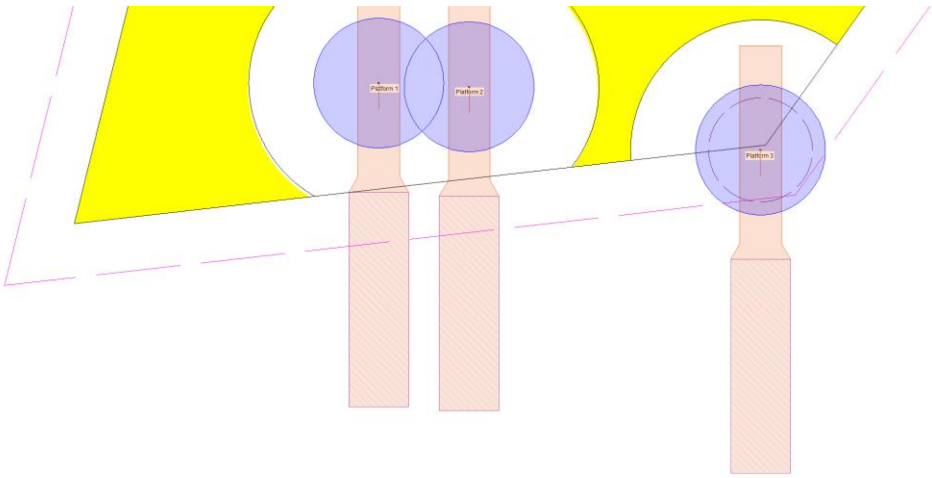


Figure 54 - Interaction of shipping routes #1 and #3 and PinS procedures for the southeast platforms (#1,2,3) in sce 3

Overall conclusion spatial layout 3

Based on the previous analysis for the different platforms and shipping routes, it can be concluded that shipping routes have no impact on PinS procedures as long as the following assumptions are valid:

- The OEI area (either 2.5 or 2 NM) is provided at helideck level and needs to be free of obstacles when a platform is in use.
- Ships' highest points remain below 300 m height and the procedure altitude defined in the PinS approach (up to the final approach segment) is at or above 1500 ft.

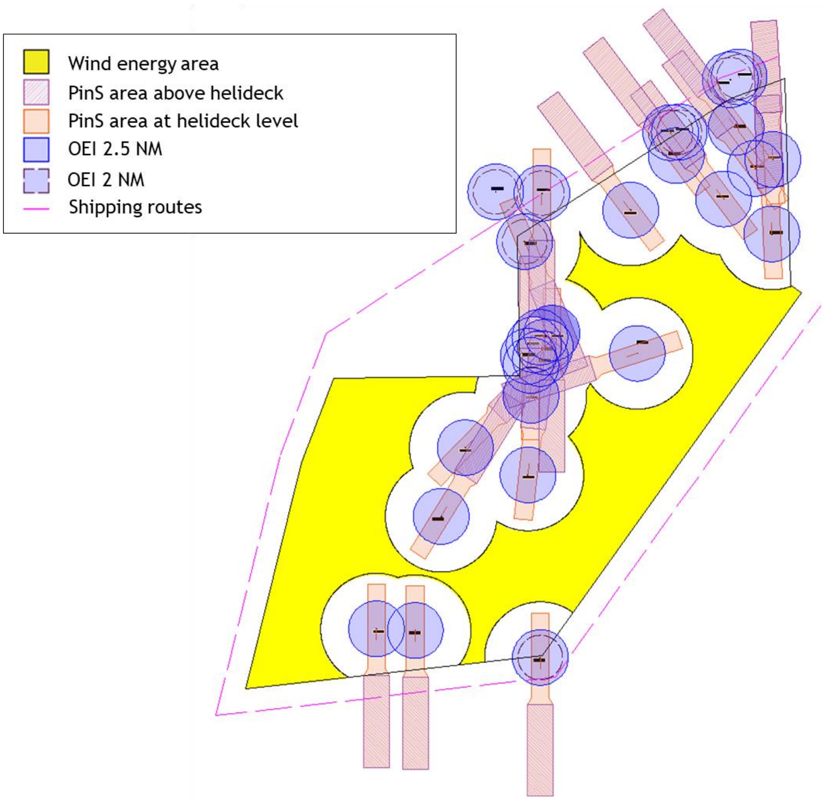


Figure 55 - Overall interaction of shipping routes and the scenario based on 5NM areas around each platform

