

# MOUNTAIN RESCUE SAFETY CHALLENGE



## UNANTICIPATED YAW

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- **Chief flight instructor pilot for mountain rescue within French “SECURITE CIVILE”**
- **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 !**





# Welcome

International Commission

ICAR provides a platform for rescue services to disseminate knowledge with 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).

09.04

/ 18

# 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 HOGGE:

« 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)**

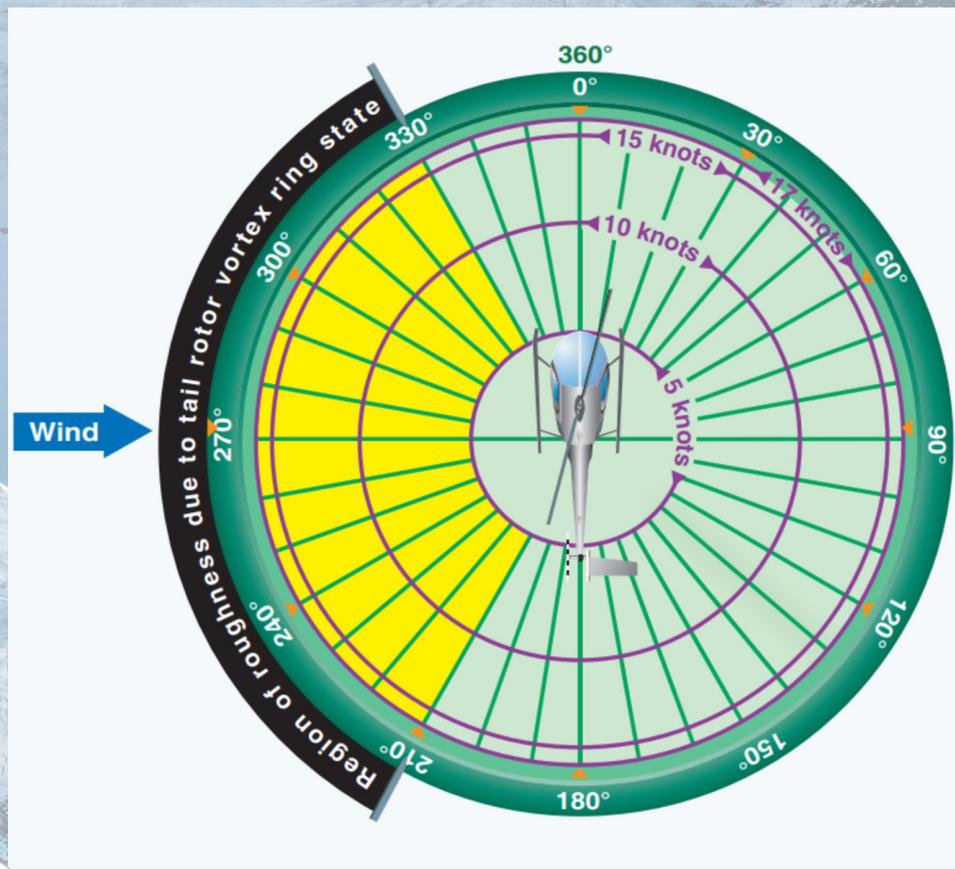
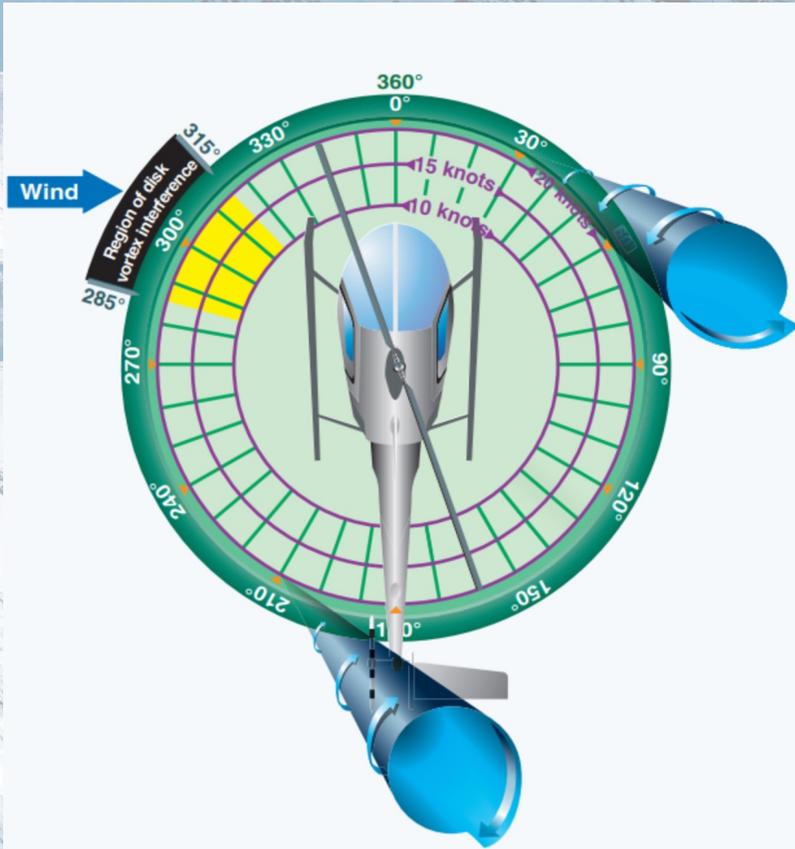
**=> tail rotor control margin = 3%**

