

MOUNTAIN RESCUE SAFETY CHALLENGE



UNANTICIPATED YAW

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- **Rescue pilot in CHAMONIX - MONT BLANC**
- **Head of H 145 evaluation team**



For better understanding the whole presentation is written

• INTERNATIONAL COMMISSION FOR ALPINE RESCUE

 132 members in 41 countries worldwide

 **4 Technical Commissions, covering all aspects of MR:**

- Air Rescue
- Medical
- Avalanche Rescue
- Terrestrial Rescue

 **RESCUERS SAFETY !**



International Commission for Alpine Rescue



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Welcome

International Commission for Alpine Rescue

ICAR provides a platform for rescue services and their safe organization that respects its cooperation.

[Watch the video](#)
(external link to the vimeo.com)





DISCLAIMER

 **I don't work for any HC manufacturer and have no commercial issue.**

 **I have flown dozens of very touchy rescue missions with the BK 117 C2 and never felt in danger.**



UNANTICIPATED YAW



ALOUETTE III

- ⇒ « Empirically » over designed
(No economic issue in the 50's)
- ⇒ Margins regarding limitations
(No HUMS, flight analysis...)

UNANTICIPATED YAW

BK117 C2

- ⇒ « optimized » design
- ⇒ ++ increased performances
- ⇒ reduced margins when approaching flight envelope limits





Paroi
verticale

2003

⇒ « Yaw control » issue

2004

Test flights Mountain rescue OPS

Description des essais réalisés

Pour cette campagne d'essai, il a été réalisé 13 points fixes et 47 vols d'essai, soit un total de 40 heures et 15 minutes. Ces essais ont été conduits autour de trois sites:

- Donauwörth (1300 ft): Tous les vols basse altitude ont été effectués sur le terrain d'Eurocopter à Donauwörth ou sur l'aérodrome voisin de Genderkingen.
- Zugspitze (9000-10000 ft): Une partie des essais en vol haute altitude en air libre ont été réalisés à proximité du Zugspitze à la frontière Allemagne-Autriche, la base de départ étant située sur l'aéroport d'Innsbruck. Plusieurs sites ont été utilisés, mais la plupart des essais ont été faits à proximité du pic Hochwanner à environ 9100 ft.
- Courchevel (6500 to 10600 ft): Des essais haute altitude en air libre et dans l'effet de sol ont été conduits sur l'héliport de Courchevel (6500 ft) et aux alentours. Le site le plus utilisé a été un petit plateau sur le flanc ouest de Bellecôte, à environ 9000 ft (Fig. 2).



Fig. 2: Zone d'essais haute altitude ~9000 ft (Bellecôte).

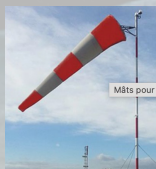
UNANTICIPATED YAW

BK 117 C2 - TEST FLIGHT - LESSONS LEARNT

10000 Ft ISA / certified perfo HOGE:

15 Kt RH crosswind

⇒ **entering AEO TORQUE transient
(91%)
= full left yaw pedal reached**



UNANTICIPATED YAW

BK 117 C2 - TEST FLIGHT - LESSONS LEARNT

10000 Ft ISA / certified perfo HOGE:

« weak » RH crosswind



⇒ using max AEO TORQUE
transient (97%)

= full left yaw pedal reached

UNANTICIPATED YAW

BK 117 C2 - TEST FLIGHT - LESSONS LEARNT

10000 Ft ISA / certified perfo HOGE:

 **17 kt RH cross wind (maxi certified)**

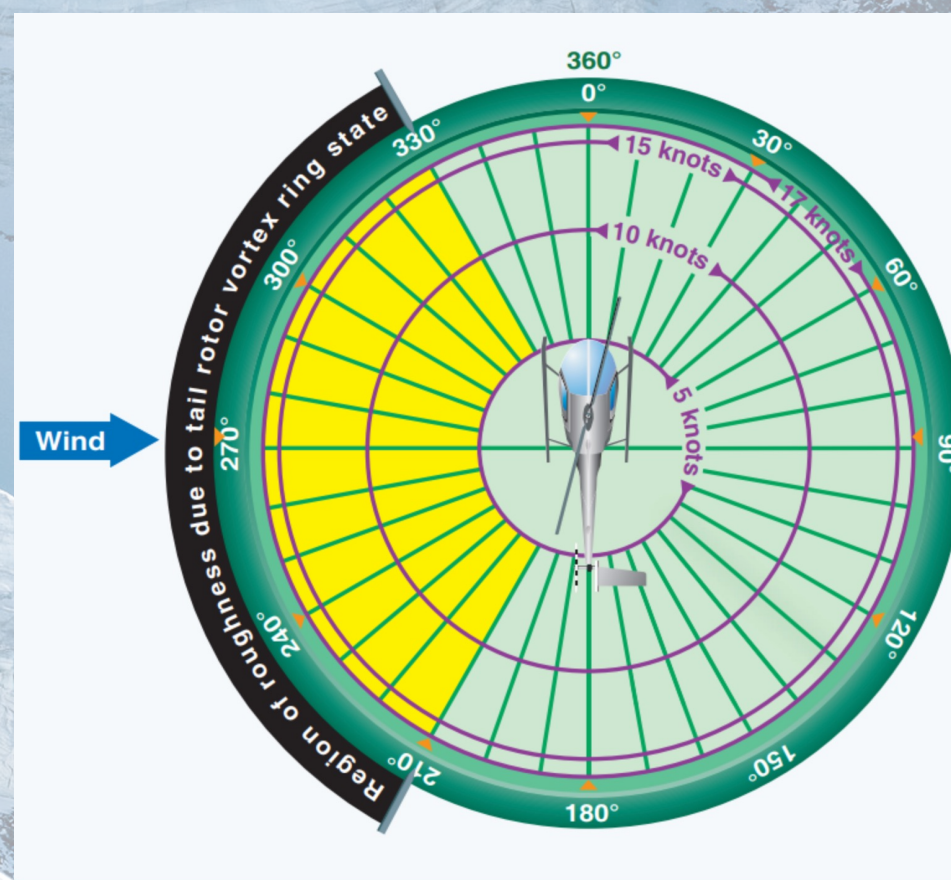
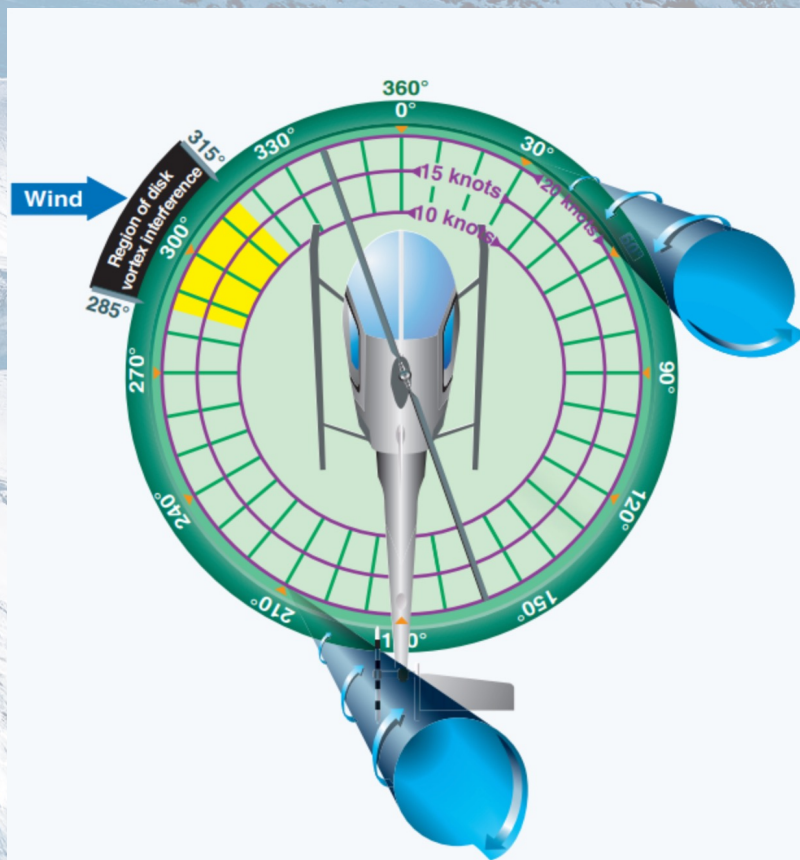
=> tail rotor control margin = 3%