4.5.4 Overall impact of shipping routes

Until detection systems are developed and available, and information on the presence (or not) of ships can be in one way or another known to the helicopter crews, alternatives are needed to mitigate the presence of possible ships in the vicinity of the area 6/7.

For the specific case of PinS procedures, the only potential mitigation to overcome the presence of ships in the area is to increase the minima (OCA) accounting for the ships as obstacles. Considering ships whose height might be up to 500 ft, the increase in minima would raise from 200-300 ft to 700-800ft and this has an impact on the accessibility figures that have been provided in section 4.3.5.

As a reference, those scenarios included in Table 9 whose PinS location is at 1 NM or 1.62 NM have been chosen to evaluate the impact of increased minima. Scenarios denoted with suffix C (0.54 NM) have not been considered due to the increase over 10% on the descent gradient that would be required if from that PinS location a descent is required from a higher altitude (minima between 700-800 ft).

Table 10 - Impact of shipping routes on PinS procedures and helideck accessibility

PinS	Visibility	Cloud-base	Average accessibility
PinS 1A (1.62NM/200ft)	3km	200ft	92.2%
PinS 1B (1NM/200ft)	1.8km	200ft	92.8%
PinS 2A (1.62NM/250ft)	3km	250ft	90.3%
PinS 2B (1NM/250ft)	1.8km	250ft	90.9%
PinS 3A (1.62NM/300ft)	3km	300ft	87.7%
PinS 3B (1NM/300ft)	1.8km	300ft	88.1%
PinS with increased minima (1.62NM/700ft)	3km	700ft	81.9%
PinS with increased minima (1NM/700ft)	1.8km	700ft	82.1%
PinS with increased minima (1.62NM/800ft)	3km	800ft	79.3%
PinS with increased minima (1NM/800ft)	1.8km	800ft	79.5%

From Table 10 it can be clearly seen the impact of shipping routes in the accessibility of the helidecks showing a decrease in accessibility of over 10%. These numbers are indicative (since they are based on very standard considerations and designs) but they give a realistic impression of the impact of shipping routes. It is recommended to use them against similar numbers obtained for ARA procedures before making a decision on the type of flight procedure for helicopters operating in the 6/7 area and while vessel detection systems and procedures are not available.

ABBREVIATIONS AND DEFINITIONS

AMSL – Above Mean Sea Level

D – The largest overall dimension of the helicopter when rotor(s) are turning measured from the most forward position of the main rotor tip path plane to the most rearward position of the tail rotor tip path plane or helicopter structure. D is sometimes referred to as D-value.

FATO (Final approach and take-off area) – A defined area over which the final phase of the approach manoeuvre to hover or landing is completed and from which the take-off manoeuvre is commenced. Where the FATO is to be used by helicopters operated in performance class 1, the defined area includes the rejected take-off area available.

Final approach segment. That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

Flight Level (FL) – Altitude AMSL in multiples of 100 ft, in standard atmosphere. FL100 is approx. 10.000 ft.

Global navigation satellite system (GNSS). A worldwide position and time determination system that includes one or more satellite constellations, aircraft receivers and system integrity monitoring, augmented as necessary to support the required navigation performance for the intended operation.

Helideck – A heliport located on a fixed or floating offshore facility such as an exploration and/or production unit used for energy collection/conversion, oil and gas.

Heliport/helideck reference point (HRP). The designated location of the heliport/helideck or landing location.