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

# UNANTICIPATED YAW

2004

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



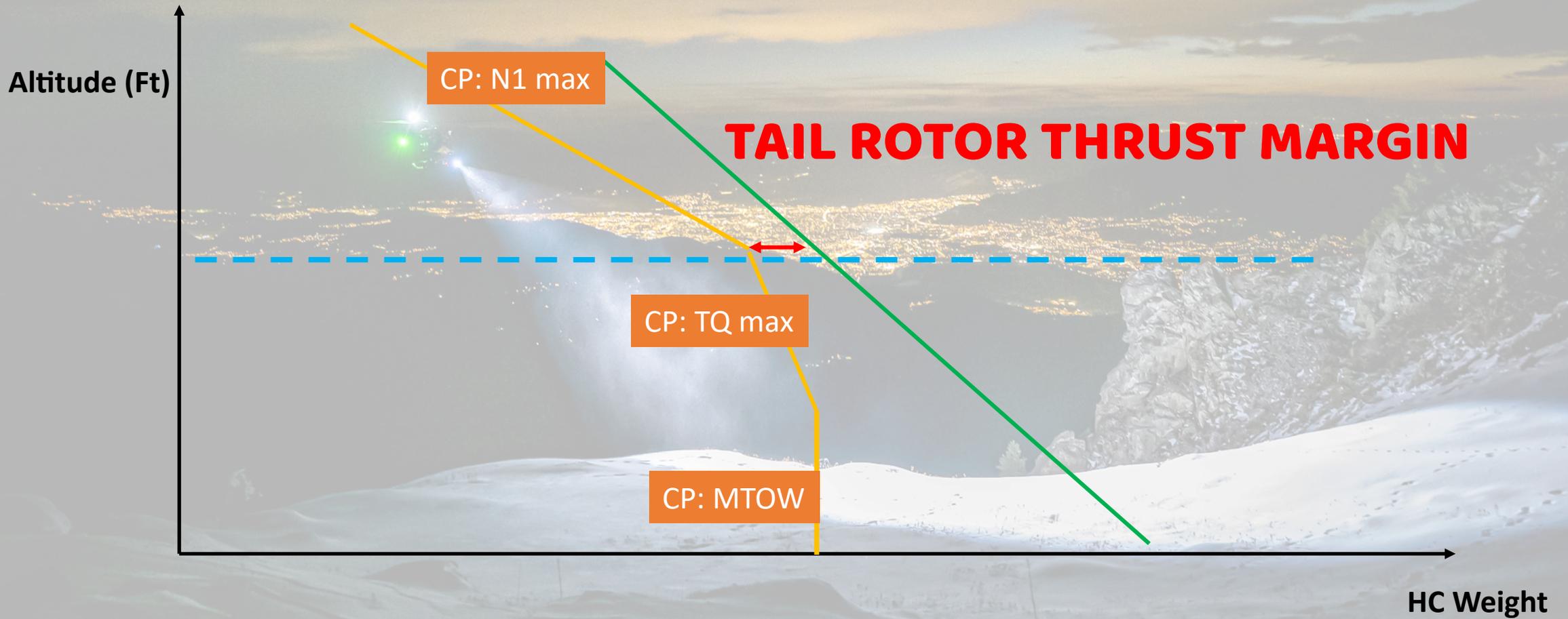
# UNANTICIPATED YAW

2004

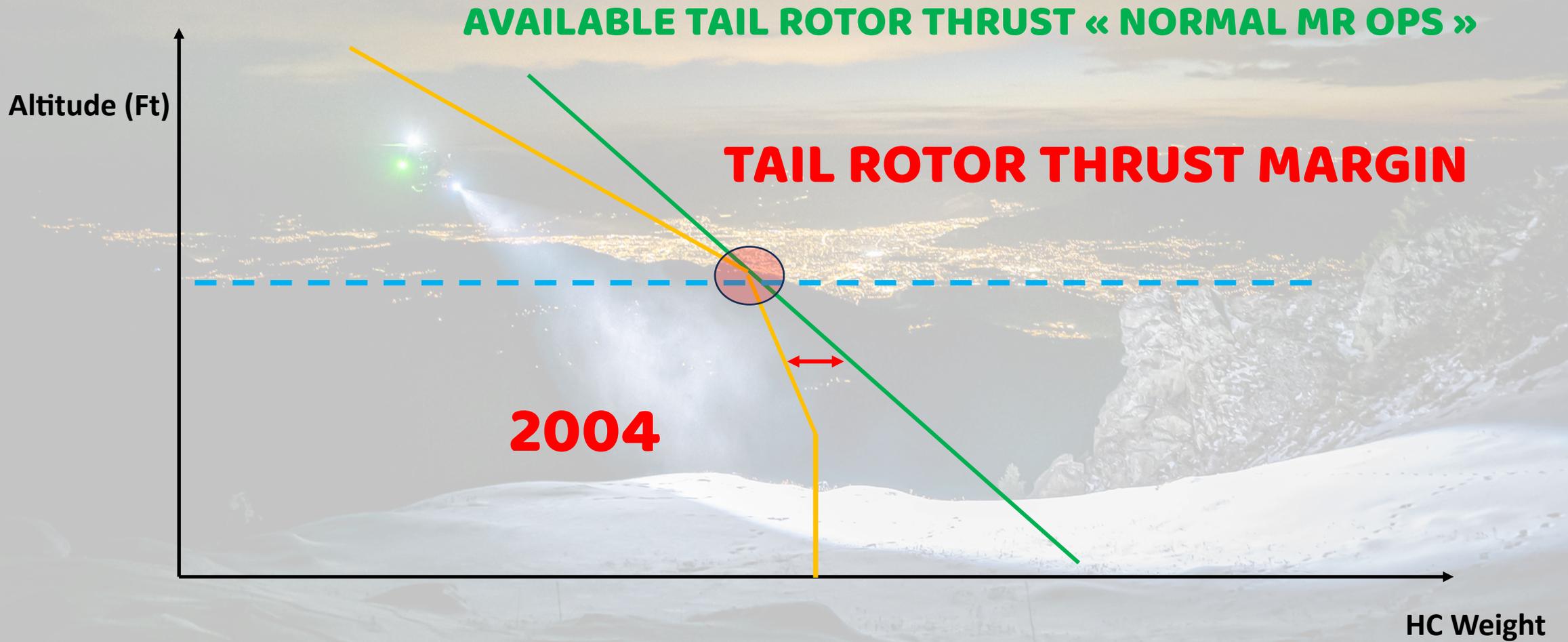
⇒ We were informed by Eurocopter that, during our mountain rescue OPS, the helicopter we were operating :  
« Was more likely to reach a *left pedal limitation* than a *LTE* »

# 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

## SAFETY INFORMATION NOTICE

**SUBJECT: GENERAL**

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

For the attention of	
	

AIRCRAFT CONCERNED	Version(s)	
	Civil	Military
S, 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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and analyzed in relation to OH-58 helicopters by the US Army, who coined veness (LTE)" even though the tail rotor always remained fully serviceable. othing to do with the full loss of tail rotor thrust.