 **a 20 % tail rotor margin is necessary to stop a 30° / sec yaw rotation**

UNANTICIPATED YAW

2004

⇒ We started to remind about « LTE »... 🤯



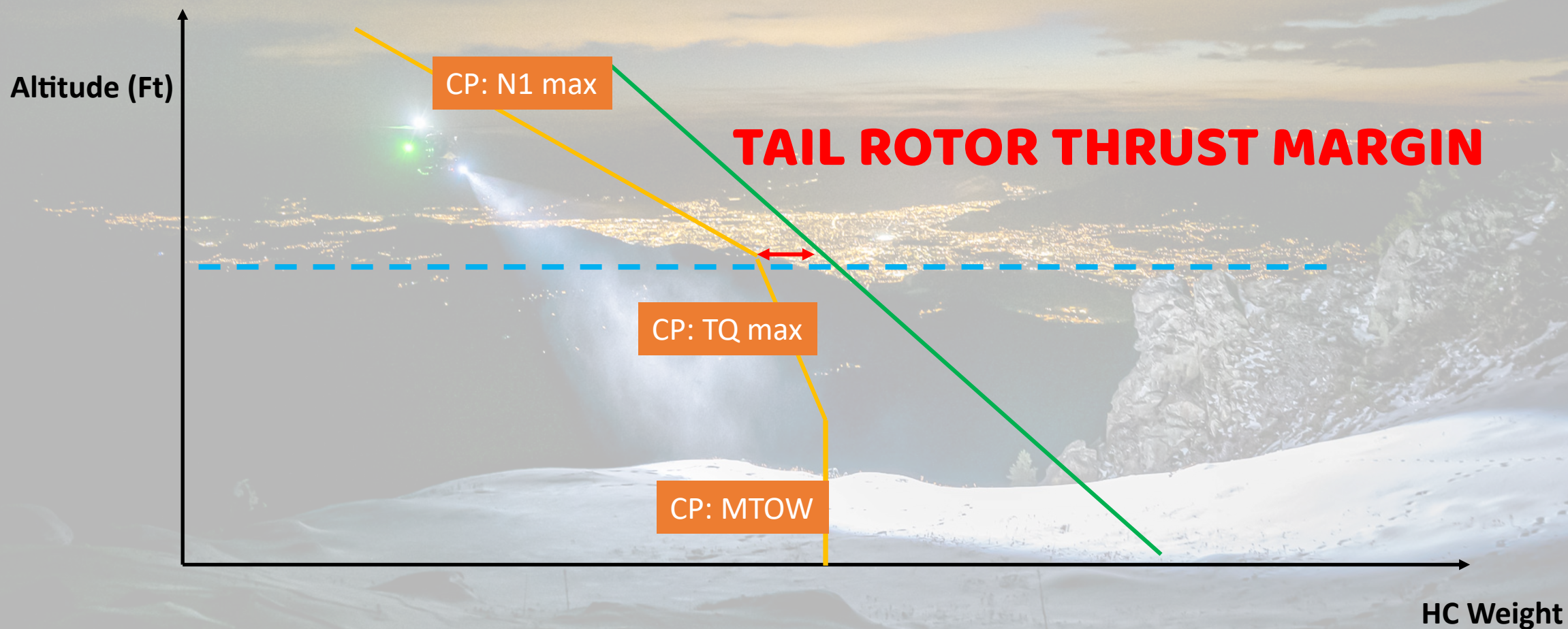
UNANTICIPATED YAW

2004

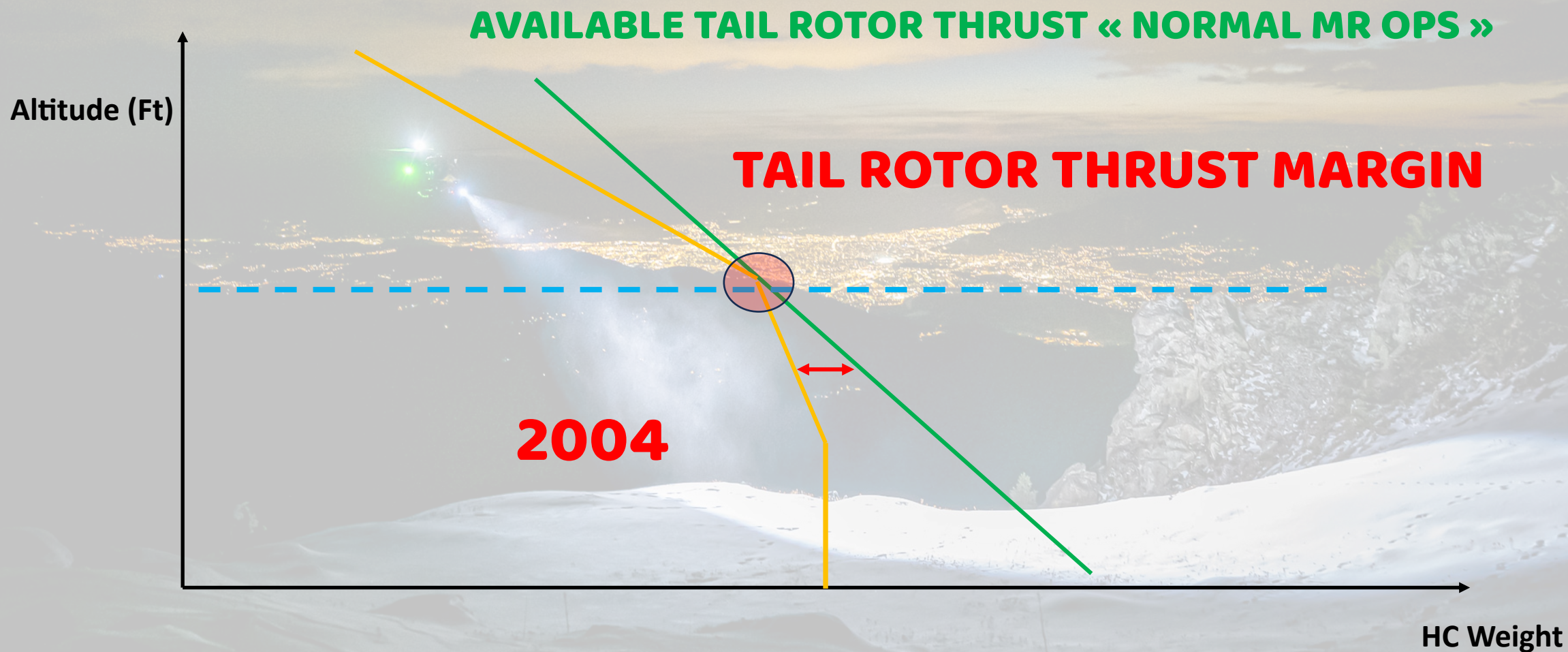
⇒ We were informed by Eurocopter that, during our mountain rescue OPS, the helicopter we were operating :
« Was more likely to reach a *left pedal limitation* than a *LTE* »

UNANTICIPATED YAW

AVAILABLE TAIL ROTOR THRUST



UNANTICIPATED YAW



UNANTICIPATED YAW

2019

Background

Unanticipated yaw is a flight characteristic to which all types of single rotor helicopter (regardless of anti-torque design) can be susceptible at low speed, dependent usually on the direction and strength of the wind relative to the helicopter.

This characteristic was first identified and analyzed in relation to OH-58 helicopters by the US Army, who coined the description "loss of tail rotor effectiveness (LTE)" even though the tail rotor always remained fully serviceable. It is not linked to any failure and has nothing to do with the full loss of tail rotor thrust.

When this type of unanticipated yaw situation is encountered, it may be rapid and most often, the pilot may not have time to react before the helicopter is in a dangerous attitude.

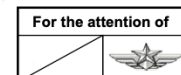


No. 3298-S-00

SAFETY INFORMATION NOTICE

SUBJECT: GENERAL

Unanticipated right yaw (main rotor rotating counter clockwise), commonly referred to as LTE



AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
5), D (DB, DBS, DB-4, DBS-4, S, CBS-4, CBS-S), LS A-3		CBS-5 KLH, E-4
2, C-1, C-2, C-2e, D-2, D-2m		D-2m
P2+, P3, EC635 T1, EC635 T2+, ,635 P2+, EC635 P3, 635 T3H, EC635 P3H		—

Background

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situation is encountered, it may be rapid and most often will be in the
of the main rotor blades (i.e. right yaw where the blades rotate
tion is needed in response otherwise loss of control and possible accident

the first instance may not cause the yaw to immediately subside, thus
causing the pilot to make inadequate use of the pedal to correct the situation because he suspects that it is
ineffective when, in fact, thrust capability of the tail rotor available to him remains undiminished. "Loss of tail
rotor effectiveness" is not, therefore, a most efficient description as it wrongly implies that tail rotor efficiency is
reduced in certain conditions.

Understanding unanticipated yaw is important to avoiding it, particularly as it appears to continue to be a
contributing factor to some accidents. Therefore, this notice gives detailed information on when the situation
may arise, why the tail rotor may wrongly appear to be ineffective, and how to respond in order to maintain full
control / recover.

Revision 0 2019-07-03

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This document is available on the internet: www.airbushelicopters.com/techpub/