Initial approach fix (IAF). A fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable.

Initial approach segment. That segment of an instrument approach procedure between the initial approach fix and the intermediate approach fix or, where applicable, the final approach fix or point.

Intermediate approach segment. That segment of an instrument approach procedure between either the intermediate approach fix and the final approach fix or point, or between the end of a reversal, racetrack or dead reckoning track procedure and the final approach fix or point, as appropriate.

Intermediate fix (IF). A fix that marks the end of an initial segment and the beginning of the intermediate segment.

Instrument Flight Rules (IFR). The symbol used to designate the instrument flight rules.

IFR flight. A flight conducted in accordance with the instrument flight rules.

Instrument Meteorological Conditions (IMC) are meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minima specified for visual meteorological conditions (VMC).

Lateral Navigation (LNAV). A non-precision approach procedures, which is designed and flown without using vertical guidance. These procedures can achieve a minimum descent altitude as low as 250ft.

Localiser Performance with Vertical Guidance (LPV). A precision approach procedure, using satellite-based augments systems (SBAS) for providing lateral and vertical guidance in the final approach phase. These procedures can achieve a decision height as low as 200ft.

Missed approach point (MAPt). That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated in order to ensure that the minimum obstacle clearance is not infringed.

Missed approach procedure. The procedure to be followed if the approach cannot be continued.

MOC (Minimum Obstacle Clearance) – The minimum obstacle clearance that will provide the vertical distance that needs to be applied and that will allow to fly the aircraft safely over terrain or obstacles.

OCA (Obstacle Clearance Altitude) – The lowest altitude or the lowest height above the elevation of the relevant runway threshold or the aerodrome elevation as applicable, used in establishing compliance with appropriate obstacle clearance criteria.

OFS (Obstacle Free Sector) – A complex surface originating at, and extending from, a reference point on the edge of the FATO of a helideck, comprised of two components, one above and one below the helideck for the purpose of flight safety within which only specified obstacles are permitted.

OLS (Obstacle Limitation Surfaces) – the airspace around heliports to be maintained free from obstacles so as to permit the intended helicopter operations at the heliport to be conducted safely and to prevent the heliports from becoming unusable by the growth of obstacles around them.

One-Engine-Inoperative (OEI). One engine inoperative is a condition where one of the engines on a multi-engine aircraft/helicopter fails and as a result, a thrust imbalance exists between the operative and inoperative sides of the aircraft/helicopter.

Point-in-space (PinS) approach. An approach procedure designed for helicopters only that includes both a visual and an instrument segment.

Point-in-space (PinS) departure. A departure procedure designed for helicopters only that includes both a visual and an instrument segment.

Point-in-space (PinS) visual segment. The segment of a helicopter PinS procedure between a point (MAPt or IDF) and the heliport or the landing location.

TLOF (Touchdown and lift-off area) – An area on which a helicopter may touch down or lift off.

VFR. The symbol used to designate the visual flight rules.

VFR flight. A flight conducted in accordance with the visual flight rules.

Visual Meteorological Conditions (VMC). Visual meteorological conditions are the meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minima.

REFERENCES

Ref 1.	ICAO Annex 14 Vol II (Heliports), 5th Edition – July 2020
Ref 2.	ICAO Annex 6 Part III (Operation of Aircraft, Helicopters), 11th Edition – July 2022
Ref 3.	ICAO Doc 8168 – Aircraft Operations – Volume II – Construction of Visual and Instrument Flight Procedures – Seventh Edition (Amendment No.9)
Ref 4.	I. S. University, "IOWA Environmental Mesonet," [Online]. Available: https://mesonet.agron.iastate.edu/request/download.phtml
Ref 5.	EASA, "EASA Easy Access Rules for Air Operations - Part SPA - Subpart K Helicopter Offshore Operations"
Ref 6.	LVNL eAIP (AIRAC Amendment 05/2024)

