

DGAC Examination process of wind farm authorization in the vicinity of radars

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CONTENT

1. Impacts of Wind Turbines on radars
 1. Primary radar (unwanted tracks)
 2. Secondary radar (ghost tracks and angle measurement)
2. French regulation for Civil Aviation equipments
3. Examination process by DGAC
 1. Line of sight
 2. SSR case
 3. PSR case

Wind turbine impacts on radar

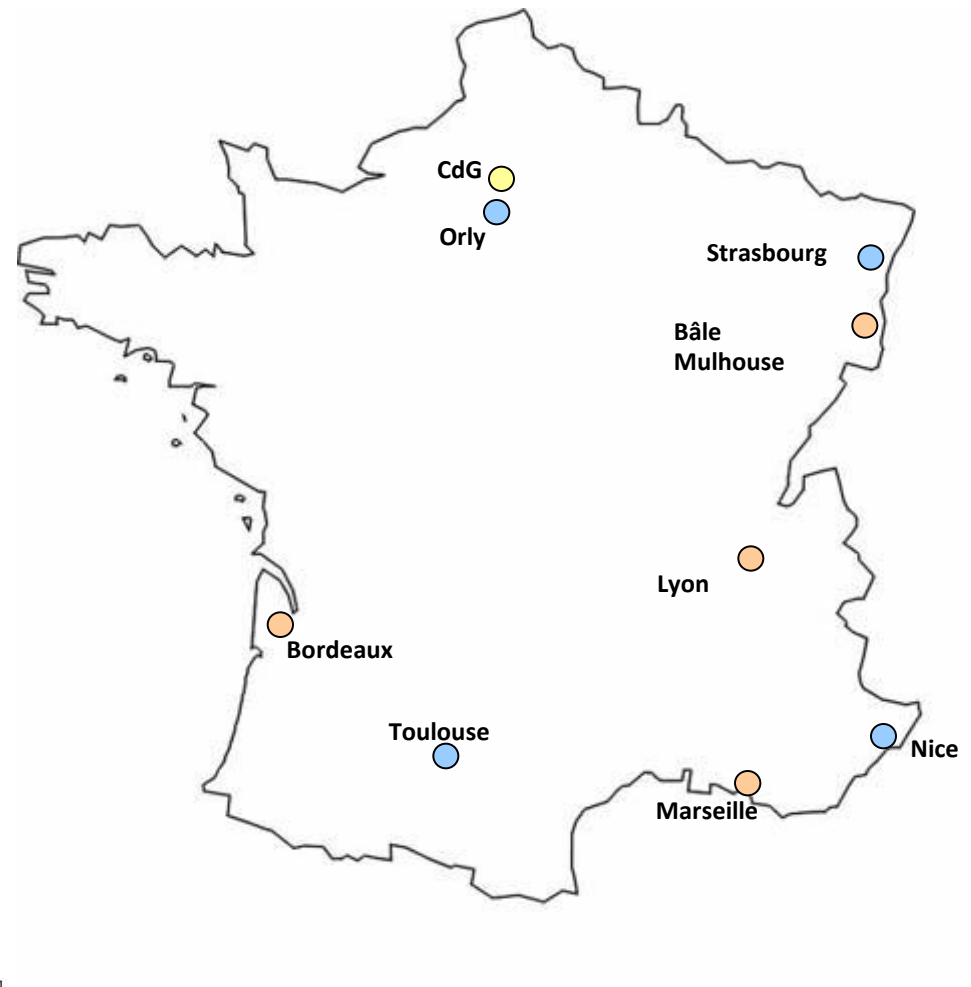


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DSNA PRIMARY SURVEILLANCE RADARS (PSR)



Primary radars

Stations (9)

- STAR2000 and NG (5)
- TRAC2000(4)

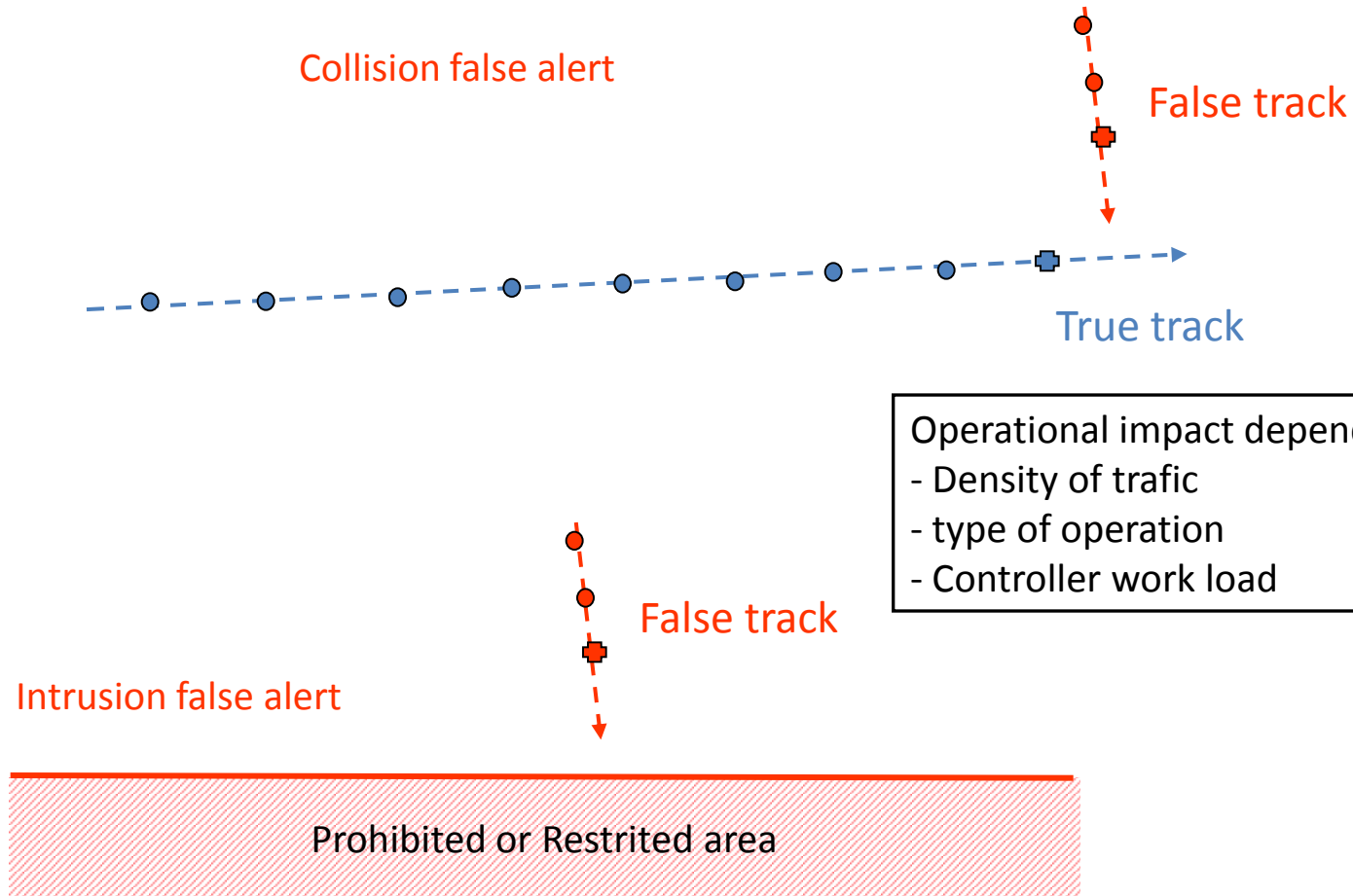
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members of

IMPACT ON PSR → FALSE TRACKS

- Example (video) : Wind farm detected by CDG radar

FALSE TRACKS IMPACT



DSNA SECONDARY RADAR INFRASTRUCTURE



En route Stations (20)

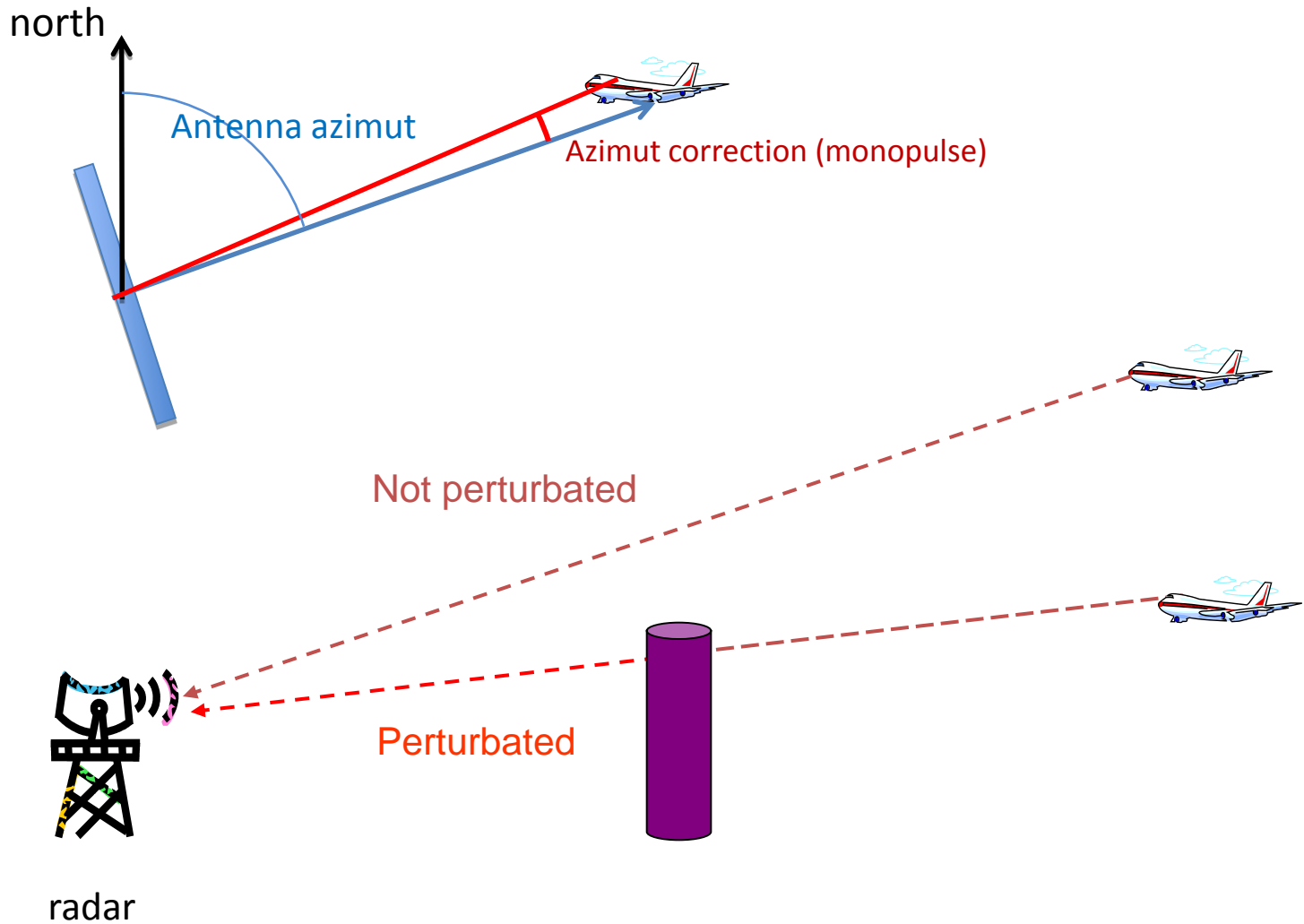
- Monoimpulsion (1)
- Mode S POEMS (7)
- Mode S CIRRIUS (12)

