DTBird® System Specifications for Wind Turbines

Day & Night
On & Offshore

DTBIRD TEAM

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DTBird® Day Detection Module		V4	V8
Service description	Automatic and real-time[1] detection in daylight of bird flights in the airspace surrounding a Wind Turbine (WTG).	✓	
	Video and audio recordings of every bird flight detected uploaded to DTBird online Data Analysis Platform with Username and Password protected access, ensuring bird flight traceability.		
Installation site	Wind Turbines (WTGs) - On & Offshore.	✓	
Module specifications			
Components	HD cameras: 4 units/WTG.	✓	
	8 units/WTG.		✓
	Environmental sensors: Light, Temperature and Humidity. Optional: Rain and Fog. From the WTG: Wind Speed and Wind Direction.	✓	
	Cabinet (1/WTG): Analysis Unit, Detection Software, Electrical and Lighting Protection Systems and Communications Hardware.		
	Mounting System (not intrusive on WTG).		
	Cables & Connections.		
Location on the facility	HD Cameras + Environmental Sensors + Mounting System (patented): outdoors on the WTG tower, from 5 to 80 m height (Project specific).	✓	
	Cabinet: indoors, normally inside the tower.		
	Cables & Connections: outdoors on the WTG tower, and inside the WTG tower.		
Cabinet			
Dimensions	51x65x25 cm, WxHxD.	✓	
	51x130x25 cm, WxHxD.		✓
Weight	10 Kg.	✓	
	20 Kg.		✓
Power supply	110-250 AC monophasic 50/60Hz (Power Grid Connection).	✓	
Power consumption	55 W.	✓	
	95 W.		✓
Operation conditions	Daylight (>50 lux).	✓	
Weatherproof	Outdoor components: IP 66 / -30° to 50° C. Falling blocks of ice protection system (optional).	✓	
	Cabinet components: IP 65 / 0° to 40° C. Heating or Cooling (optional).		
Communications	Wind Farm Network/Mobile Router 4G/ADSL/Optic Fiber/Satellite Internet.	✓	
Service specifications			
Detectable bird Species/Groups	All bird Species/Groups.	✓	
Bird Species/Group identification	Yes, through the review of bird flight video and audio recordings.	✓	
Surveillance area	360° around the WTG. See pages 7-8 (Examples of the Surveillance Area of DTBird Detection Module models V4 and V8).	✓	

	Bird wingspan	Set up range	V4	V8
Radius around the WTG	>150 cm	200-320 m	✓	
		350-600 m		✓
	75-150 cm	100-200 m	✓	
		175-350 m		✓
	<75 cm	25-100 m	✓	
		25-175 m		✓

		V4	V8
Simultaneous detection of multiple bird flights	Yes (360° around WTG), detection of an unlimited number of flights and birds at the same time.	✓	
Bird flight detectability	>80%[2]	✓	
Bird flight traceability[3]	Video and audio recordings of every bird flight stored in the Wind Farm online Data Analysis Platform, with Username and Password protected access.	✓	
False Positive rate (recording with no bird)	0.5 - 5.5 FP/day (yearly average).	✓	
Recorded data	Location.	✓	
	Flight ID.		
	Flight time data: Init time and total length.		
	Flight video records, with embedded audio record.		
	Online Snapshots of HD cameras every hour.		
	Environmental data, and WTG operational parameters during bird flight.		
	Species/group and bird behavior analysis from video and audio recordings.		
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.	✓	
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.		
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.	✓	
Warranty	2-year worldwide.	✓	

[1] Real-time means that time from image capture by the HD Camera to bird detection, is <1 second.

[2] Norwegian Institute for Nature Research (NINA). 2012. Evaluation of the DTBird video-system at the Smola wind-power plant. Detection capabilities for capturing near-turbine avian behavior.