ANNEX A COMBINATIEVARIANTEN

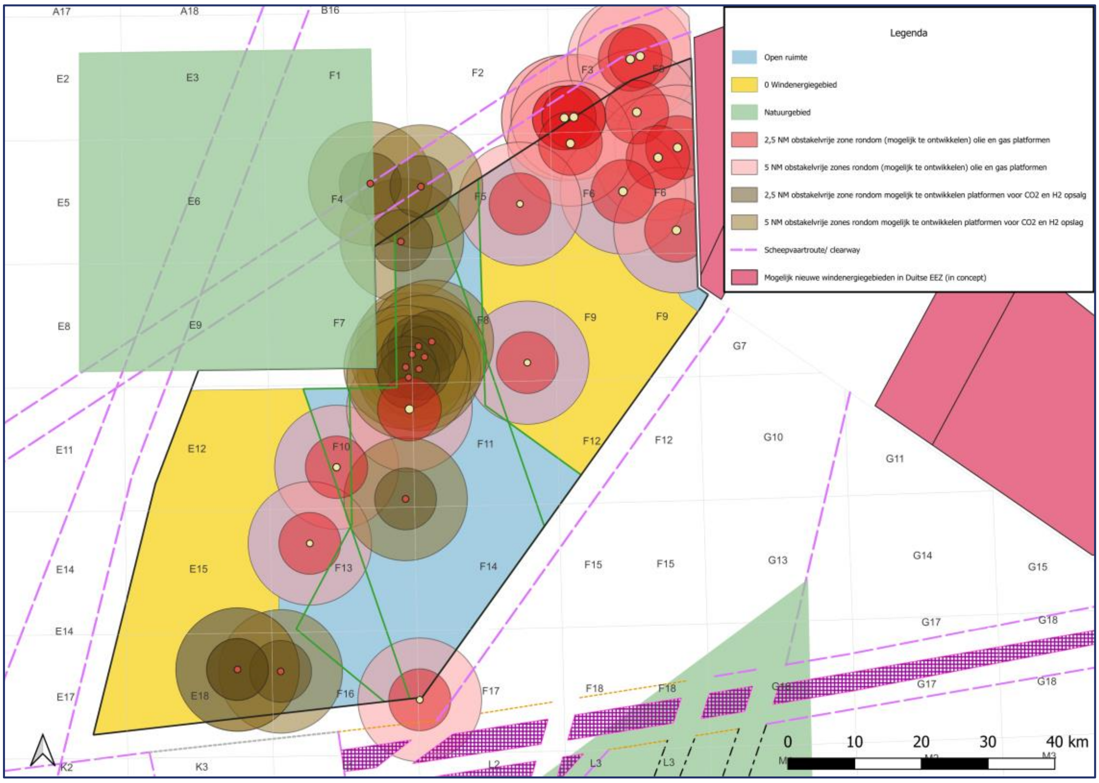


Figure 56: Combinatievariant 0

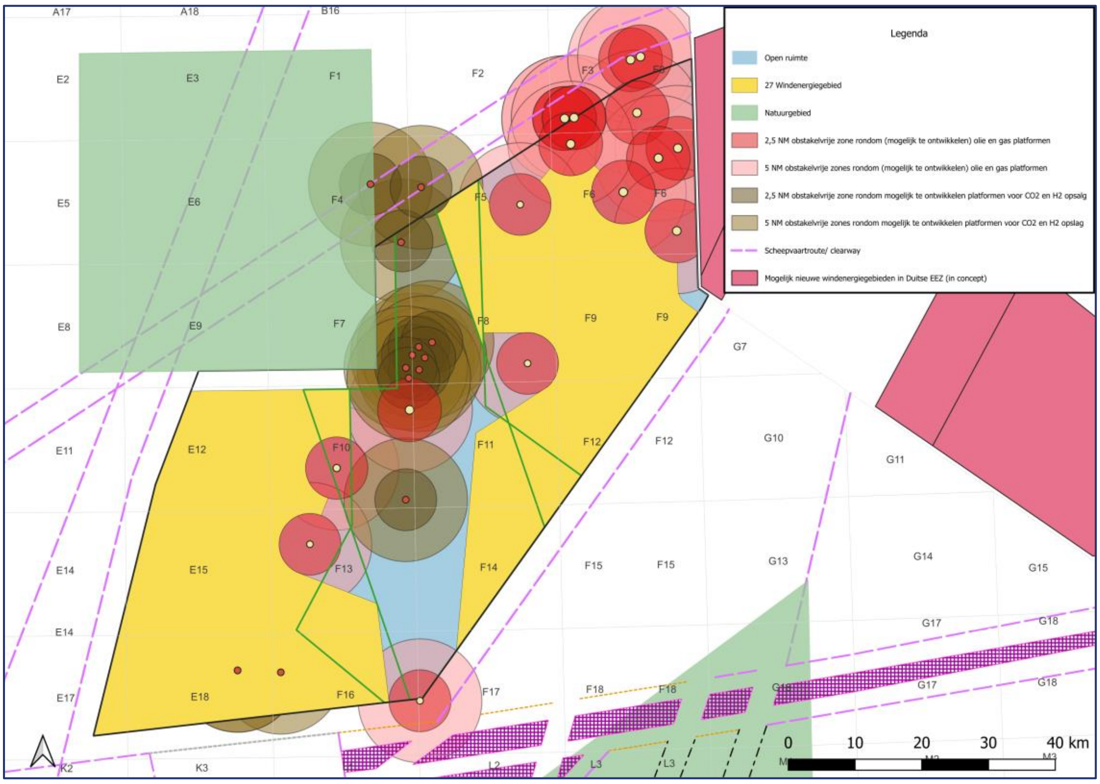