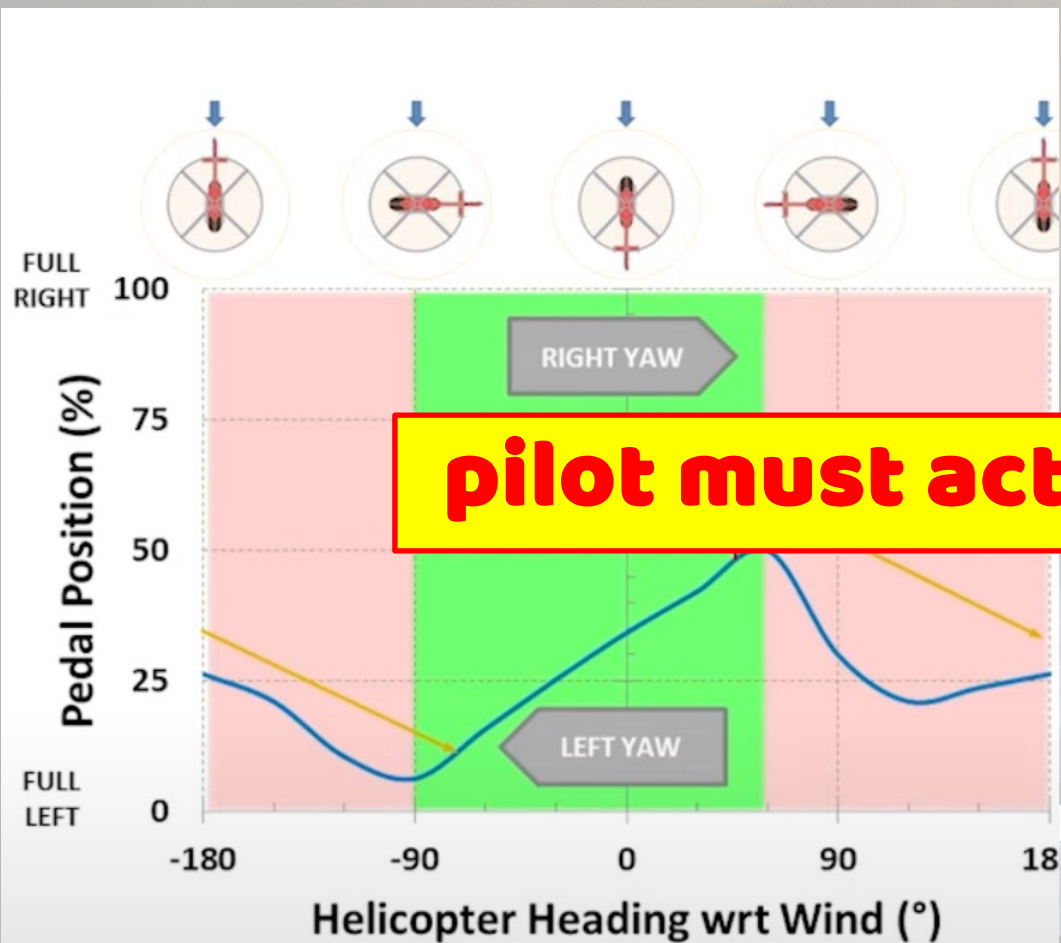
2019

« The myth of loosing tail rotor effectiveness »

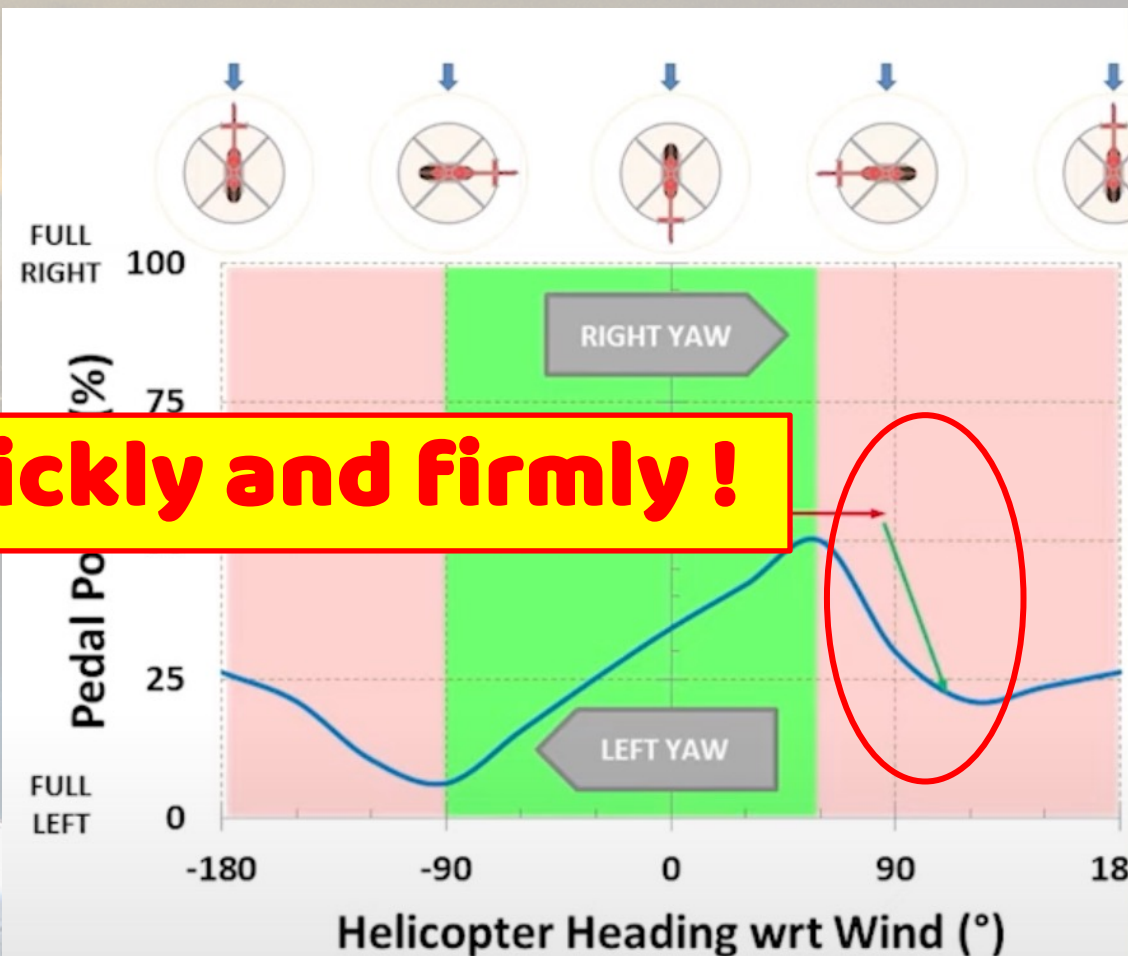
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UNANTICIPATED YAW



pilot must act quickly and firmly !






Paroi
verticale

2003

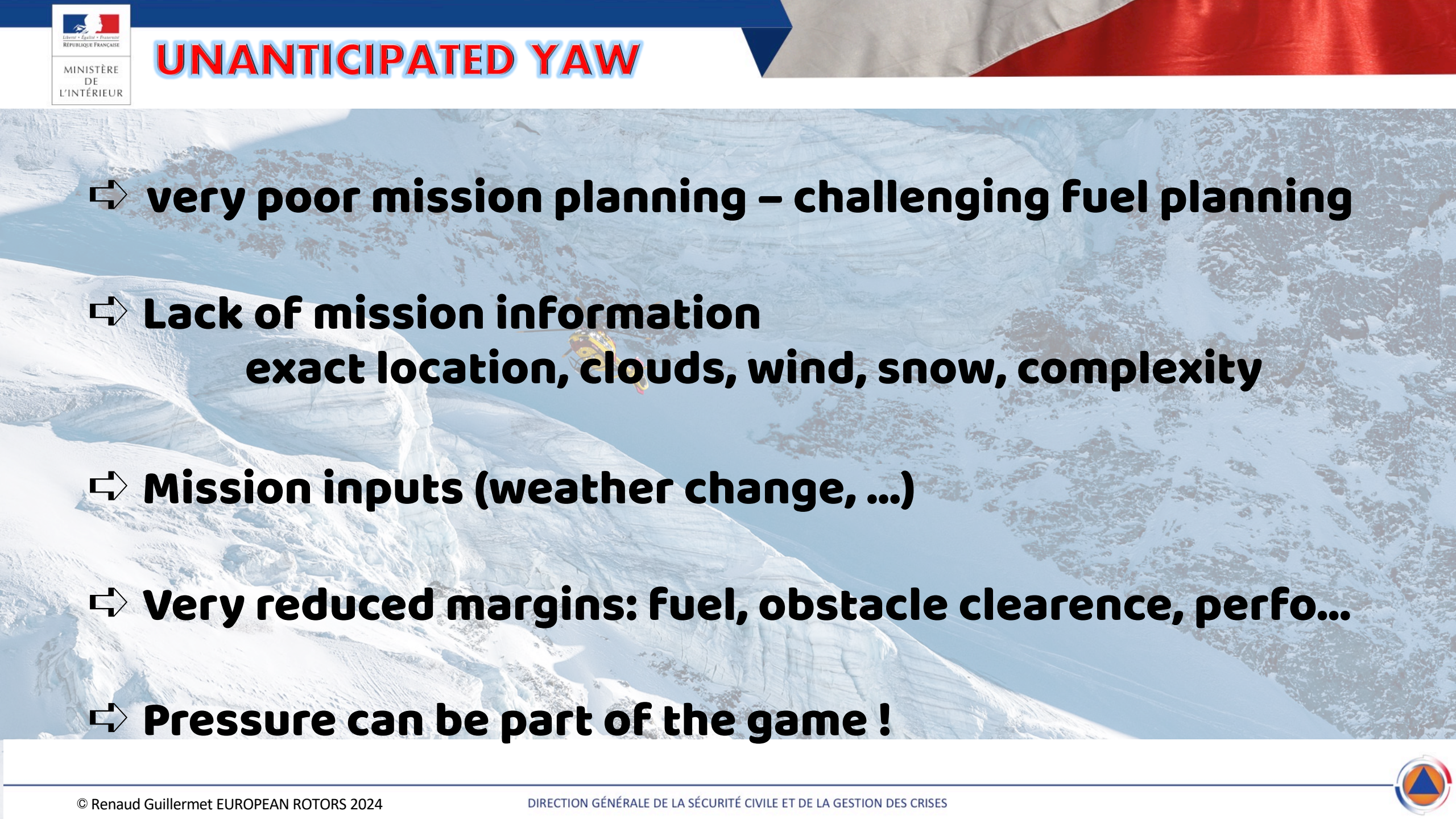
⇒ « Yaw control » issue

⇒ Human factor issue

MOUNTAIN RESCUE AND HELICOPTERS

- 
- ⇒ **The Mountain always has the final decision**
 - ⇒ **Operations at altitude = limited performances**
 - ⇒ **Rescue missions = « Heavy » mission payload when taking off from the base**

UNANTICIPATED YAW

- 
- ⇒ **very poor mission planning – challenging fuel planning**
 - ⇒ **Lack of mission information
exact location, clouds, wind, snow, complexity**
 - ⇒ **Mission inputs (weather change, ...)**
 - ⇒ **Very reduced margins: fuel, obstacle clearance, perfo...**
 - ⇒ **Pressure can be part of the game !**

UNANTICIPATED YAW

A highly demanding mission...