Approach Stations (6)

- Mode S POEMS (2)
- Mode S CIRRIUS (4)

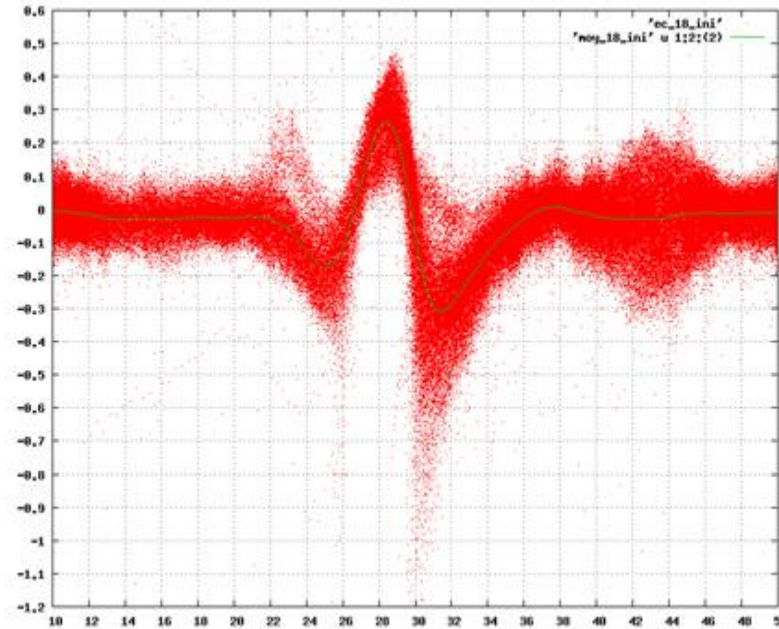
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ANGLE MEASUREMENT PERTURBATION



ANGLE MEASUREMENT

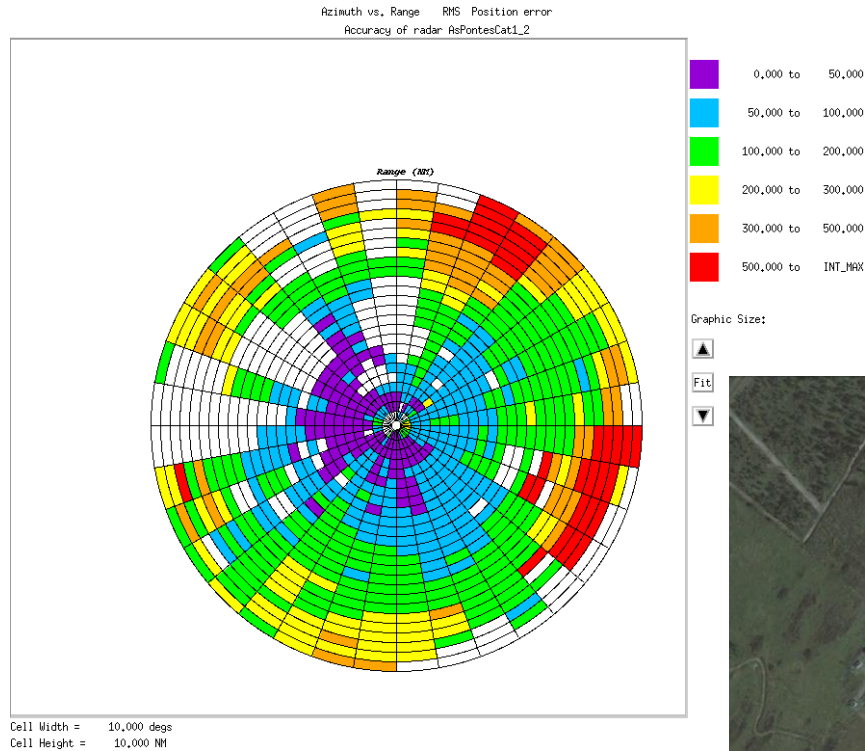
Azimuth
error



azimut

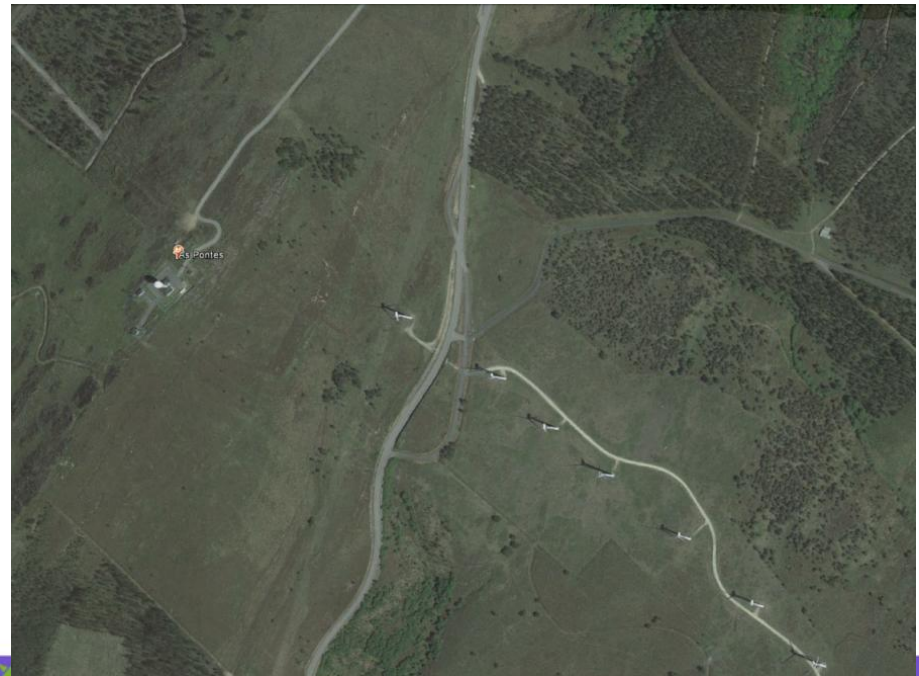
Perturbation spreads over about 20° ($\pm 10^\circ$ around the obstacle)

WIND TURBINE PERTURBATIONS (SPAIN)

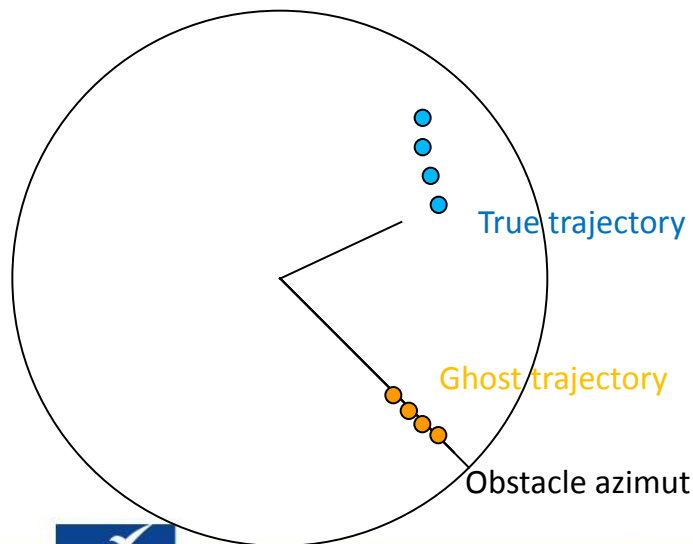
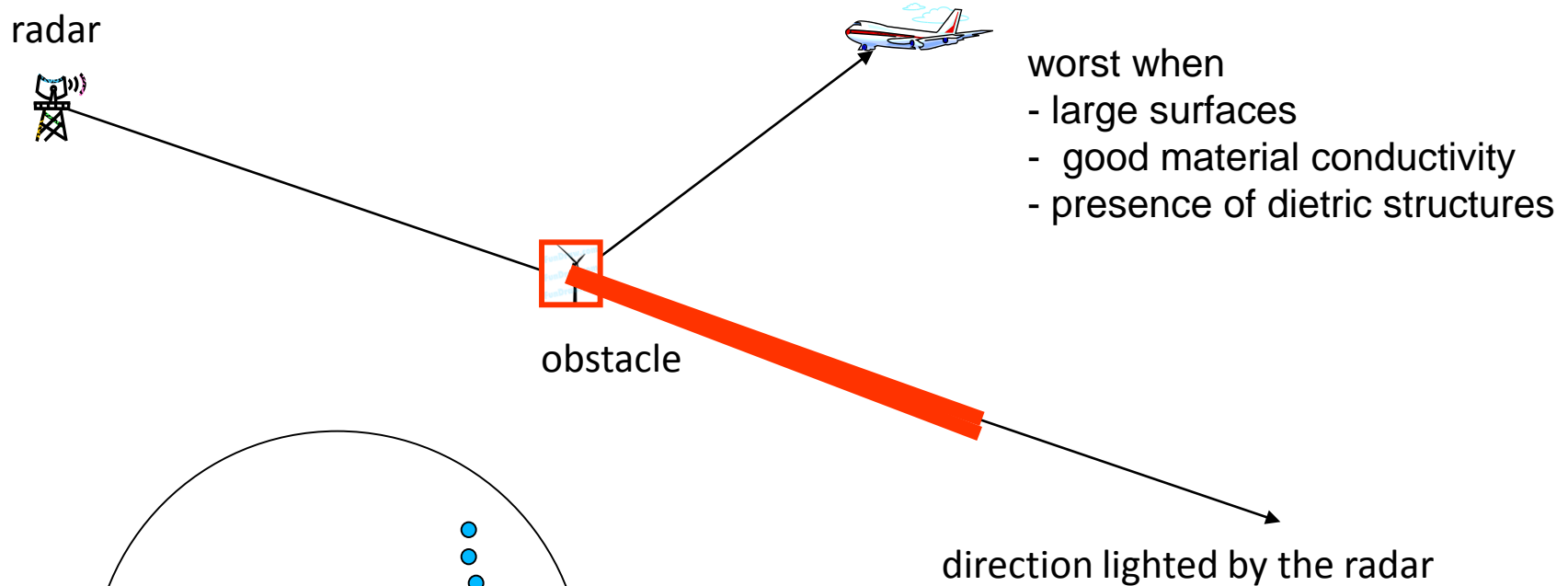