Figure 57: Combinatievariant 27

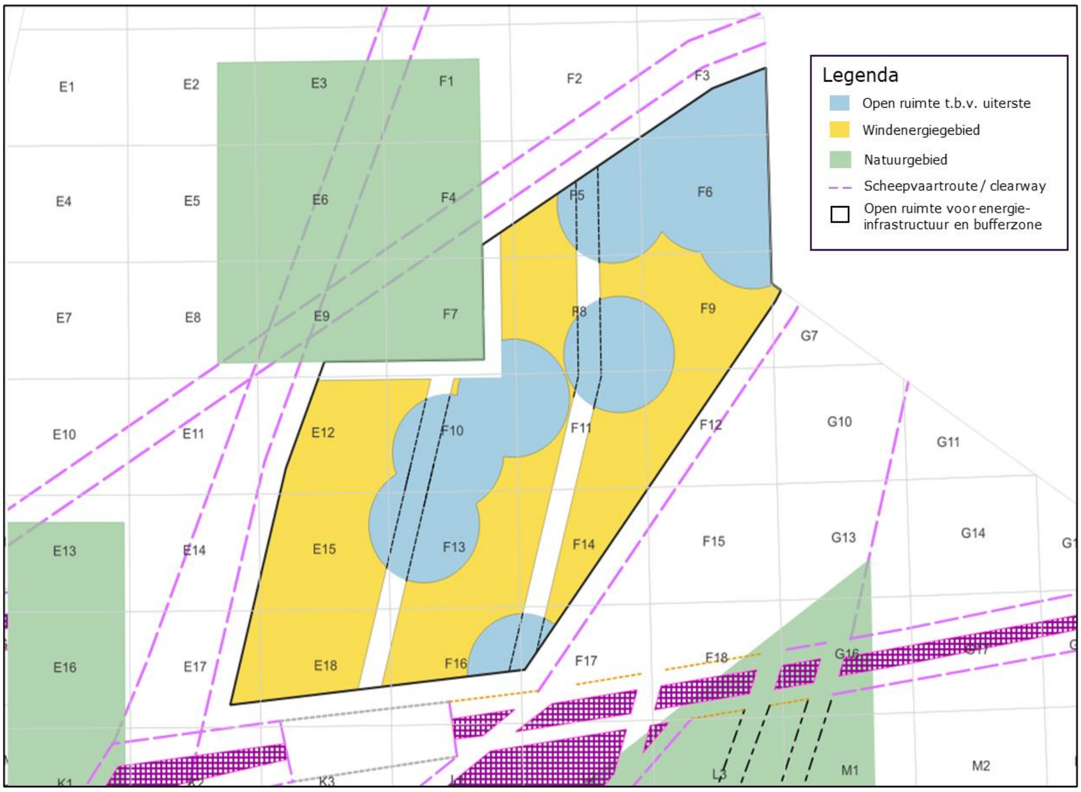


Figure 59: Variant with 5 NM free circles