Hypoxia



Workload



Negative transfer !





UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS

MOST DEMANDING MISSION

+ A HIGHLY CRITICAL PHASE: « Hoist Lift off »



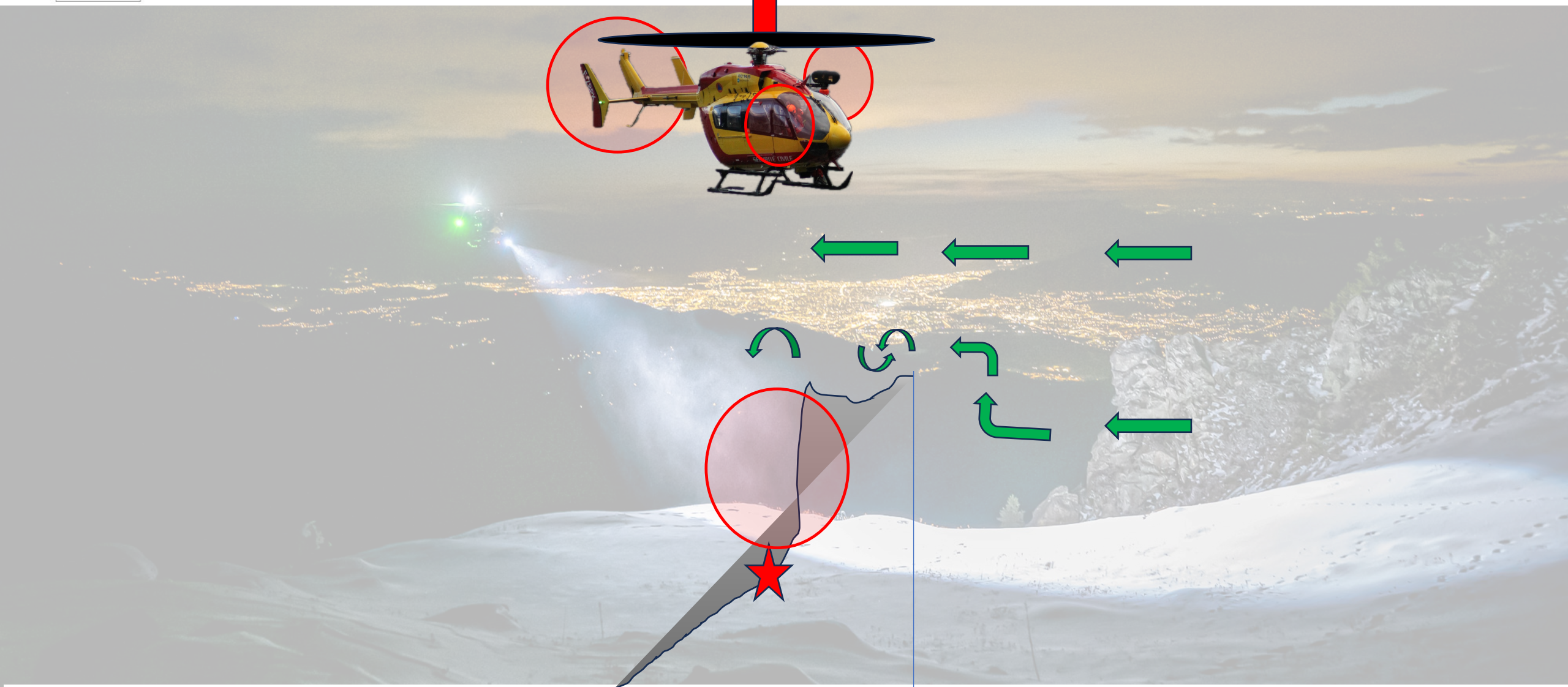
UNANTICIPATED YAW RISK

- close to obstacles: tail/blade margins (↓ - ← - →)
- Load lift off = power adjustment
- Hoist Load = humans !
- Connexion: **HC – rescuer - mountain**