DTBird® Night Detection Module

Service description	Automatic and real-time detection at night of bird flights in the airspace surrounding a Wind Turbine (WTG).
	Video and audio recordings of every bird flight detected uploaded to DTBird online Data Analysis Platform with Username and Password protected access, ensuring bird flight traceability.
Installation site	Wind Turbines (WTGs) - On & Offshore.
Module specifications	
Components	Themal Cameras: Variable number per WTG (Project specific).
	Environmental sensors: Light, Temperature and Humidity. Optional: Rain and Fog. From the WTG: Wind Speed and Wind Direction.
	Cabinet (1/WTG): Analysis Unit, Detection Software, Electrical and Lighting Protection Systems and Communications Hardware.
	Mounting System (not intrusive on WTG).
	Cables & Connections.
Location on the facility	Thermal Cameras + Environmental Sensors + Mounting System (patented): outdoors on the WTG tower, from 5 to 80 m height (Project specific).
	Cabinet: indoors, normally inside the tower.
	Cables & Connections: outdoors on the WTG tower, and inside the WTG tower.
Cabinet	
Dimensions	51x65x25 cm, WxHxD.
Weight	10 Kg.
Power supply	110-250 AC monophasic 50/60Hz (Power Grid Connection).
Power consumption	55 W.
Operation conditions	Night (<50 lux).
Weatherproof	Outdoor components: IP 66 / -30° to 50° C. Falling blocks of ice protection system (optional).
	Cabinet components: IP 65 / 0° to 40° C. Heating or Cooling (optional).
Communications	Wind Farm Network/Mobile Router 4G/ADSL/Optic Fiber/Satellite Internet.
Service specifications	
Detectable bird Species/Groups	All bird Species/Groups.
Bird Species/Group identification	The review of bird flight video and audio records, allows the indentification based on bird shape, flight pattern, and wing beats frequency.
Surveillance area	45° horizontal and 33° vertical per HD Camera.

Radius around the WTG	Bird wingspan	Set up range
	>150 cm	140-230 m
	75-150 cm	70-140 m
	<75 cm	20-70 m

Simultaneous detection of multiple bird flights	Yes, detection of an unlimited number of flights and birds at the same time.
Bird flight detectability	Under evaluation.
Bird flight traceability[1]	Video and audio recordings of every bird flight stored in the Wind Farm online Data Analysis Platform, with Username and Password protected access.
False Positive rate (recording with no bird)	1 - 4 FP/day (yearly average)/Camera. Based on preliminary test.
Recorded data	Location.
	Flight ID.
	Flight time data: Init time and total length.
	Flight video records, with embedded audio record.
	Environmental data, and WTG operational parameters during bird flight.
	Species/group and bird behavior analysis from video and audio recordings.
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.
Warranty	2-year worldwide.

[1] Traceability: Ability to verify bird flights' location, time and Species/Group identification by means of recorded video and data.