Closest wind turbine : 300 m
1 wind turbine every 150 m

As Pontes radar



UNWANTED REFLEXIONS



IMPACT ON SSR → GHOST TRACKS

- Example with a crane (see video)

French regulation



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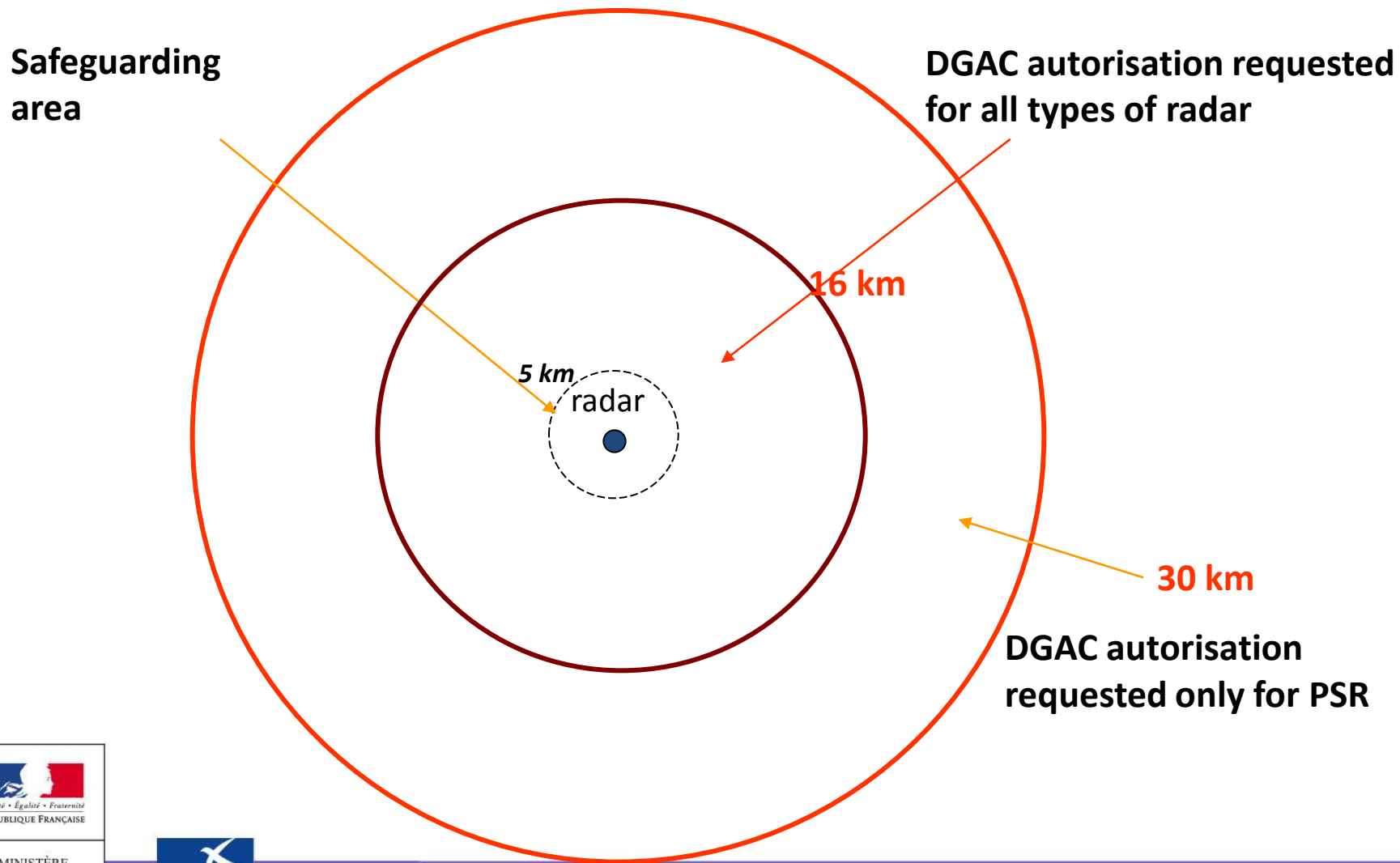
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REGULATION - REFERENCES

- Protection against obstacles
 - Code des postes et télécommunications électroniques : general regulation that protects state equipments
 - Radioelectric safeguarding area
 - ICAO EUR DOC 015 (obstacle and safeguarding zones)
- Protection against Wind Turbines
 - Decret 2015-1614 december 9th 2015
 - Arrêté august 26th 2011 → Wind turbine oriented
 - Eurocontrol Guide line on how to assess the potential impact of WT on surveillance sensors

REGULATION- RADAR DGAC VS WIND TURBINE



DGAC assessment methodology for radars



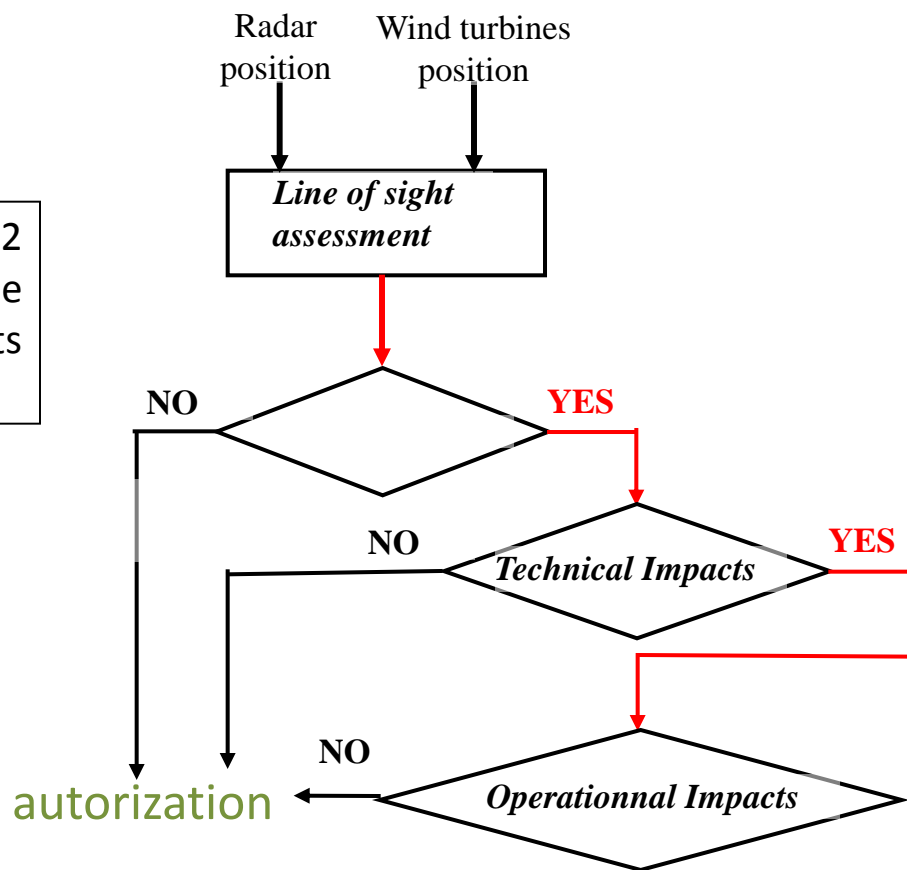
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EXAMINATION PROCESS

Published in a January 12th 2012 « circulaire » related to the examination of wind farm projects by DGAC