UNANTICIPATED YAW



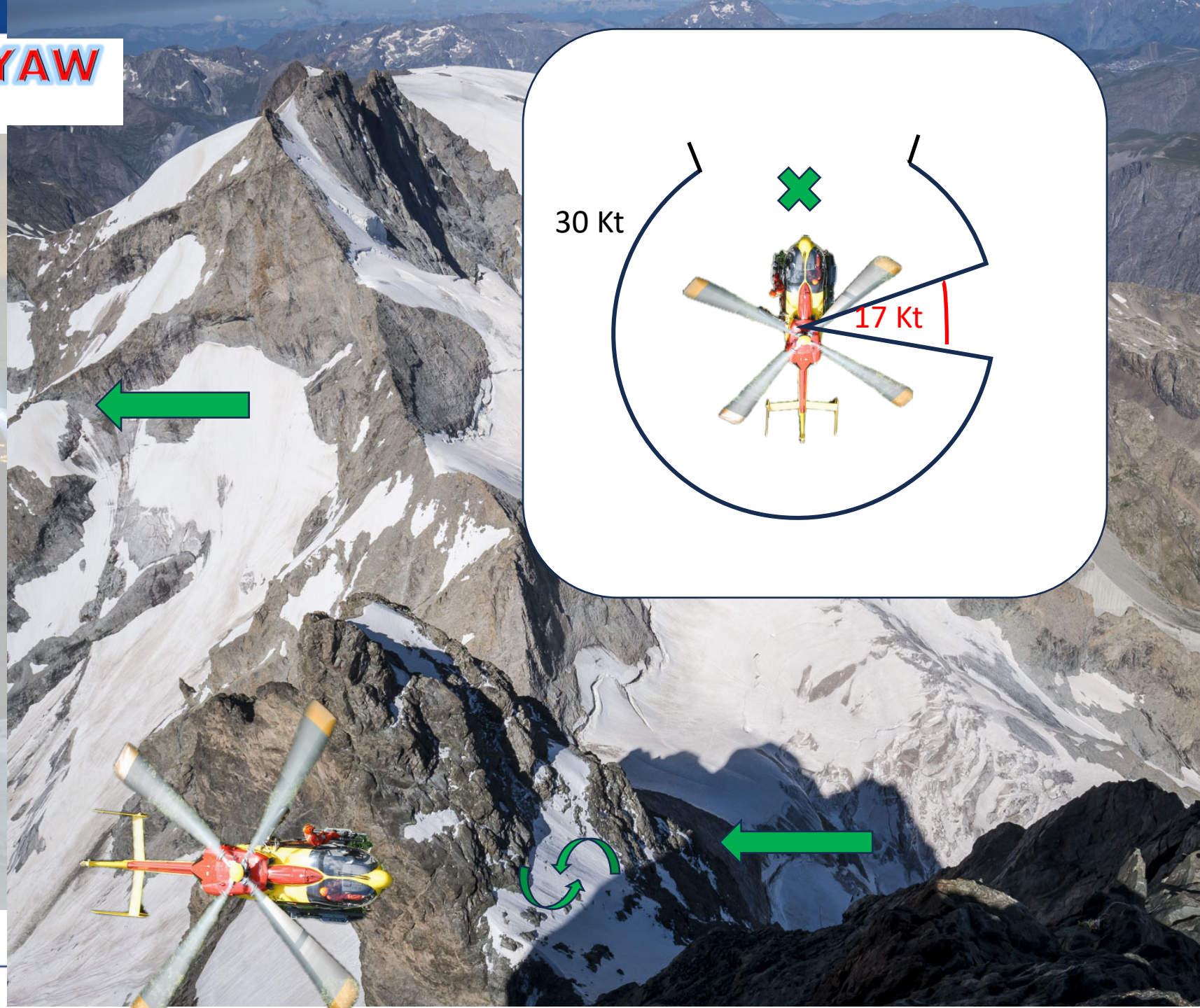
UNANTICIPATED YAW



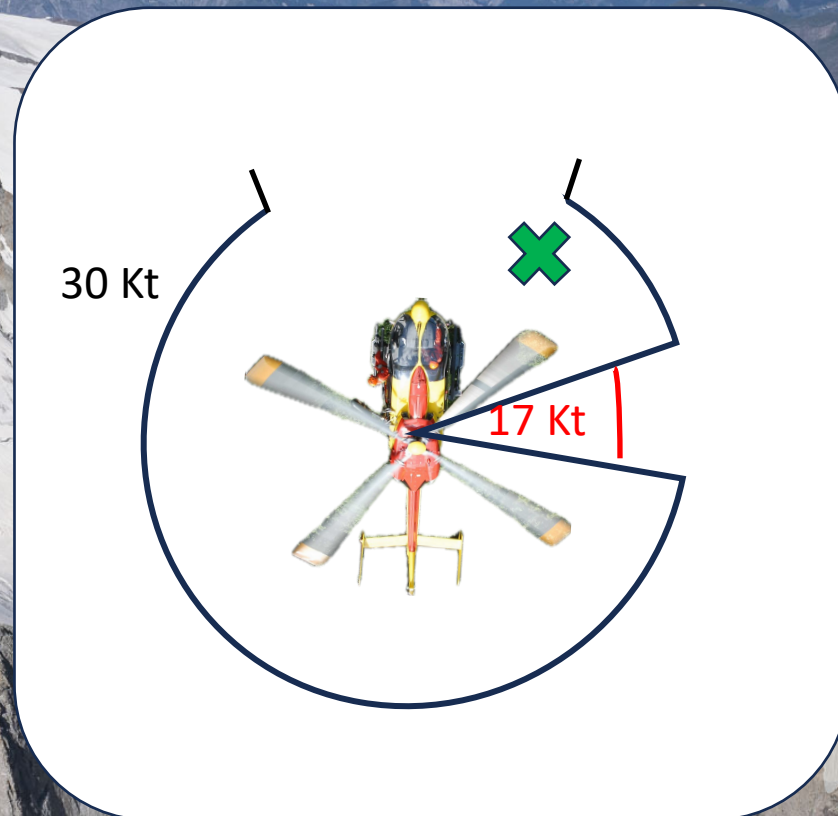
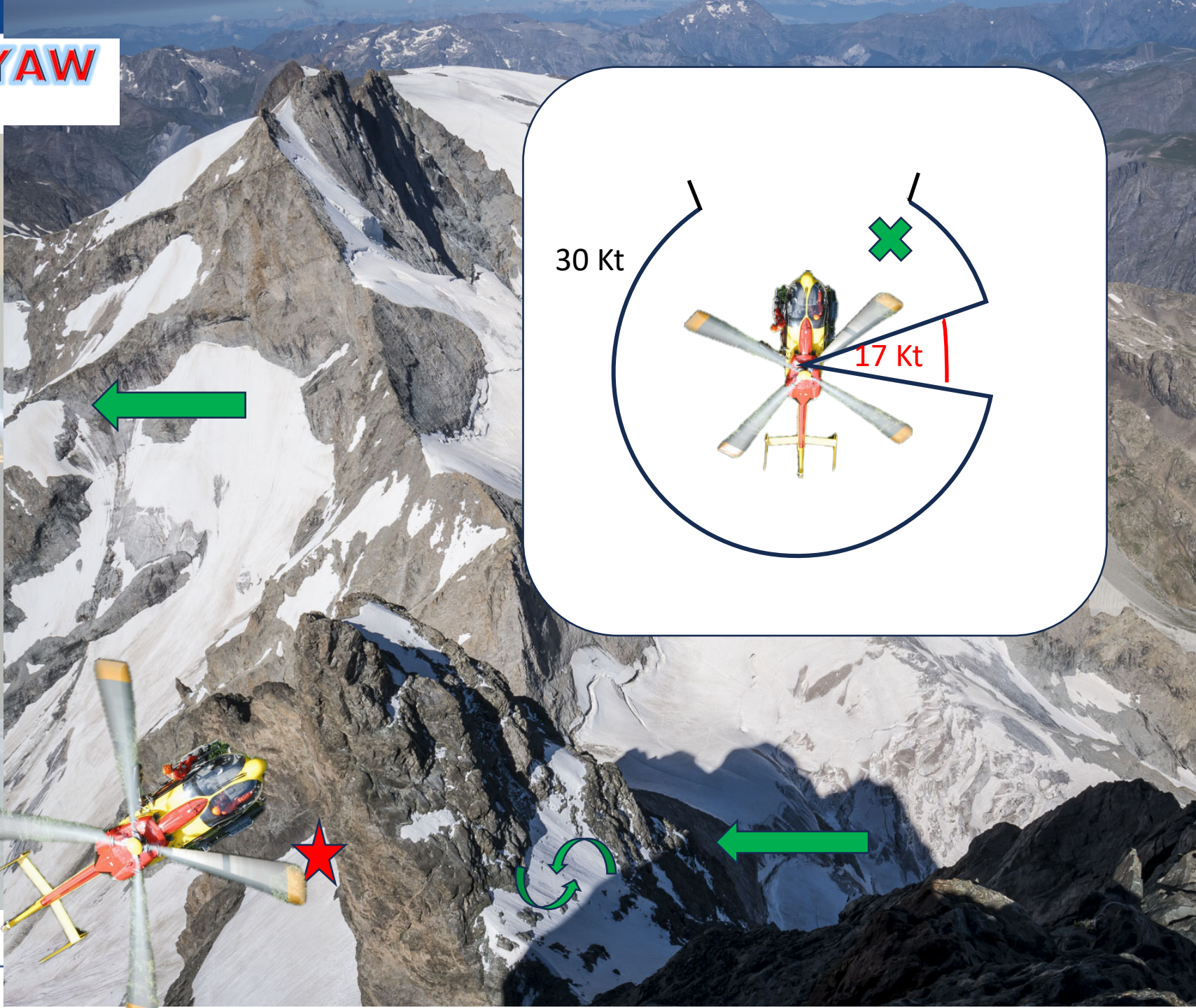
UNANTICIPATED YAW

HOVERING

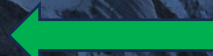
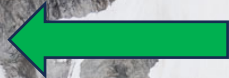
**VALIDATION
« HOVERING »**