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DTBird® Collision Avoidance Module	
Service description	Automatic emission of Warning/Discouraging sounds from the WTG linked to real-time bird flight detection in collision risk.
	Video and audio recordings of every bird flight detected uploaded to DTBird online Data Analysis Platform with Username and Password protected access, ensuring bird flight traceability.
Installation site	Wind Turbines (WTGs) - On & Offshore.
Module specifications	
Components	DTBird® *Detection Module V4 or V8.*
	1 Amplifier & 4 – 10 Speakers per WTG.
	Sound signal:
	Frequency range: 250-12,500 Hz
	Maximum Power: 120 W RMS
	Mounting System (not intrusive for WTG).
	Cables & Connections.
Location on the WTG	Amplifier: DTBird® Cabinet inside the WTG tower.
	Speakers: outdoors on the WTG tower, from 10 to 130 m height and occasionally on the nacelle (Project specific).
	Cables & Connections: outdoors on the WTG tower, and inside the WTG tower.
Dimensions	Amplifier 26x43x9 cm, WxHxD
	Speaker 25x25x35 cm, WxHxD
Weight	20 – 30 Kg.
Power supply	Standard Power Grid Connection: 110-250 AC monophasic 50/60Hz
Power consumption	Including DTBird® Detection Module: 135 – 240 W
Weatherproof	Outdoor components: IP 66 / -30° to 50° C. Falling blocks of ice protection system (optional).
	Cabinet components: IP 65 / 0° to 40° C.
Service specifications	
Sound type:	Adjustable to target Species.
	Emission of Warning sounds to bird flights with Potential Collision Risk.
	Emission of Discouraging sounds to bird flights in High Collision Risk Area & Rotor Swept Area.
Sound power	Adjusted to legal requirements and bird sensitivity (Project specific).
	Maximum power location: Rotor Swept Area.
	Attenuation proportional to distance from the Rotor Swept Area.
Sound coverage	360° around WTG.
Sound trigger	Automatic and in real-time, <2 s after flight detection with Potential Collision Risk.
	Standard sound emission only with the WTG operating. No sound or low sound emission with the WTG stopped.
Sound emission traceability[1]	Sound recordings of every trigger uploaded to online Data Analysis Platform, with Username and Password protected access.
Collision Risk Reduction [2]	Reduction of the bird flight time in the danger zone, especially larger birds, by 61-87%. Change of the bird flights' direction in 88% of cases where the bird is on a collision course with the wind turbine.[2]
False Positive rate (sound trigger by DTBirdV4 with no bird)	0.2 – 4.0 FP/day, with a total duration of 0.1 - 2.5 min/day (yearly average).
Recorded data	Location.
	Flight with sound trigger ID.
	Sound time data: Init time and total length.
	Flight video records, with embedded audio record.
	Flight video with environmental data and WTG operational parameters.
	Species/group and bird behavior analysis from video and audio recordings.
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.
Warranty	2-year worldwide.