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.



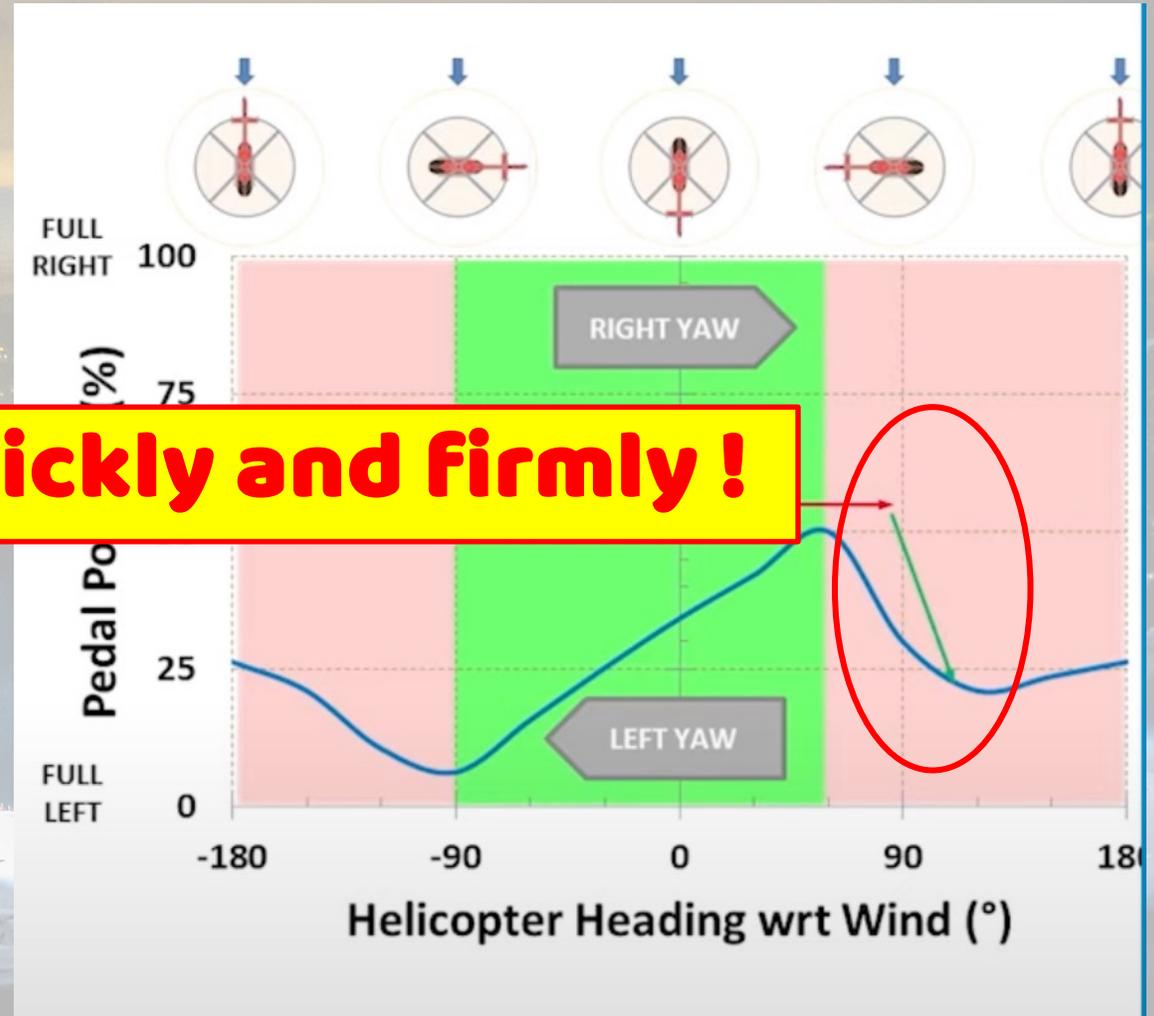
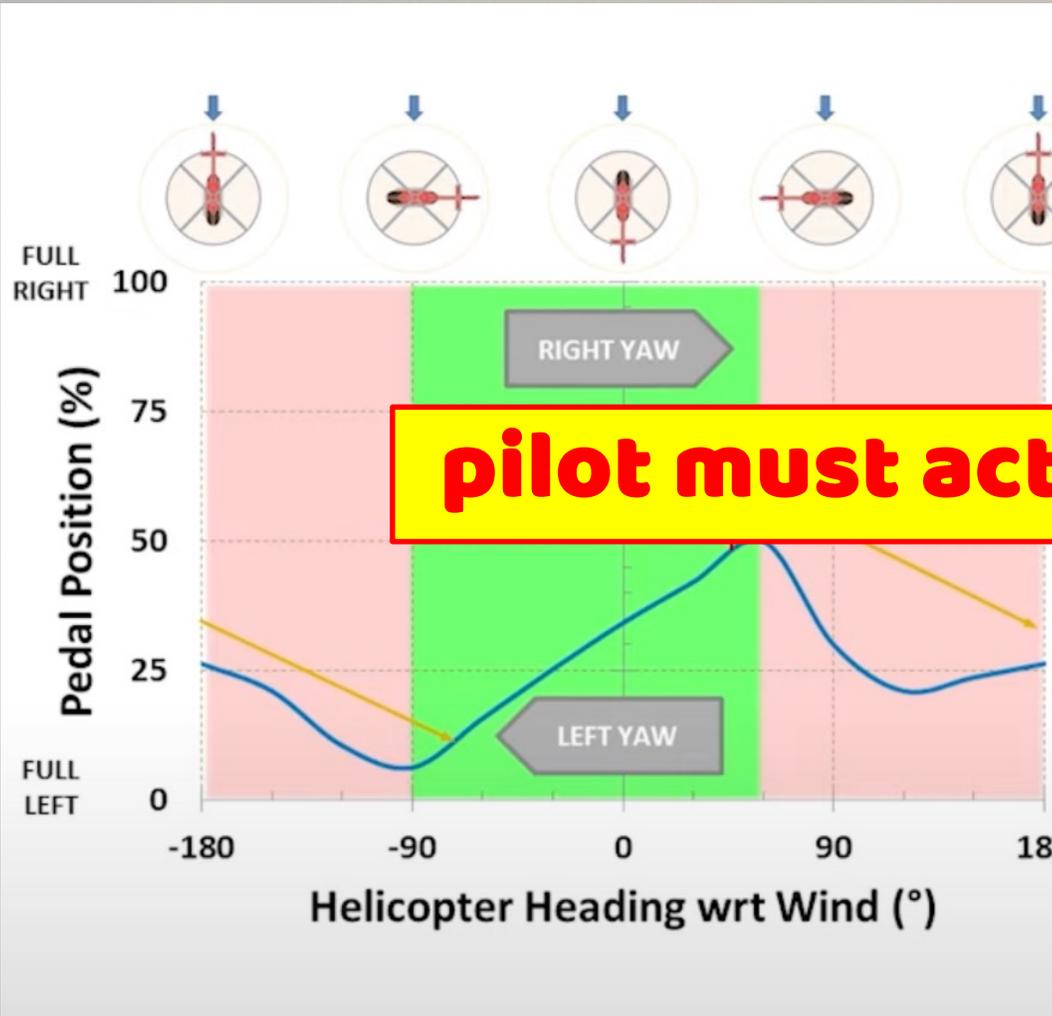
**2019**