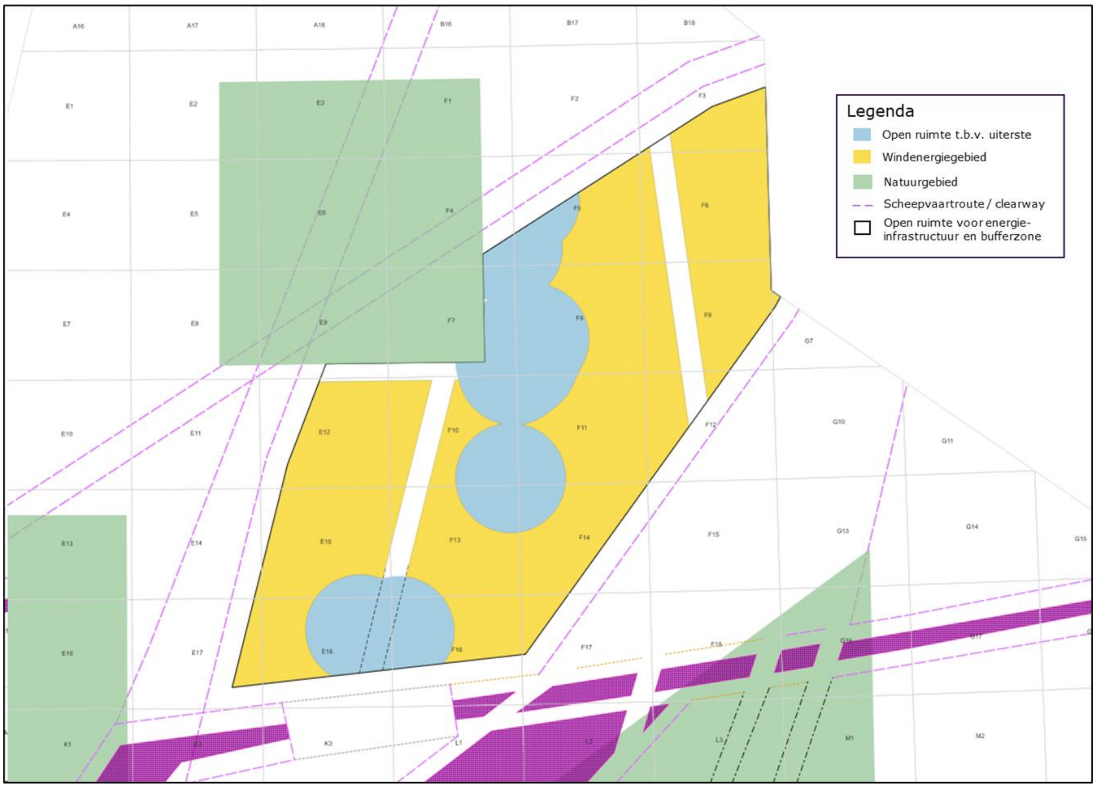


Figure 58: Variant with 5 NM free circles

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