LINE OF SIGHT : HEIGHT REFERENCE

Primary Radar
height of blades

Secondary radar
Height of nacelle

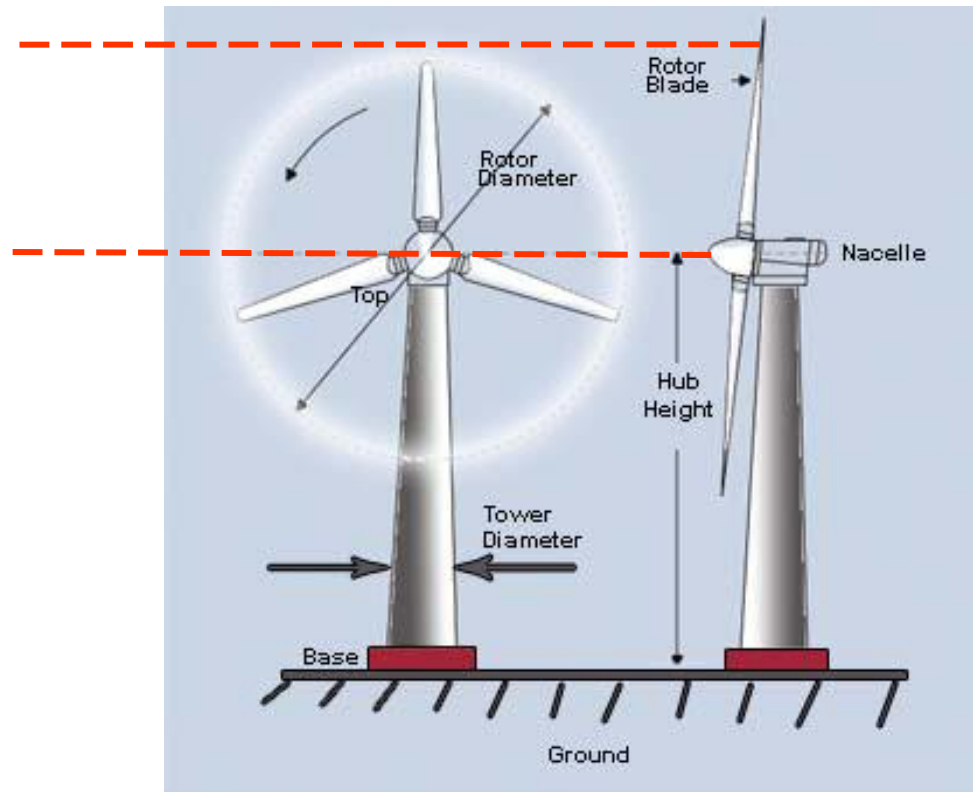
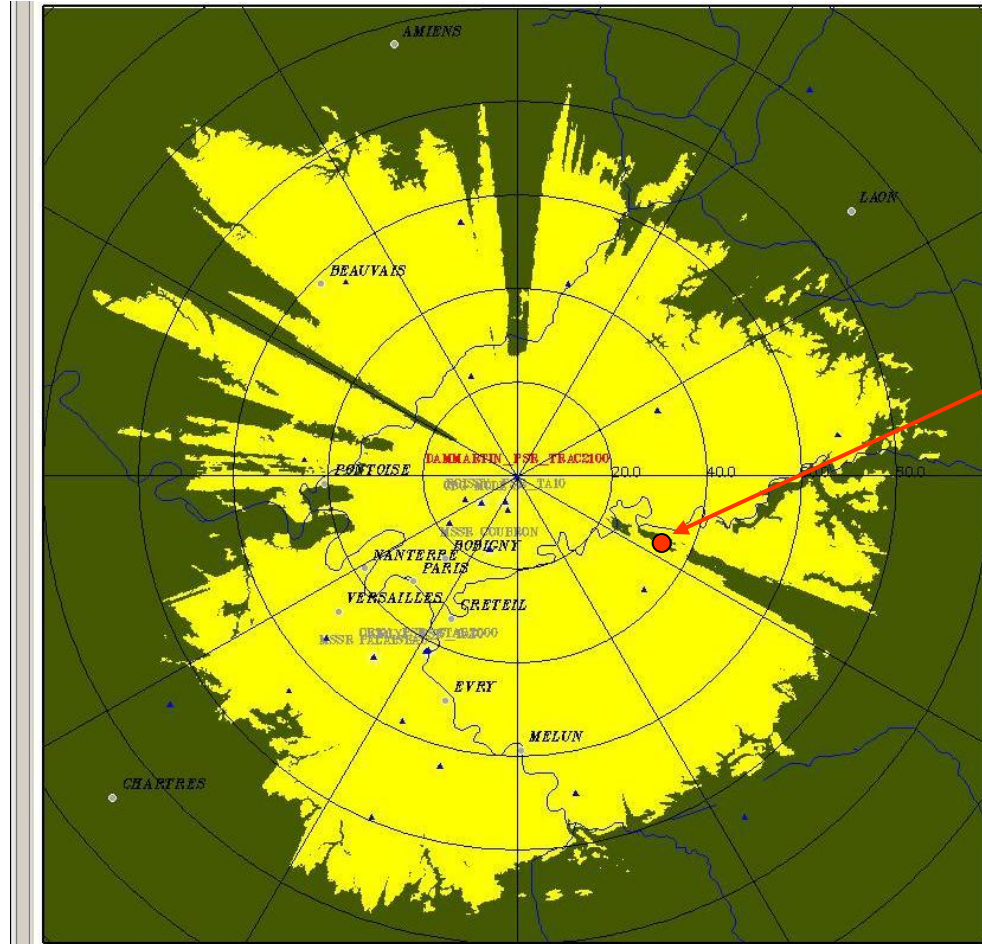


Illustration identifying wind turbine components and key parameters

RADAR COVERAGE AT 150M AGL



Wind farm



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RÉPUBLIQUE FRANÇAISE

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RADAR / WIND TURBINES LINE OF SIGHT PROFILES



Line of sight PSR L Band CDG
(wind farm 42 km far from the radar)



Go to technical impact assessment



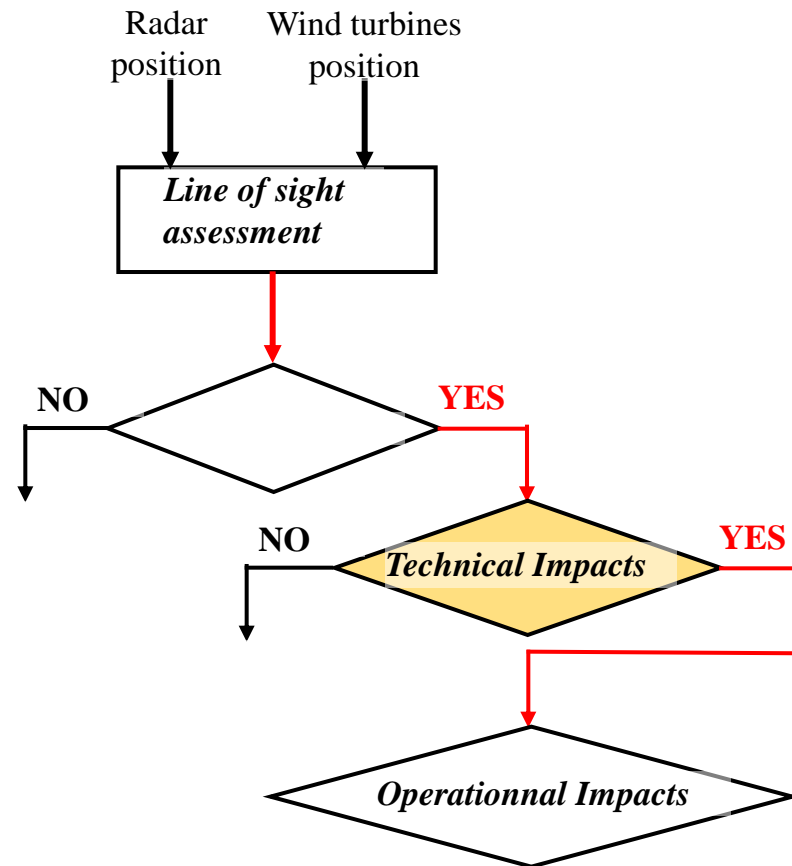
Line of sight PSR S Band CDG
(wind farm 45 km far from the radar)