UNANTICIPATED YAW



UNANTICIPATED YAW



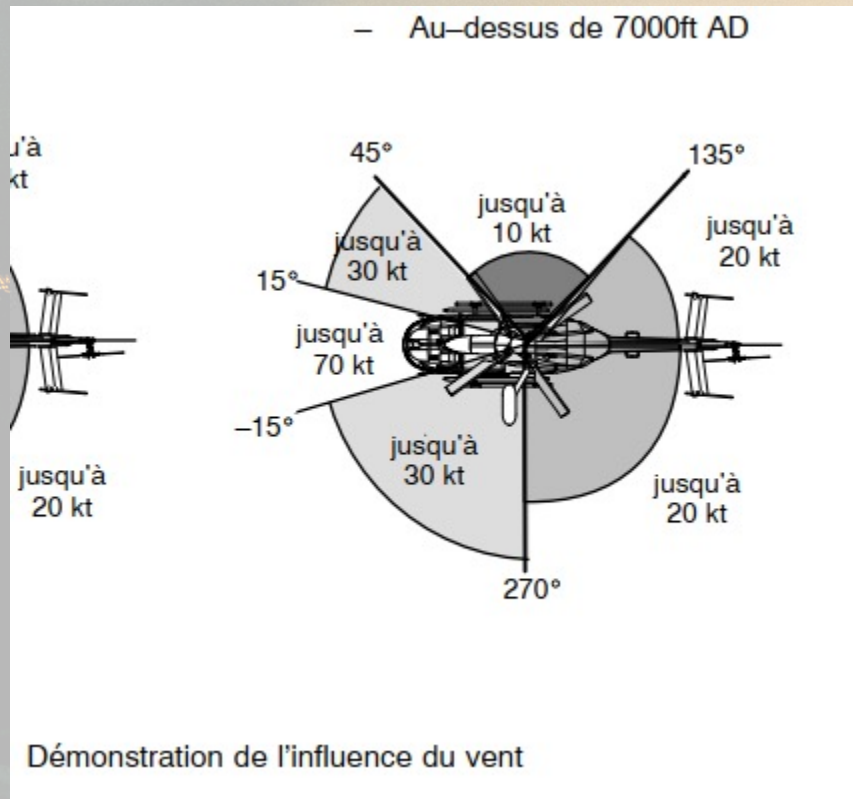
30 Kt

17 Kt



UNANTICIPATED YAW

HIGH ALTITUDE HOISTING BK 117 C2



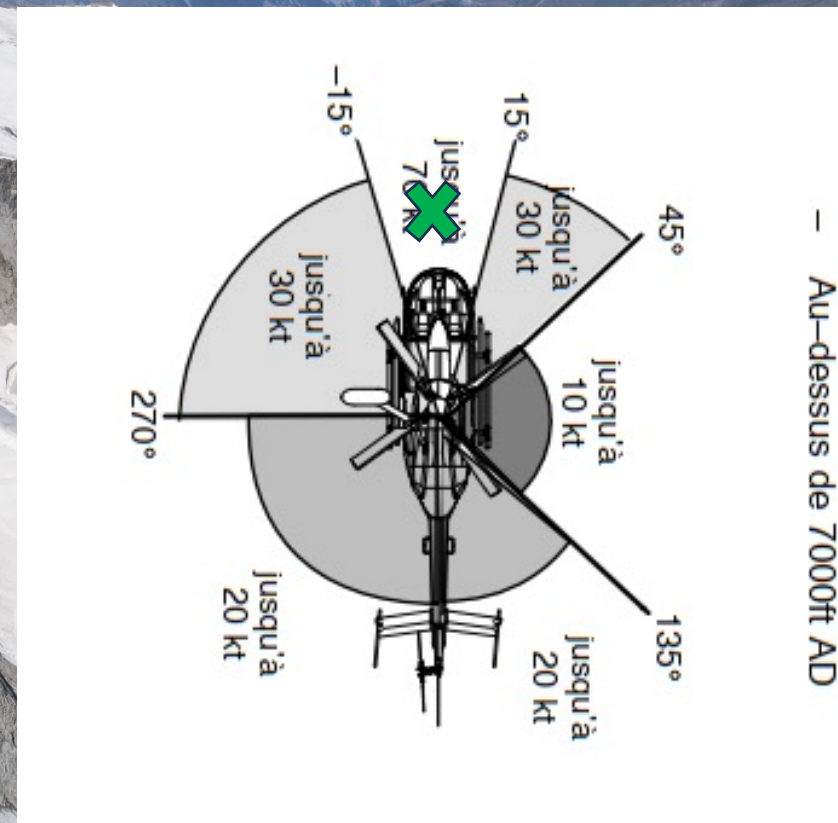
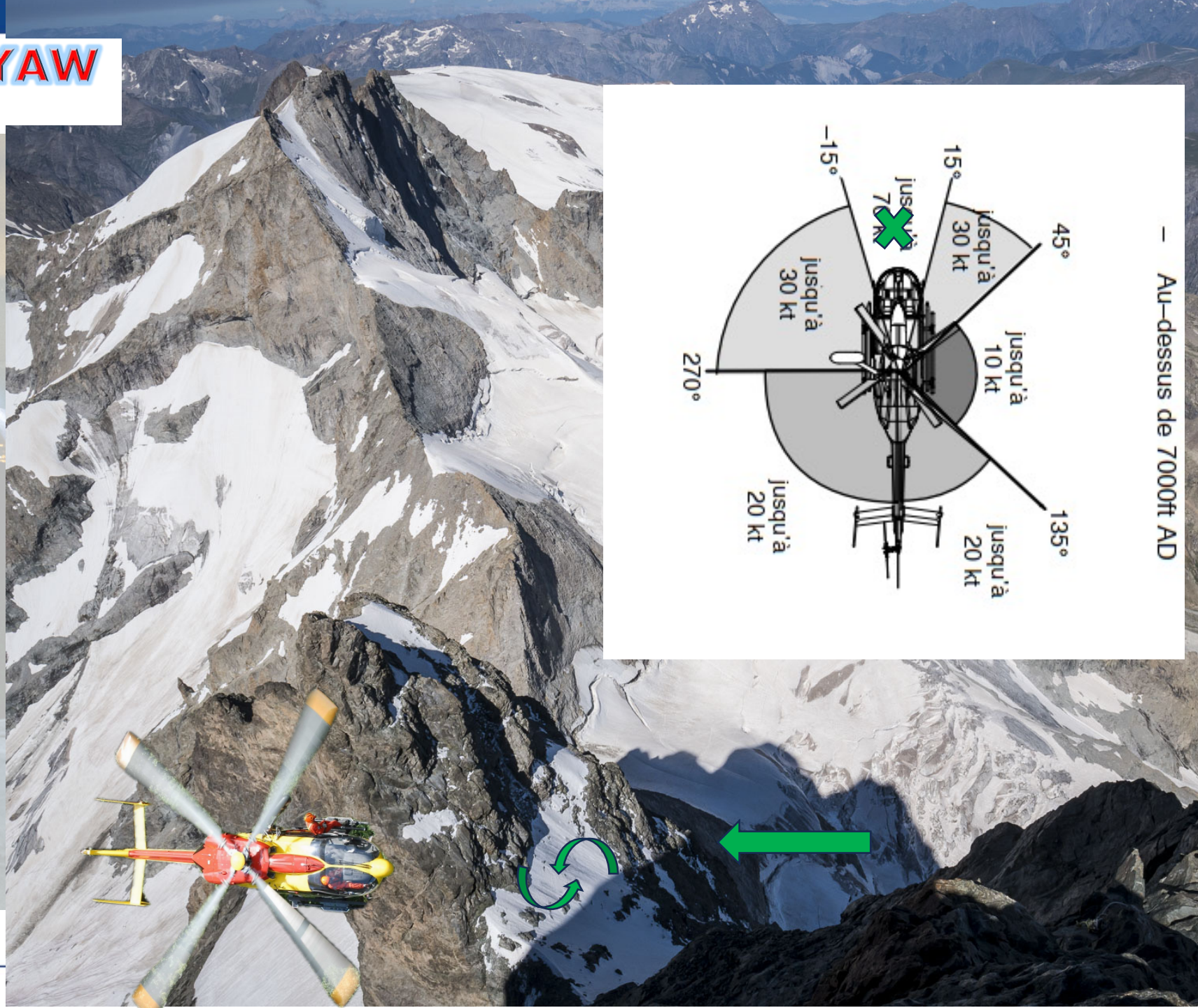
⇒ LH Hoist deployed
⇒ Maximum load

10 Kt = 5 + 5 !

UNANTICIPATED YAW

Vertical lift off

- ⇒ More COLL Pitch
- available ?
- yaw control
- references
- rescuers' safety



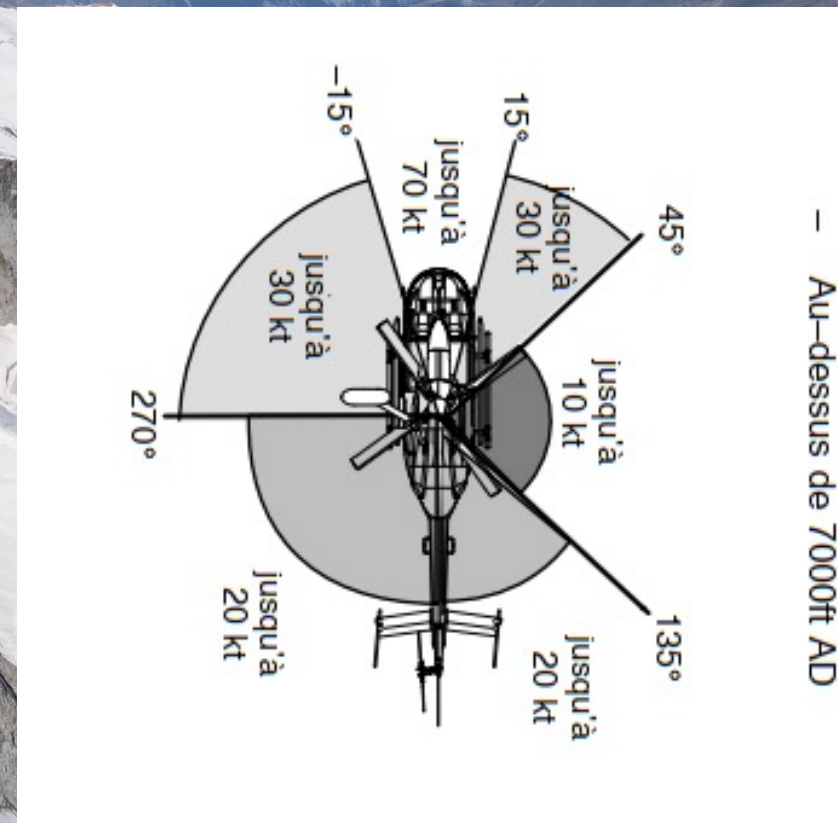
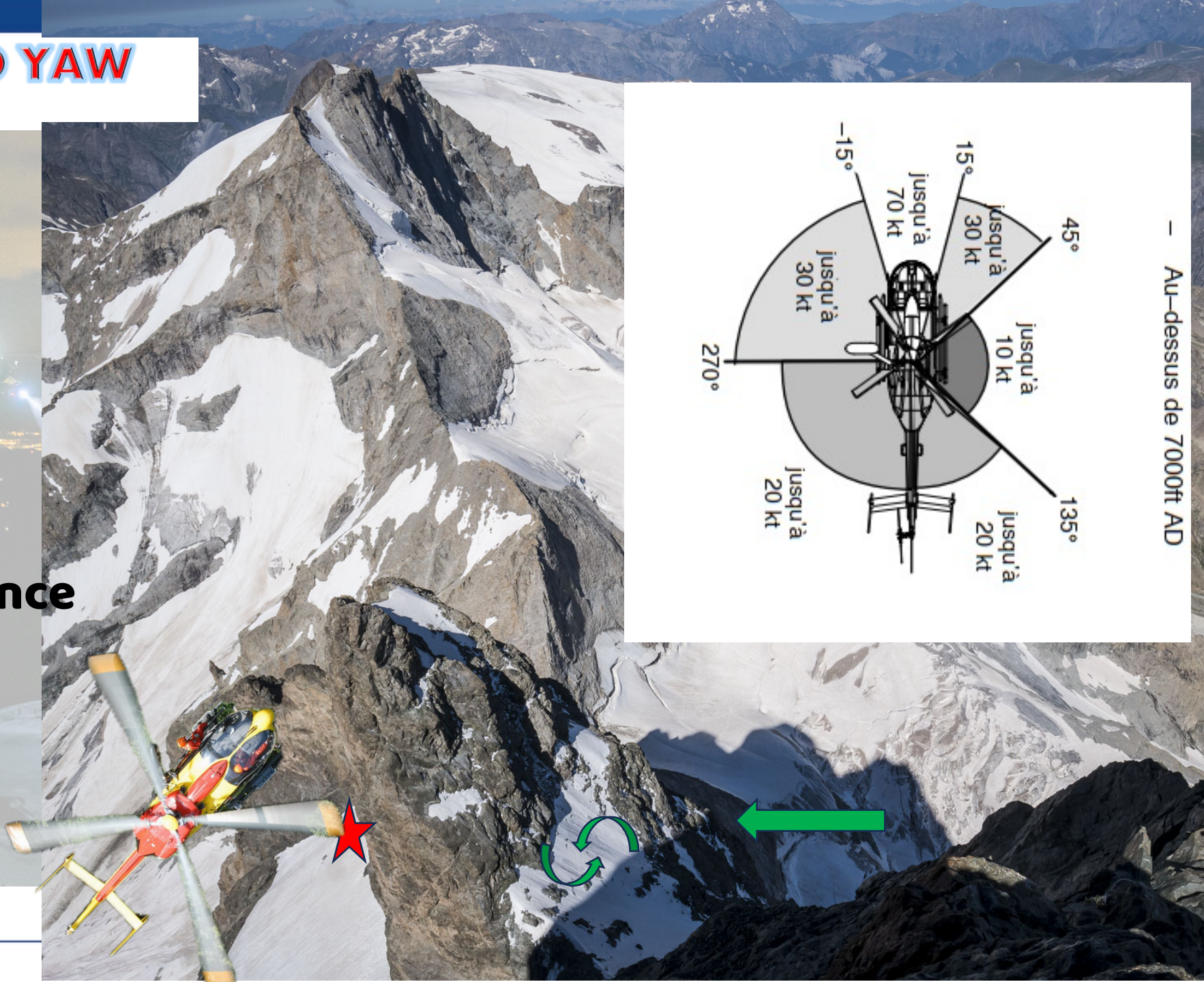
UNANTICIPATED YAW

Stay hovering until
Hoisting is finished

⇒ **MAX TOP 5'**
- available ?