**« The myth of loosing tail rotor effectiveness »**

<https://youtu.be/MGC0jeDUD9Q>



# UNANTICIPATED YAW





**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 »**

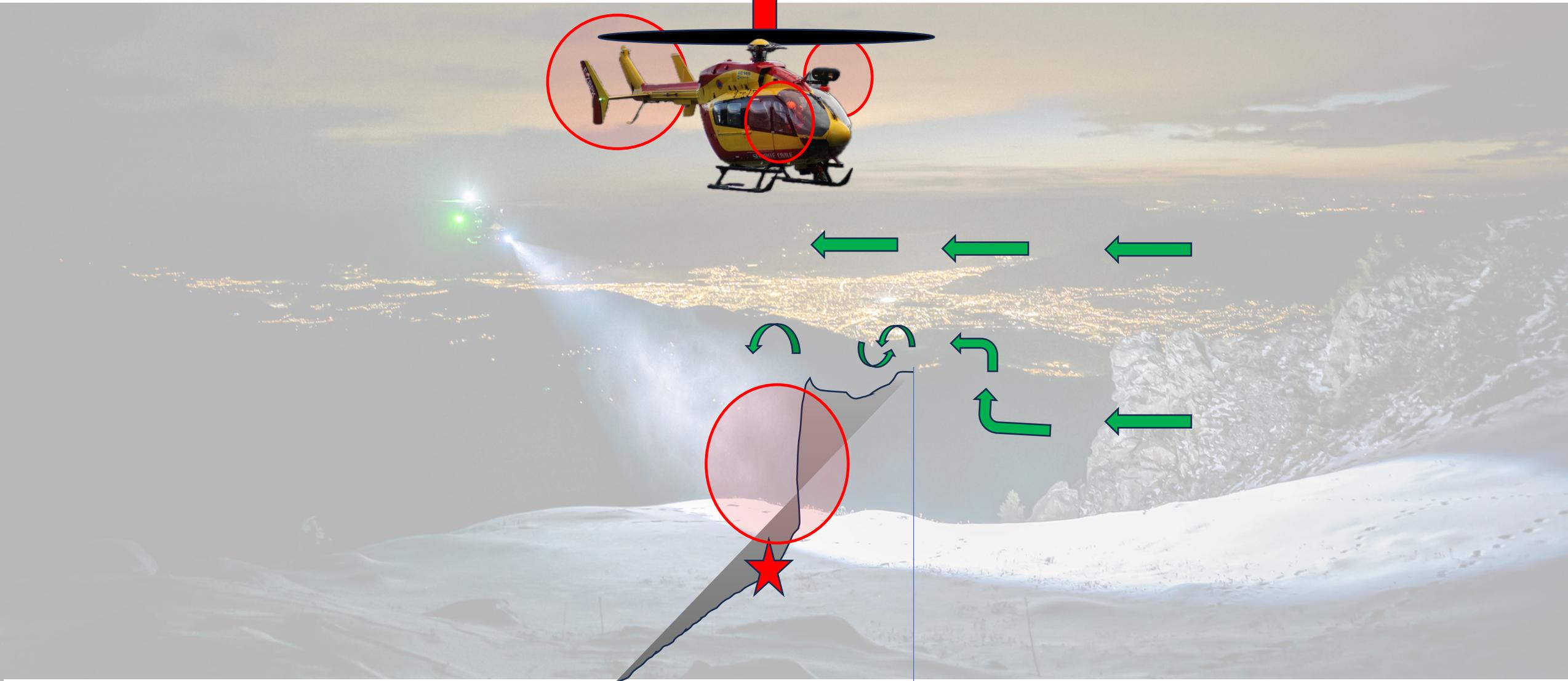