OK

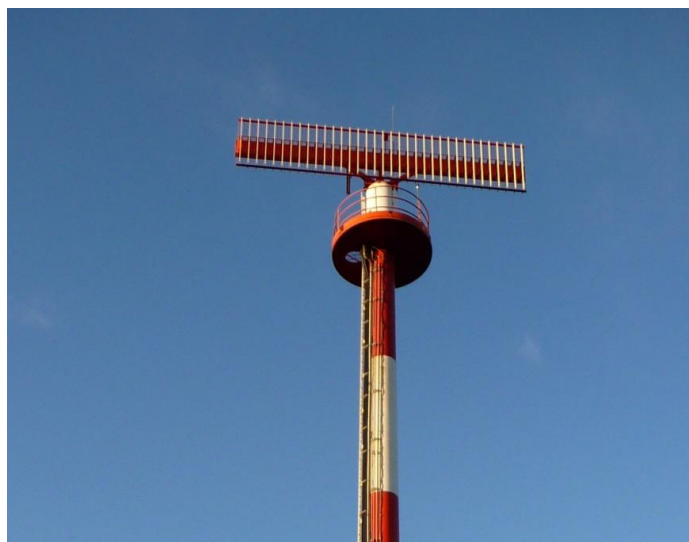


EXAMINATION PROCESS : TECHNICAL IMPACTS

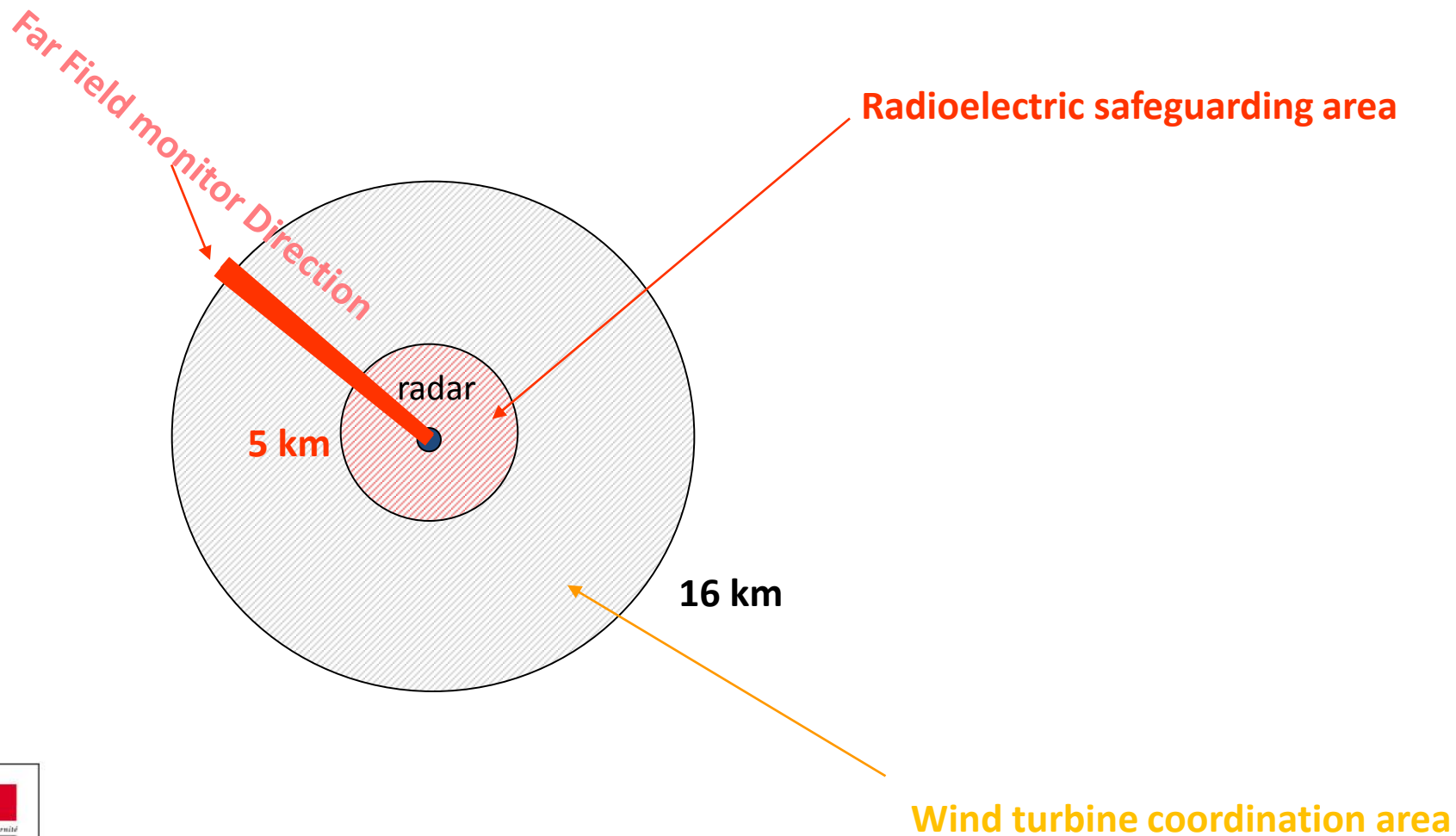


SECONDARY RADAR

Technical Impacts



AREAS CONCERNED BY THE ASSESSMENT



SAFEGUARDING 0 – 5 KM

Wind turbines **not** authorized

except when

→ Blades are not in the line of sight of the radar

OR

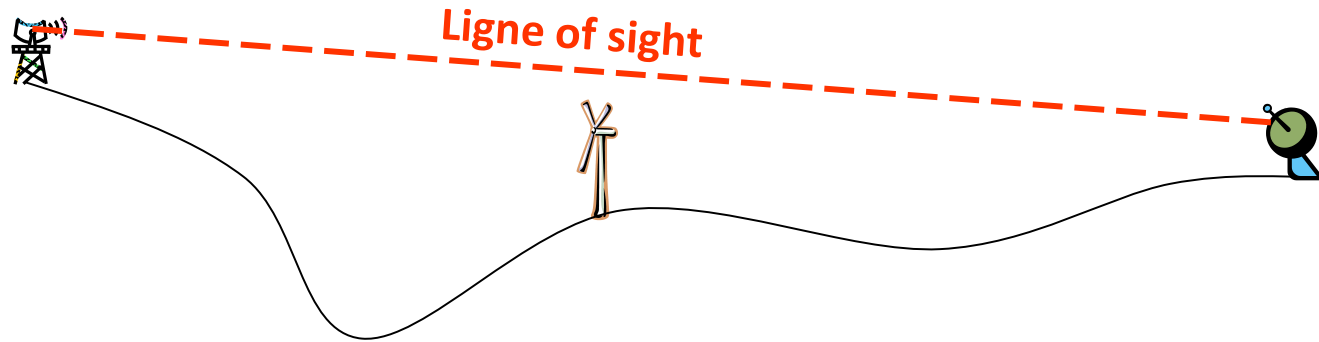
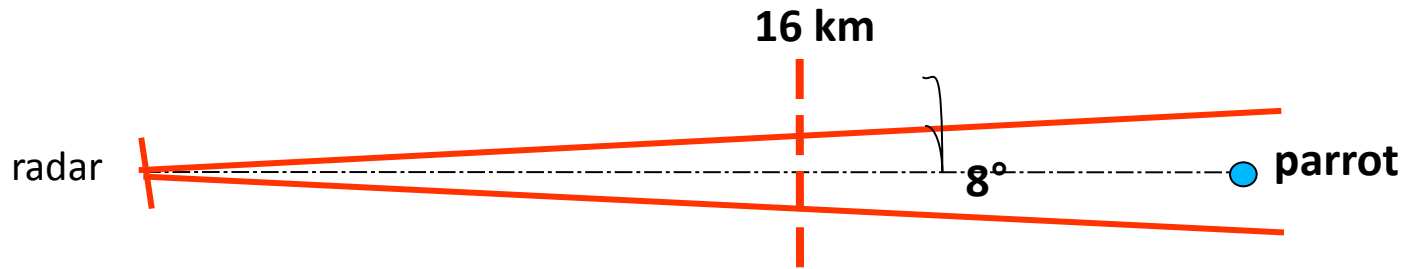
→ Radar located on top of a mountain **AND** specific conditions spécifiques are respected

This rule allows to

→ Garanty that the azimuth measurement is not perturbed
(monopulse function protection)

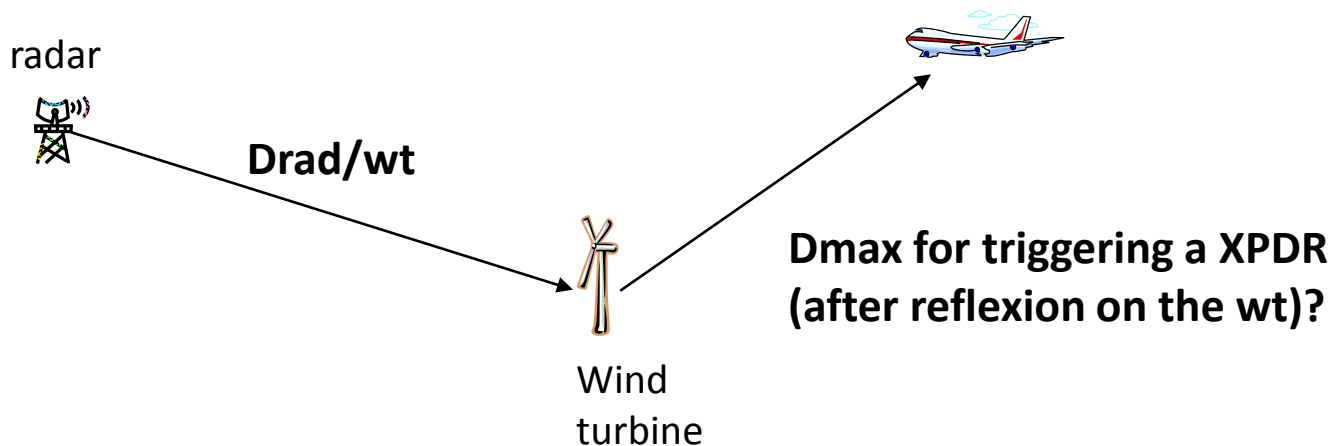
→ Reduce the masking effect

(ZONE 5-16 KM) FAR FIELD MONITOR PROTECTION



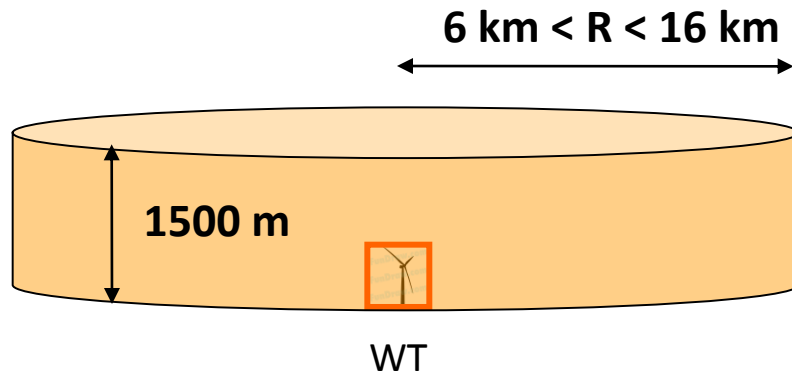
RISK OF REFLECTED INTERROGATIONS (1)

Determination of the volume where unwanted interrogations due to reflexions may occur



RISK OF REFLECTED INTERROGATIONS (2)

Volume where reflected interrogations are « active »

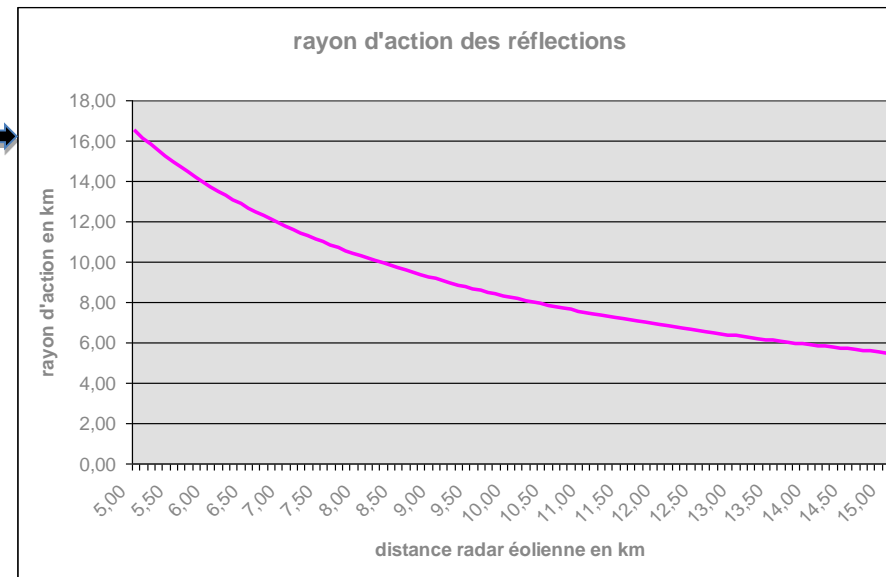


$$R = \sqrt{\frac{r_{CS} \cdot G_r \cdot G_t \cdot P \cdot \lambda^2}{(4\pi)^3 \cdot D_{rad/wt}^2 \cdot S_{trig}}}$$