[1] Traceability: Ability to verify location, time and sound emission by means of recorded sound, video and data.
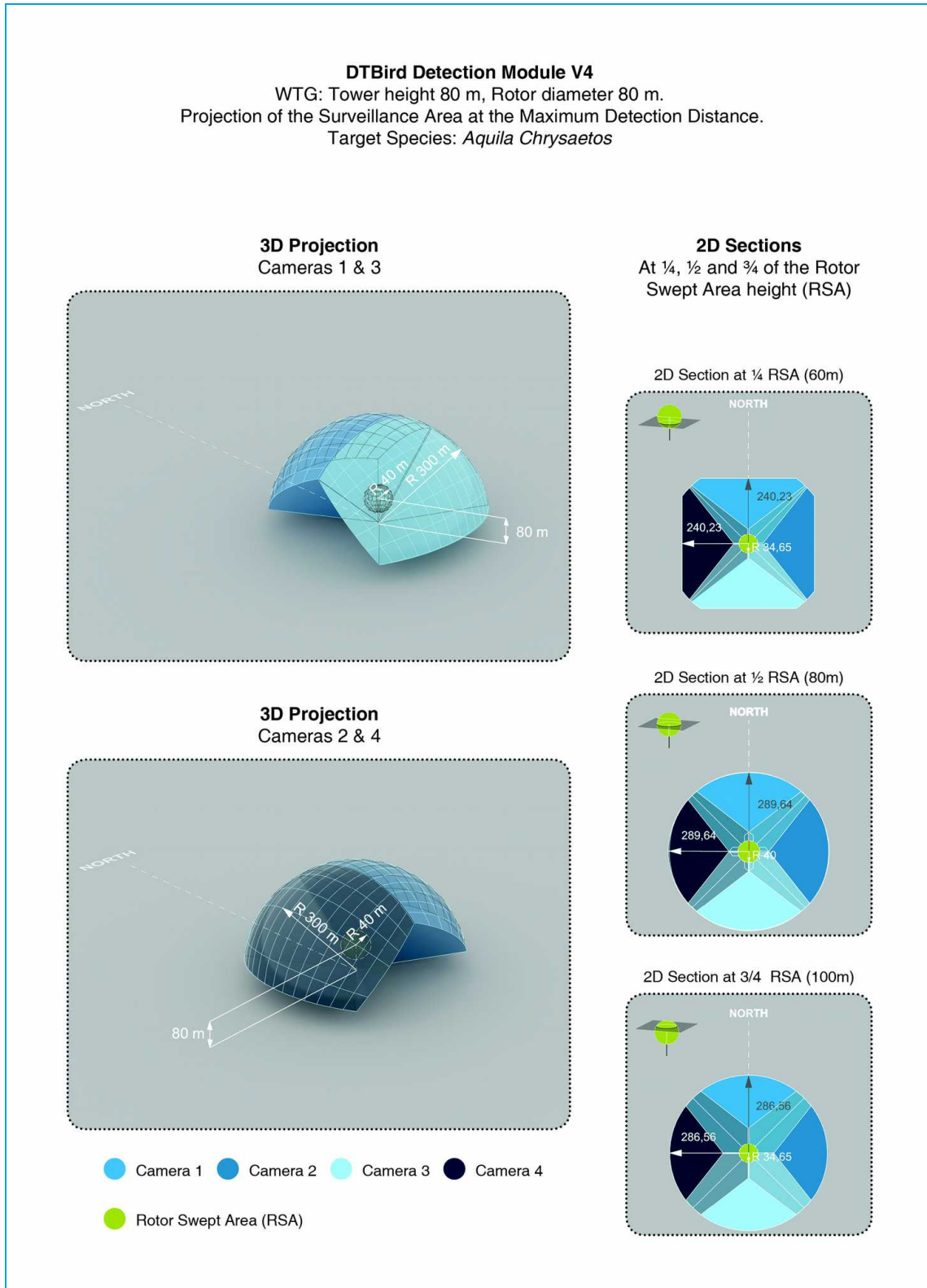
[2] Ecocom AB. 2016. "Pilotinstallation av DTBird-systemet i Sverige. Möjligheter med skyddssystem för fågelfaunan vid vindkraftanläggningar – erfarenheter från Sveriges första installation av DTBird.". Report´s summary translated by DTBird available in http://www.dtbird.com/index.php/downloads-3 Experiencies From Sweden´s first DTBird Installation. Ecocom AB. December 2016.

DTBird® Stop Control Module	
Service description	Automatic and real-time WTG Stop triggered by bird flights detected with Collision Risk.
	Video recordings of the entire WTG Stop uploaded to DTBird Data Analysis Platform, with Username and Password protected access, ensuring bird flight and stop traceability.
Installation site	WTGs (On & Offshore).
Module specifications	
Components & Location	DTBird® Detection Module V4 or V8 + Stop Control Software installed within DTBird® cabinet.
Dimensions/Weight/Power supply/Power consumption/Operation conditions/Weatherproof	Within DTBird® *Detection Module. See DTBird Detection Module* specifications for day or night (pages 2 and 3).
Communications	Connection with WTG PLC/Scada.
Service specifications	
Species/Group Stop trigger sensitivity (true positives) and specificity (true negatives)	Variable, depending on target Species/Group and bird community inhabiting the installation site.
Surveillance area	360° around WTG.
Radius of the Surveillance area around the wind turbine	DTBird® Detection Module V4 or V8.
Simultaneous detection of multiple bird flights	Yes (360° around WTG), detection of an unlimited nº of flights and birds at the same time.
Bird flight detectability	>80%
Stop trigger	Automatic and linked to real-time bird flight detection with collision risk.
	Collision risk calculation according to bird flight features.
Rotor Stop init time	Depending on WTG manufacturer, 2 – 18 s after DTBird® stop trigger[1].
Complete rotor Stop	Depending on WTG manufacturer, 15 – 35 s after WTG Stop init[1].
Stop length	Linked to real-time bird flight detection in collision risk.
	Automatic restart of WTG when the collision risk disappears.
Stop & bird flight traceability[2]	Video recordings of every Stop & bird flight uploaded to DTBird Data Analysis Platform with Username and Password protected access.
	Automatic e-mail notification of every Stop: trigger time (first e-mail), end time and duration (second e-mail).
False Positive rate (Stops with no bird triggered by DTBirdV4)	0.5 – 10 hours/year/WTG
Recorded data	Flight with Stop trigger ID.
	Stop time data: Init time and total length.
	Stop video records, with embedded audio record.
	Environmental data and WTG operational parameters of every stop event.
	Species/group, bird behavior and Stop analysis from video and audio recordings.
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.
Service Control	Self-checking and daily verification done remotely from DTBird Headquarters.
Warranty	2-year worldwide.