### UNANTICIPATED YAW RISK

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

# UNANTICIPATED YAW



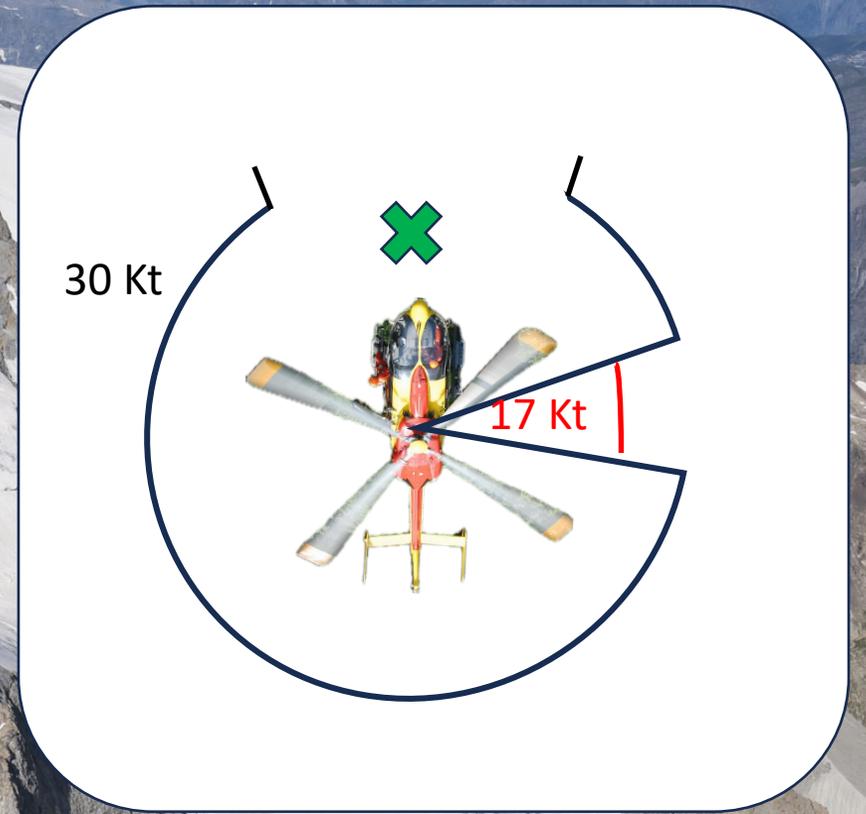
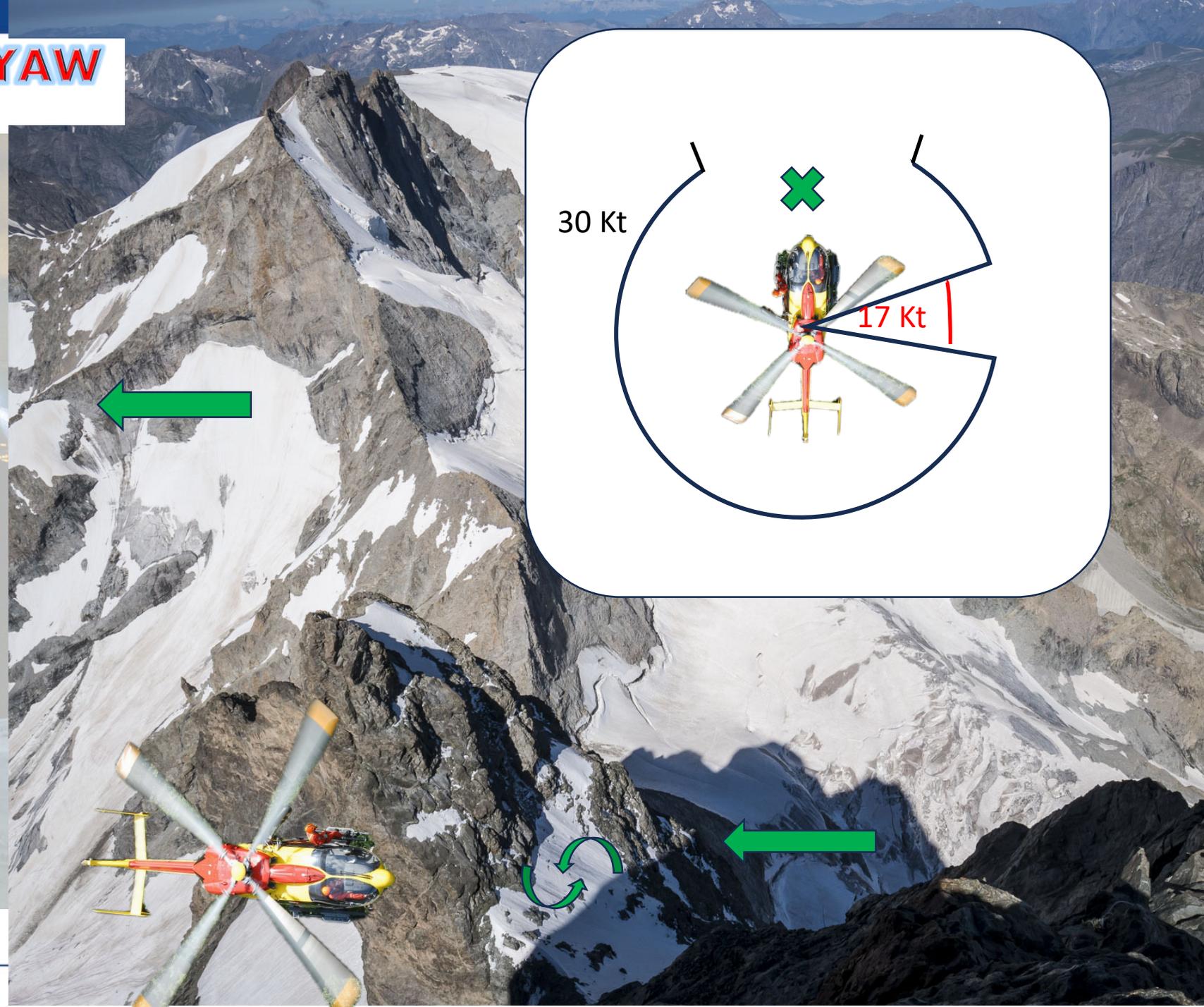
# UNANTICIPATED YAW