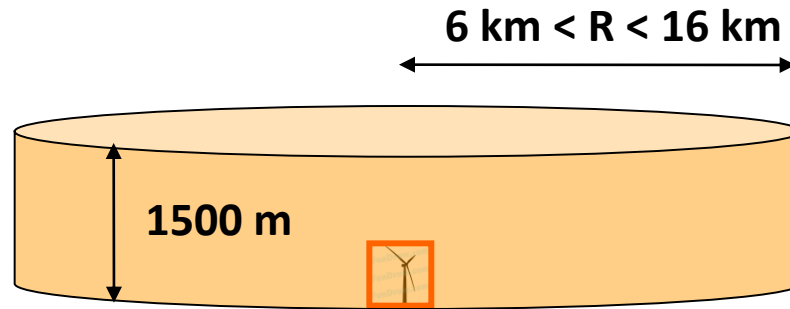
With a nacelle $r_{CS} = 5000 \text{ m}^2$
(figure given by Eurocontrol guide)

Max r_{CS} of non rectangular nacel is less than $5000 \text{ m}^2 \rightarrow$ Range of reflected is less

But no information available about true r_{CS} of nacelles \rightarrow Range is often over evaluated



RISK OF GHOST OCCURRENCE

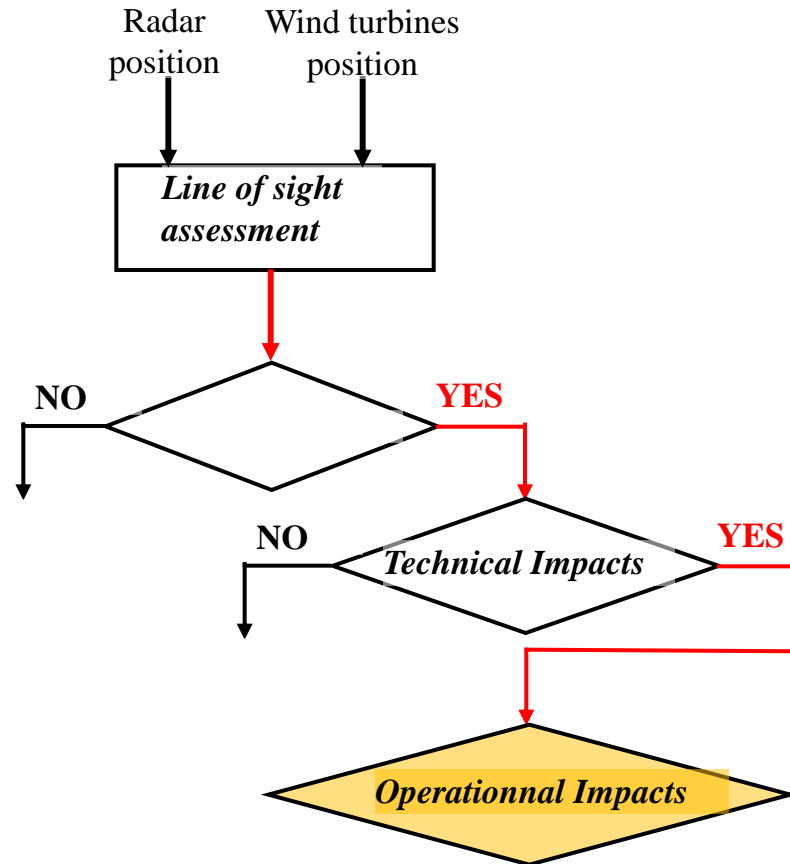


If no traffic fly the volume the probability of triggering a XPDR is 0 → NO RISK

Le risk increases with the presence of traffic into the volume. So in case of presence of :

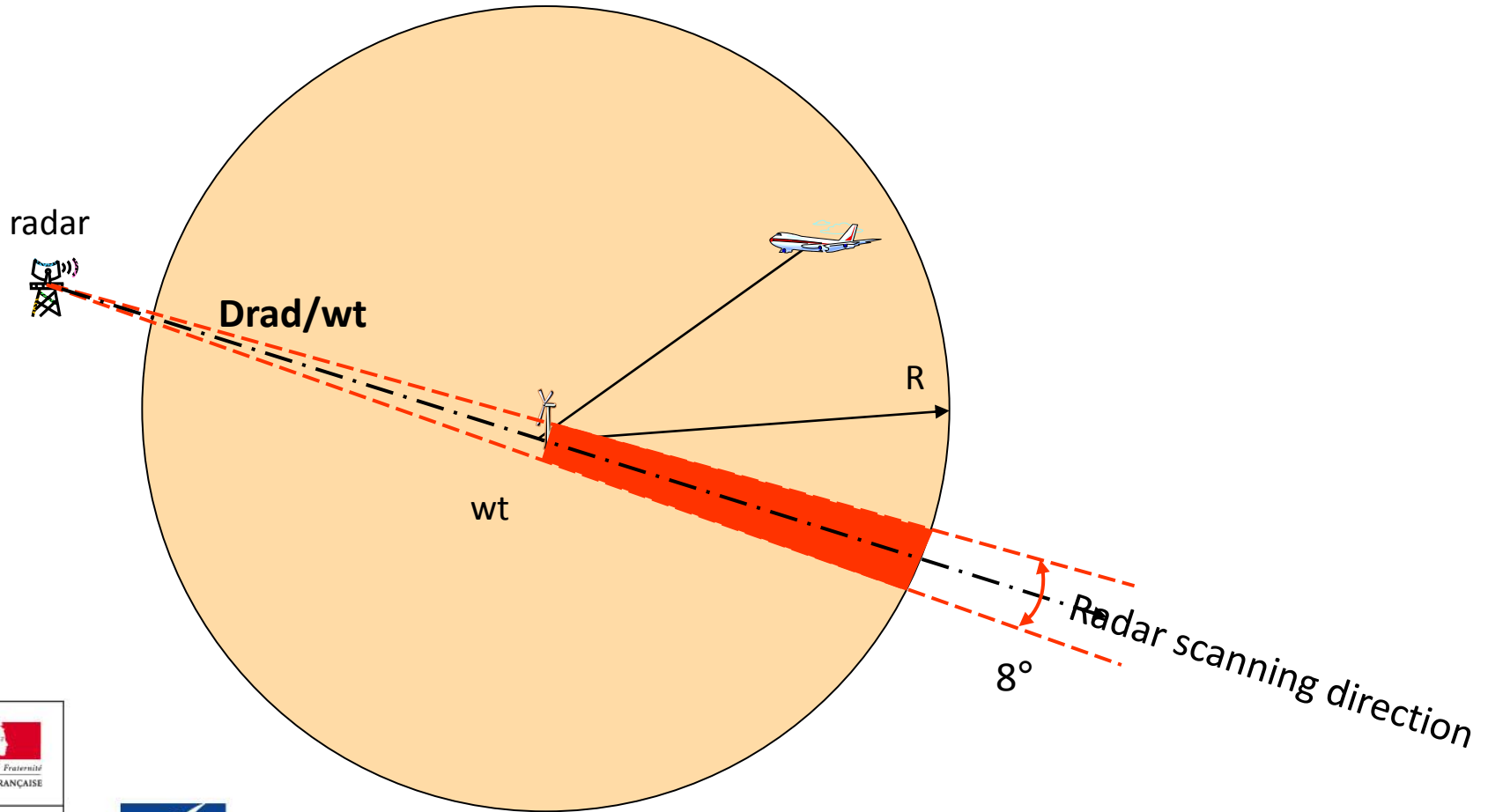
- Airport and airfield
- Routes or sectors with dense traffic

EXAMINATION PROCESS : OPERATIONAL IMPACTS

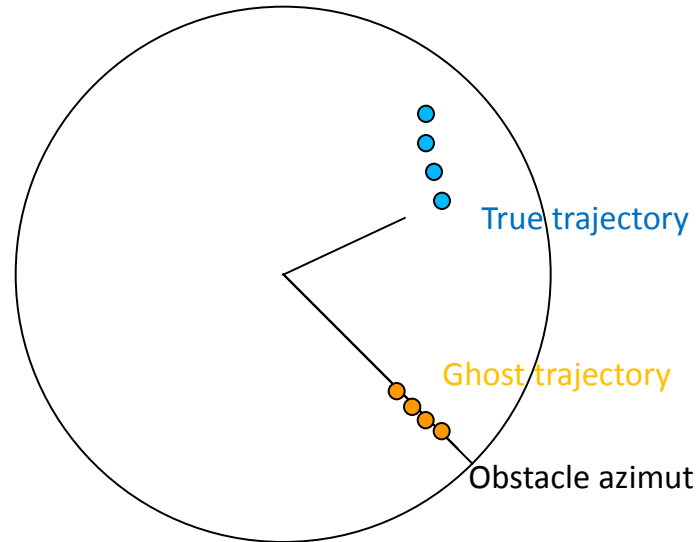


POSITION OF UNWANTED REPLY

If reflected interrogation trigger a transponder, the ghost reply will be positioned on the radar/ WT axis