[1] The lowest wind turbine Stop time technically feasible should be used to achieve the maximum collision risk reduction. For individual bird flight efficient stops values below 30 s are recommended (species and site specific). DTBird stop protocol based on bird flight thresholds can be very efficient depending on the local bird activity.

[2] Traceability: Ability to verify location, time and Stop of the rotor/blades by means of recorded documented identification.

DTBird® Collision Control Module	
Service description	Automatic and real-time detection of bird flights in Collision Risk Areas, and collision check from video and sound recordings, including birds potentially injured that fly away.
	Video and audio recordings uploaded to DTBird online Data Analysis Platform, with Username and Password protected access, that ensure bird flight and collision traceability.
Installation site	WTGs - On & Offshore.
Module specifications	DTBird® Detection Module V4 or V8. See pages 7-8 (Examples of the Surveillance Area of DTBird Detection Module models V4 and V8).
	Simultaneous video and sound recording of interconnected cameras for every detected bird flight.
	Continuous video recording saved for 5-10 days.
Service specifications	
Detectable bird Species/Groups	All bird Species/Groups.
Bird Species/Group identification	Yes, through the review of bird flight video and audio recordings.
Surveillance area	Whole WTG (including blades, nacelle and tower).
Multiple bird flights track & detection	Yes.
Nº of bird collisions simultaneously recorded	Unlimited.
Bird flights detectability	>80%
Bird collision detectability in video recordings	>96% (within the bird flights detected).
Overall bird collision detectability	>77% 0.8 (bird flight detectability) x 0.96 (collision detectability in video recordings) = 0.77
Collision traceability[1]	Video with audio recordings of every bird flight and potential collision uploaded to DTBird online Data Analysis Platform, with Username and Password protected access.
Request of in situ inspection to verify a potential collision and/or to recover a potentially injured bird	E-mail notifications of potential collision events, including online video data of the bird flight.
Recorded data	Location.
	Collision ID.
	Collision time data: Init time and total length.
	Collision video records, with embedded audio record.
	Environmental data, and WTG operational parameters of the collision event.
	Species/group, bird behavior and collision event analysis from video and sound recordings.
Online Data Analysis Platform	Bird flights videos with audio storage for 2 years (up to 50 Gb/Year/DTBird unit) and data storage for 5 years, in DTBird® Server in Data Center Classified Tier 4. Optional one-year extensions.
	Flight Analysis tools: review of video and audio records, flight analysis, data export, video download and automatic service reports.
Service Control	Self-checking and daily verification done remotely from DTBird® Headquarters.
Warranty	2-year worldwide.

[1] Traceability: Ability to verify bird flight collision events, time and Species/Group identification by means of recorded video and sound.

Annex. Examples of the Surveillance Area of DTBird Detection Module models V4 and V8.