⇒ **Obstacles clearance**
⇒ **exposure time**

⇒ **ETC...**



UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS 🚦 UNANTICIPATED YAW RISK:

- Hoist Lift off:

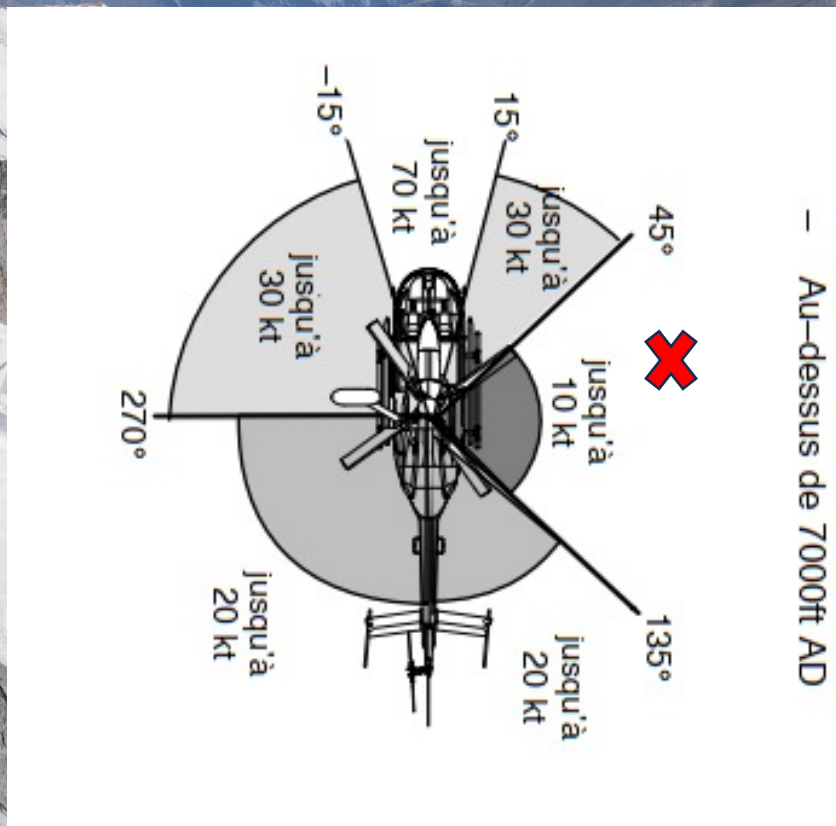
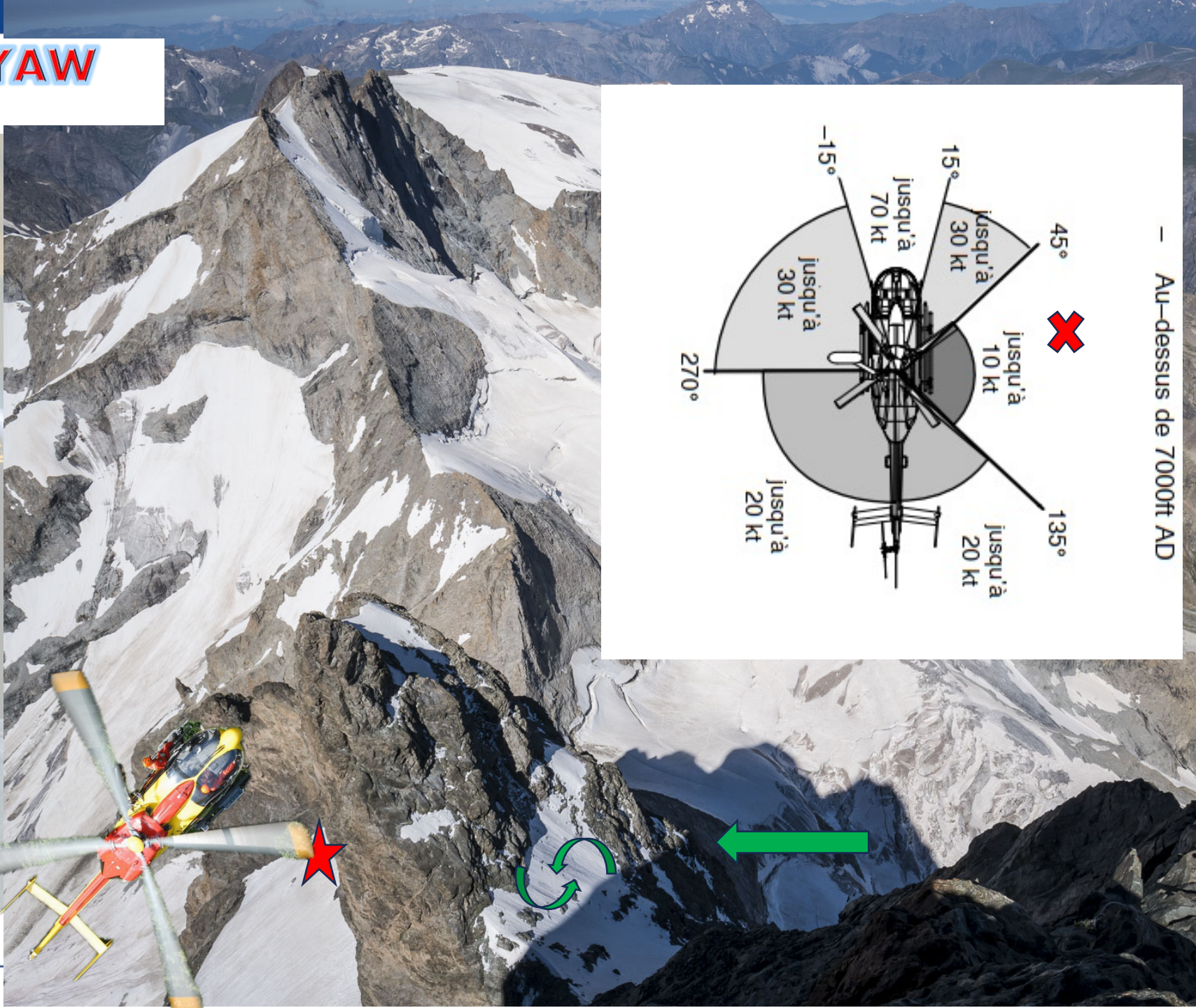
NORMAL SITUATION

- Flight controls entries
- Hoist load - safe trajectory

The pilot modifies and can increase relative wind

⚠️ **It can be challenging not to reach limitations !**

UNANTICIPATED YAW



UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS 🚦 UNANTICIPATED YAW RISK:

NORMAL SITUATION

- Hoist Lift off:

The pilot modifies and increases relative wind

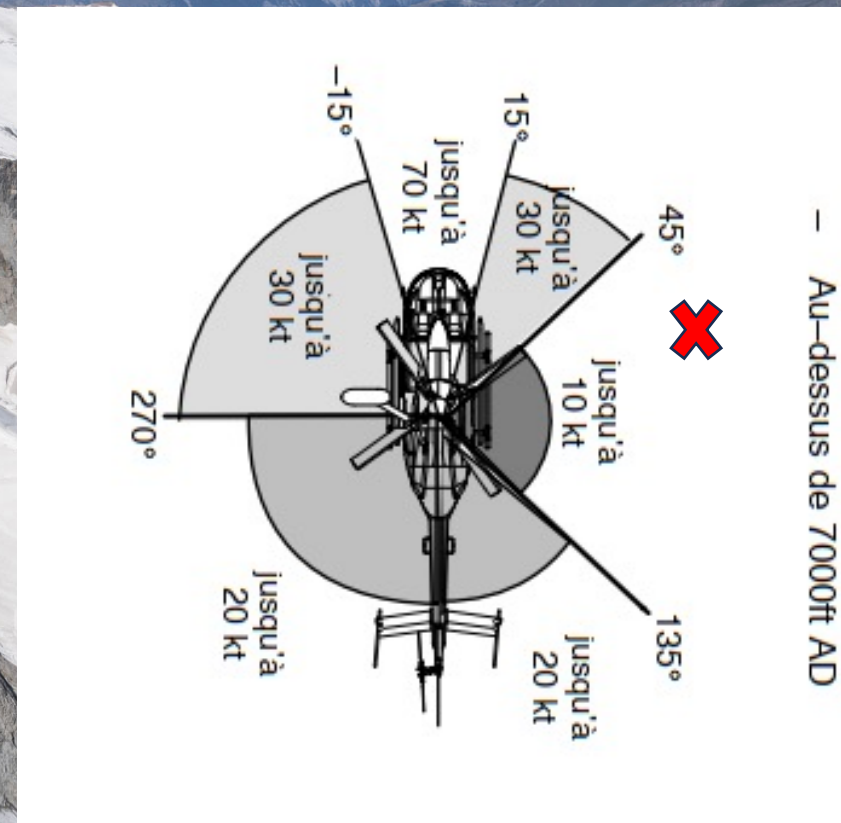
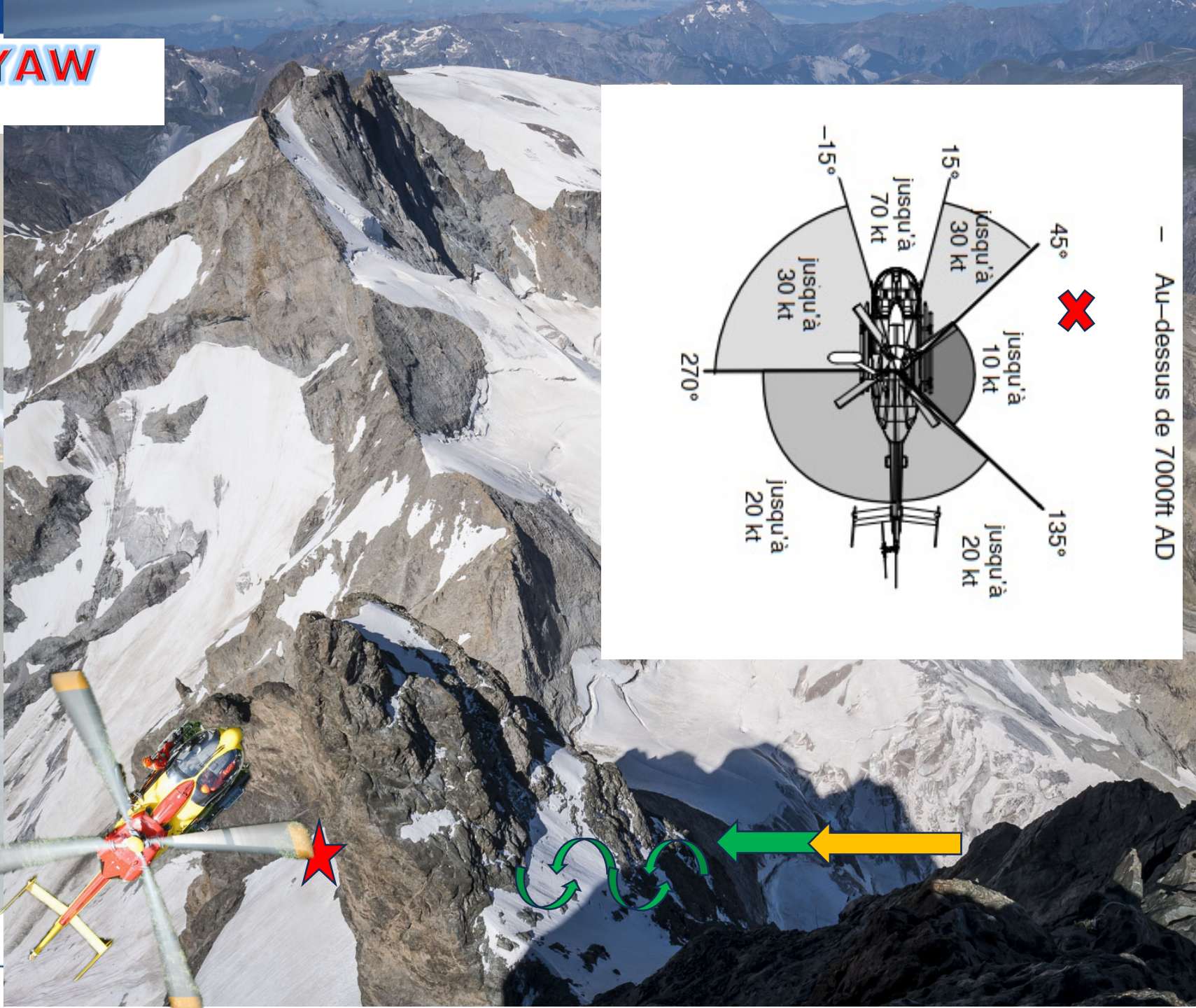


- Relative wind can be modified by « Mother nature »!



We can be thrown beyond limitations !

UNANTICIPATED YAW



UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS UNTICIPATED YAW RISK:

Hoist Lift off:

UNEXPECTED SITUATION

3800 m / Hoist operations to evacuate 3 climbers,

When the first 2 persons are lifted off, the lanyard from the other 2 climbers got caught on the secondary hook of the hoist,

All 4 persons ended up hanging on the hoist,

Hoist and engines max N1 exceeded but no damage.

UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS UNANTICIPATED YAW RISK:






UNANTICIPATED YAW

MOUNTAIN RESCUE OPERATIONS UNANTICIPATED YAW RISK:

Hoist Lift off:

UNEXPECTED SITUATION

 **Downdraught / turbulence**
and/or  **Issue with connexion device**
 **Technical issue**

 **POWER APPLICATION = INCREASED UNANTICIPATED YAW RISK**

 **HIGH WORKLOAD PIL / HOIST / RESCUERS**

UNANTICIPATED YAW



Hypoxia



Workload



Negative transfer !

MOUNTAIN RESCUE SAFETY CHALLENGE



UNANTICIPATED YAW

UNANTICIPATED YAW

NS



© DCRFPN - SDMA -



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SDMA - DIP - SPM - GF-2018

urance

MOUNTAIN RESCUE OPERATIONS

 **UNANTICIPATED YAW RISK:**

WHITE OUT !

 **loss of references +  obstacles**

Stress + lack of references ➡ over TRQ / transient

Over torque ➡ increased unanticipated yaw risk

UNANTICIPATED YAW

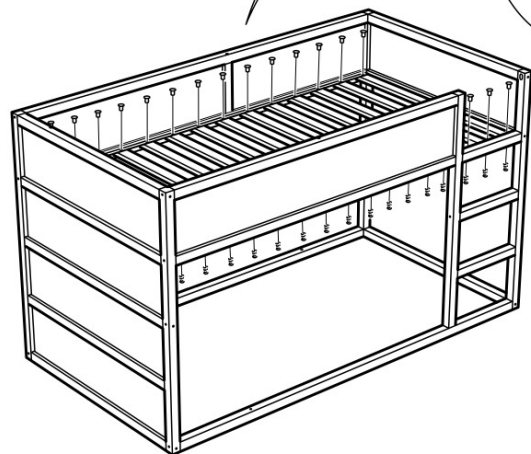
MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

TRAINING

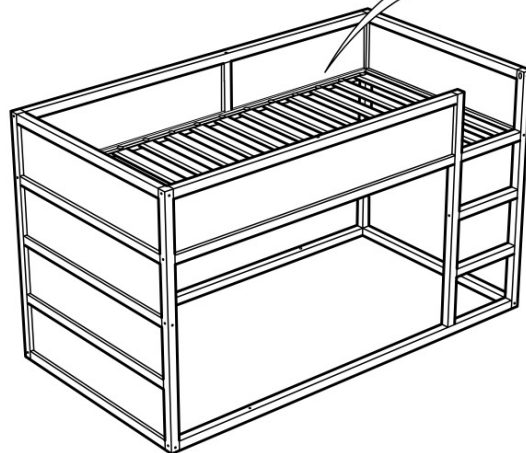
SOPs

+ SPECIAL SKILLS

26



SOPs



ATT

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obta

SOPs + SPECIAL
SKILLS



UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

SPECIAL SKILLS

⇒ EDUCATE



SEAT / PEDALS:

Adjust like a mountain rescue pilot

**Memorize pedal's position: Proprioceptive
memory can save your live !**



FLY AS LIGHT AS POSSIBLE

Take margins / as far as possible

UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

SPECIAL SKILLS – EDUCATE



Continuous trajectory analysis:

**IAS / felt ground speed,
Vertical speed / COLL pitch
yaw entry / COLL pitch**



UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

SPECIAL SKILLS – EDUCATE



Hovering position:

Manage rotor & tail margins



move / UY / technical issue... « what if ? »



« Fly the tail » & control the nose VERY CLOSELY



The good escape trajectory = the one that allows to lower collective

UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ? SPECIAL SKILLS

⇒ **TRAIN – FLY – SHARE EXPERIENCE**



identify traps



Resist to OPS pressure !

⇒ **ANTICIPATE – KEEP MARGINS**



Don't cumulate negative factors

UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

SPECIAL SKILLS

⇒ COMMUNICATE



Complex coordination pilote : hoist OP / rescuers



Cable entenglement

⇒ DEBRIEFINGS

⇒ FLIGHT ANALYSIS



MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?



SOME PERSONAL THOUGHTS



⇒ **We have so many different missions within the EASA HEMS scope**

« I am a mountain pilot ! »

« We fly HEMS mission ! »

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

They transport persons over the seas !



© RRJ



MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?



THOUGHTS



A mountain rescue helicopter pilot job shouldn't be considered as a part time job...

- ⇒ **We carry people on the hook, not big bags !**
- ⇒ **Pressure, the HC is a small part of the whole rescue system**

UNANTICIPATED YAW

MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?



THOUGHTS



A mountain rescue helicopter MUSN'T be considered as an ambulance...



PERFORMANCES : Power and wind envelope margin are key safety issues



UNANTICIPATED YAW

MOUNTAIN RESCUE SAFETY CHALLENGE - DEALING WITH UNANTICIPATED YAW DURING HIGHLY DEMANDING MISSIONS

**Thanks to latest generation of helicopter we have margins...
...It's our duty to:**



Manage operational pressure



Never forget where we come from and why we operate in such a special way



Keep our safety margins



UNANTICIPATED YAW



International Commission for Alpine Rescue

THANK YOU !