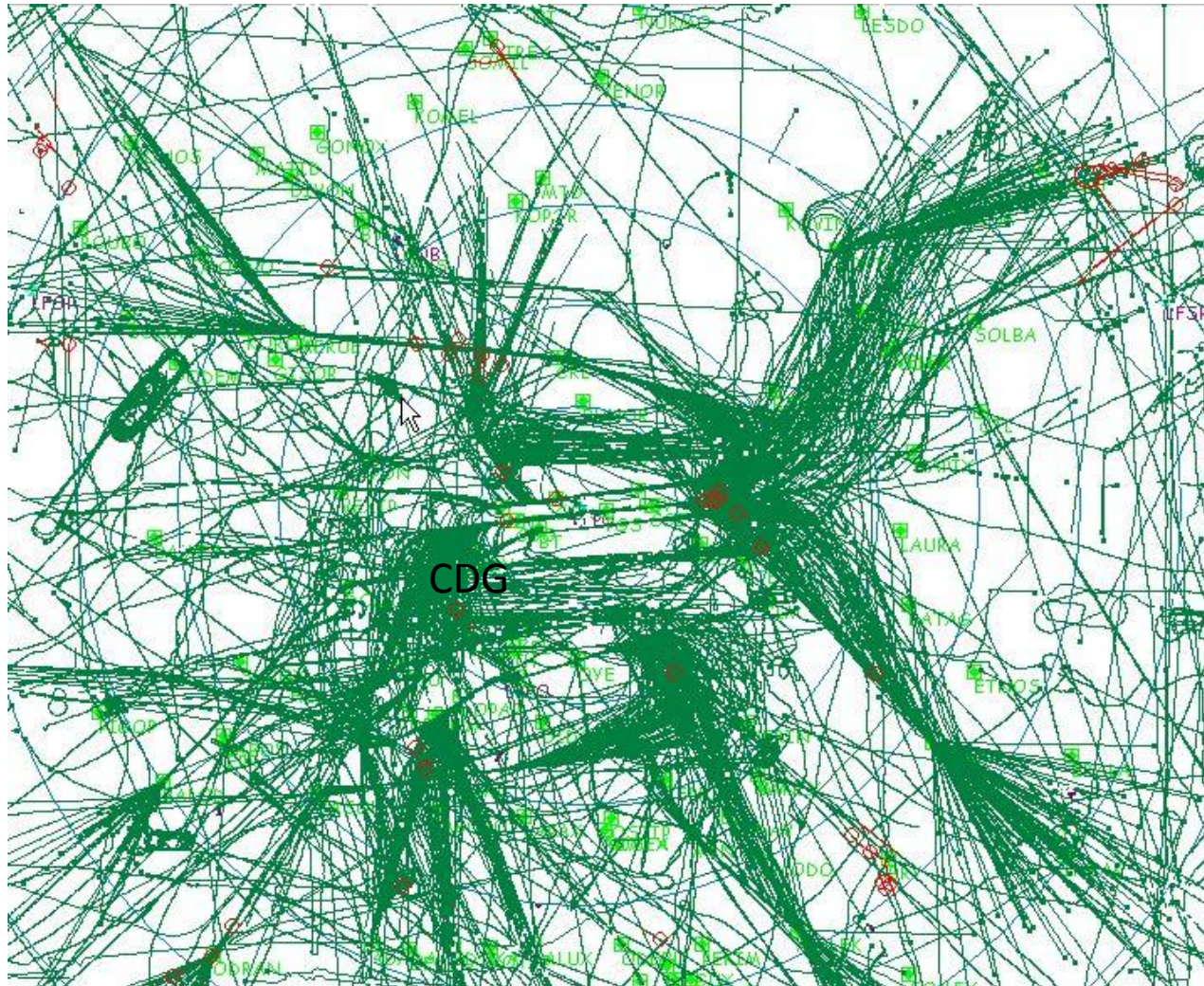
RISK OF ATC INCIDENT



The risk of ATC incident increases with the presence of traffic in the area, or in the vicinity of the area, where the ghost detections are positioned by the radar. So in case of presence of :

- ➔ Airport and airfield
- ➔ Routes or sectors with dense traffic
- ➔ Restricted airspace (ex. military) or class A,B,C or D controlled airspace (intrusion monitoring)

EX TRAFIC AROUND CDG BELOW FL150



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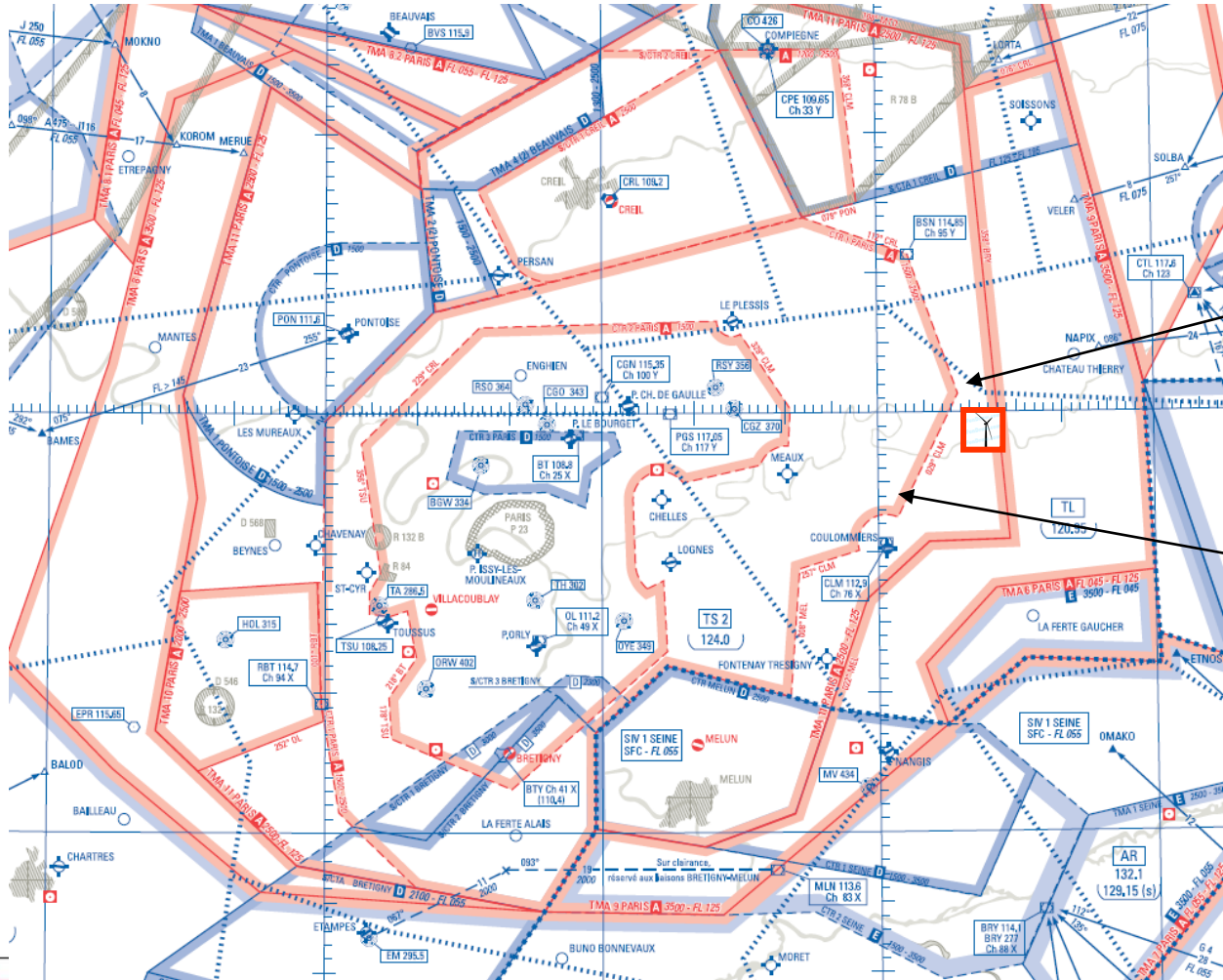


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AIRSPACE AROUND CDG



Class A
above
2500 ft

Class A
above
1500 ft

Pb = Intrusion de vols VFR non coopératifs en espace de Class A



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PRIMARY RADAR



WIND TURBINE ASSESSMENT AREA 0 – 30 KM

Wind turbines **never** authorized

The reasons are :

1- wind turbine are detected whatever the distance

→ Impacts of wind farms located beyond 30 km have to be mitigated

→ This can be achieved using specific processing zones (blanking, non init etc...)

2- DSNA primary radars are 20 to 30 years old

→ Poor processing and memory capacities

→ Number of processing zones limited (16 max per type)

3- Most of the processing zones are already used for cancelling unwanted echos from trains, trucks on motorway etc..

4- The few remaining zones are reserved for wind farms located beyond 30 km where installation is « free »

→ Forbidding wind farm installation within 30 km is a way of saving processing zones that are essential to mitigate wind farm impact beyond 30 km

Questions?



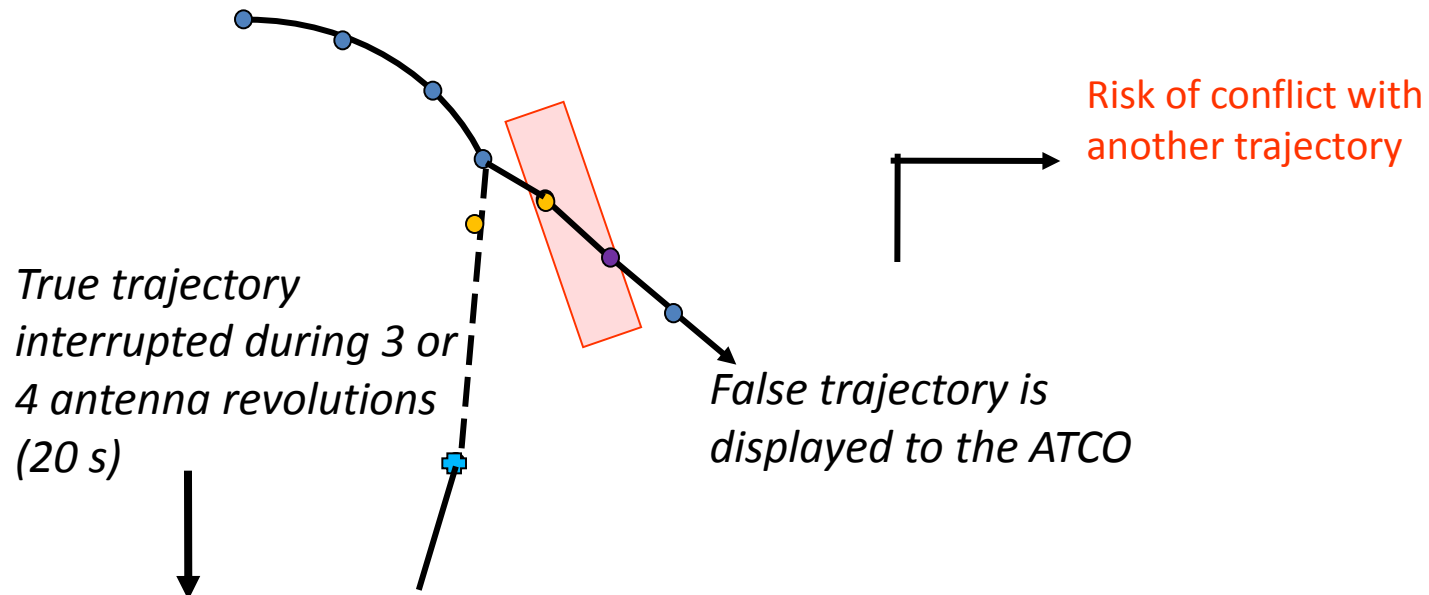
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Back up slides