DTBird Detection Module V4
WTG: Tower height 80 m, Rotor diameter 80 m.
Projection of the Surveillance Area at the Maximum Detection Distance.
Target Species: *Aquila Chrysaetos*

3D Projection
Cameras 1 & 3

2D Sections
At ¼, ½ and ¾ of the Rotor
Swept Area height (RSA)

2D Section at ¼ RSA (60m)

3D Projection
Cameras 2 & 4

2D Section at ½ RSA (80m)

2D Section at 3/4 RSA (100m)

● Camera 1 ● Camera 2 ● Camera 3 ● Camera 4
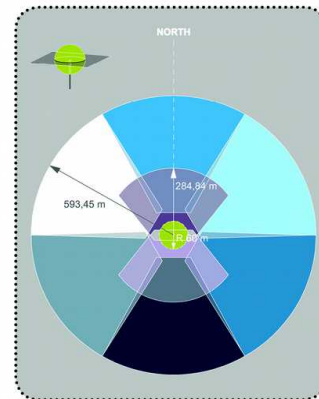
● Rotor Swept Area (RSA)

DTBird Detection Module V8
WTG: Tower height 130 m, Rotor diameter 120 m.
Projection of the Surveillance Area.
Target Species: . Golden Eagle *(Aquila chrysaetos)*
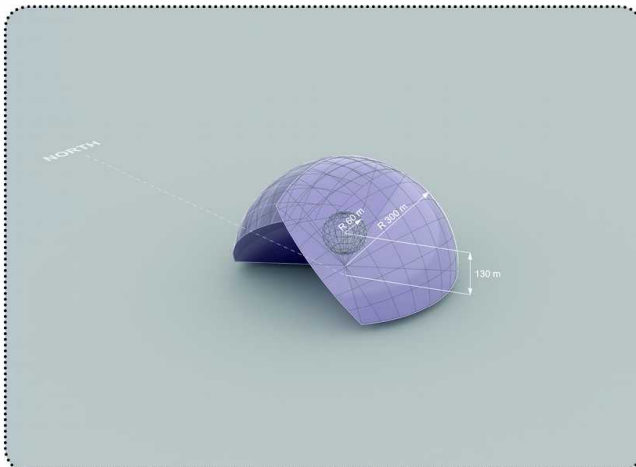. WTE *(Haliaeetus albicilla)*

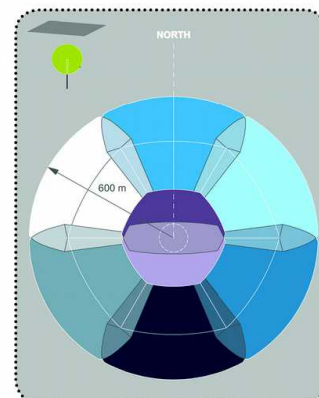**3D Projection**
Long Distance Cameras 1-2-3-4-5 & 6
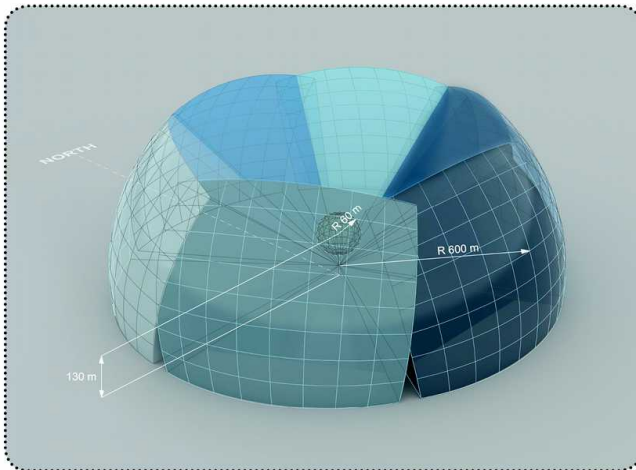
2D Sections
At ½ of the Rotor Swept Area height (RSA)

3D Projection
Medium to Short Distance Cameras 7 & 8

2D Plan projection

● Camera 1　○ Camera 2　● Camera 3　● Camera 4
● Camera 5　 Camera 6　● Camera 7　● Camera 8
● Rotor Swept Area (RSA)