IMPACT OF DETECTION ON WIND TURBINES

WRONG PLOT/TRACK ASSOCIATION



True trajectory interrupted during 3 or 4 antenna revolutions (20 s)

False trajectory is displayed to the ATCO

Risk of conflict with another trajectory

Loss of detection

Risk of not anticipating a coming conflict

Operational impact depends on:

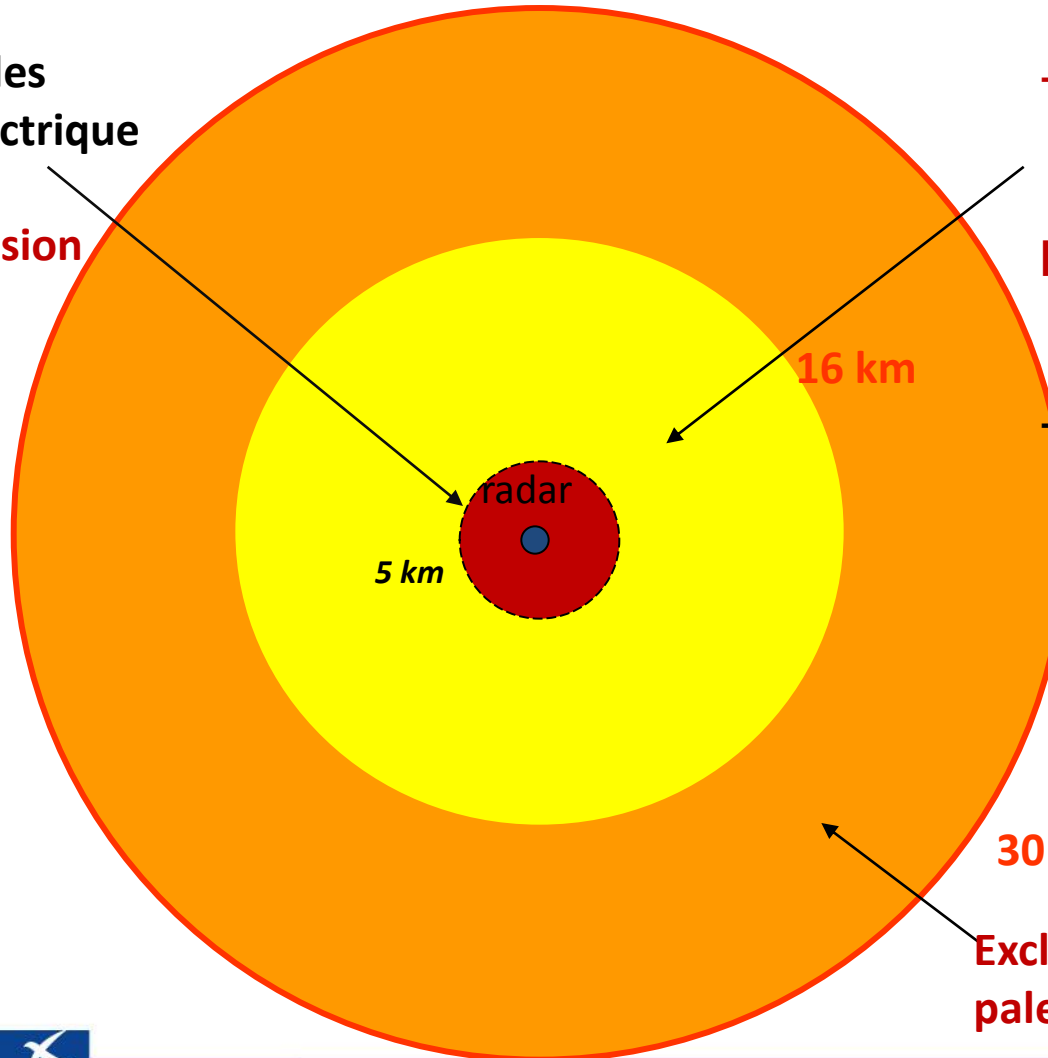
- Density of traffic
- type of operation
- Controller work load

Application par la DGAC

Servitudes
radioélectriques

s

→ exclusion



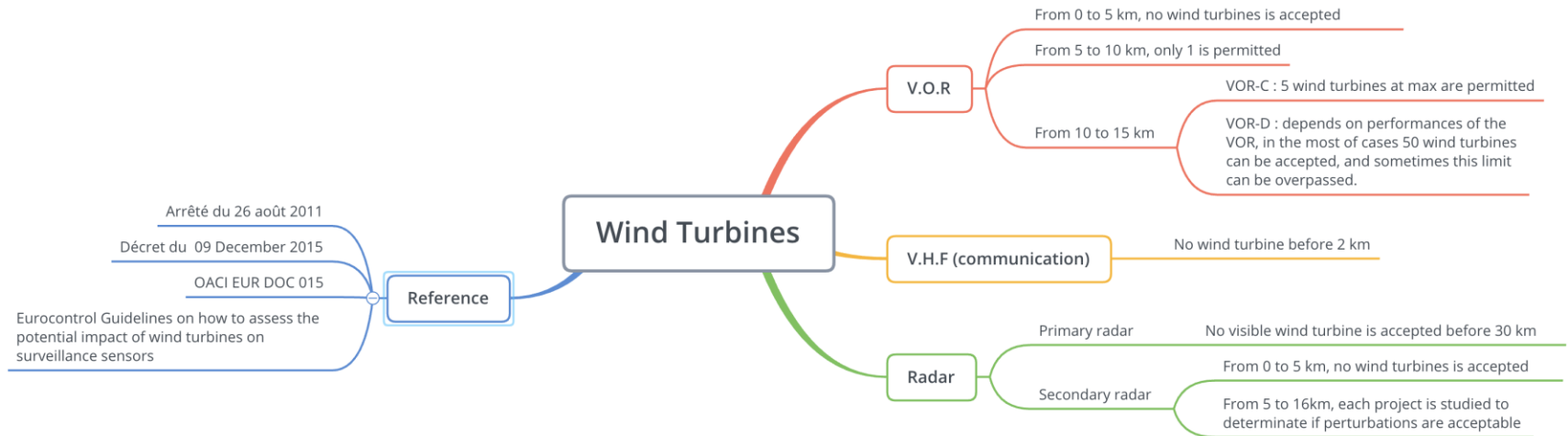
- Exclusion si
radar primaire
et
pales en
visibilité
directe

Etude au cas
par cas si
radar
secondaire

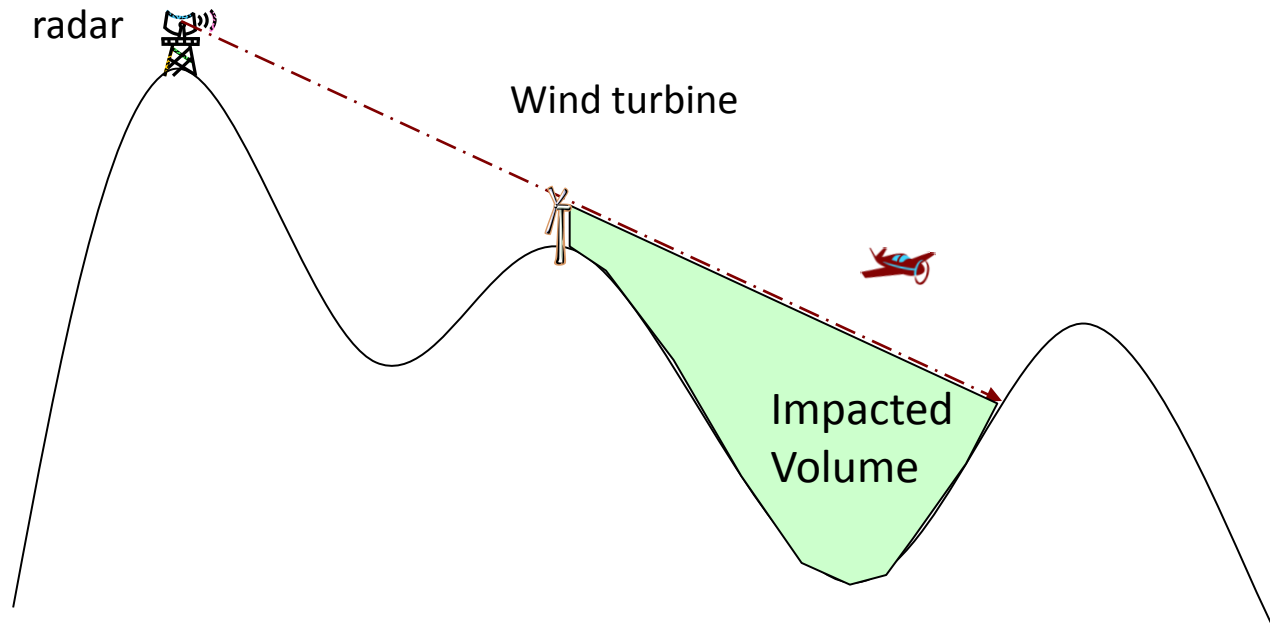
30 km

Exclusion si radar primaire et
pales en visibilité directe

REGULATION



Mountain radars



Conditions for positive decision:

- No traffic in the perturbed volume

AND

- Compliance with the same conditions as the ones required in the 5 → 16 km area

Case with positive decision



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Case with negative decision