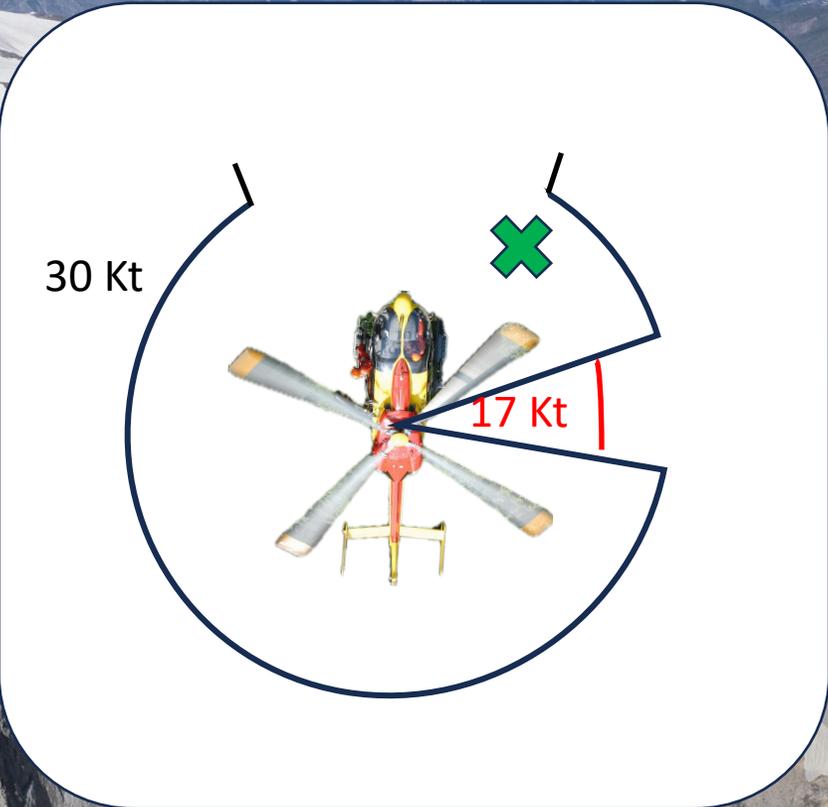
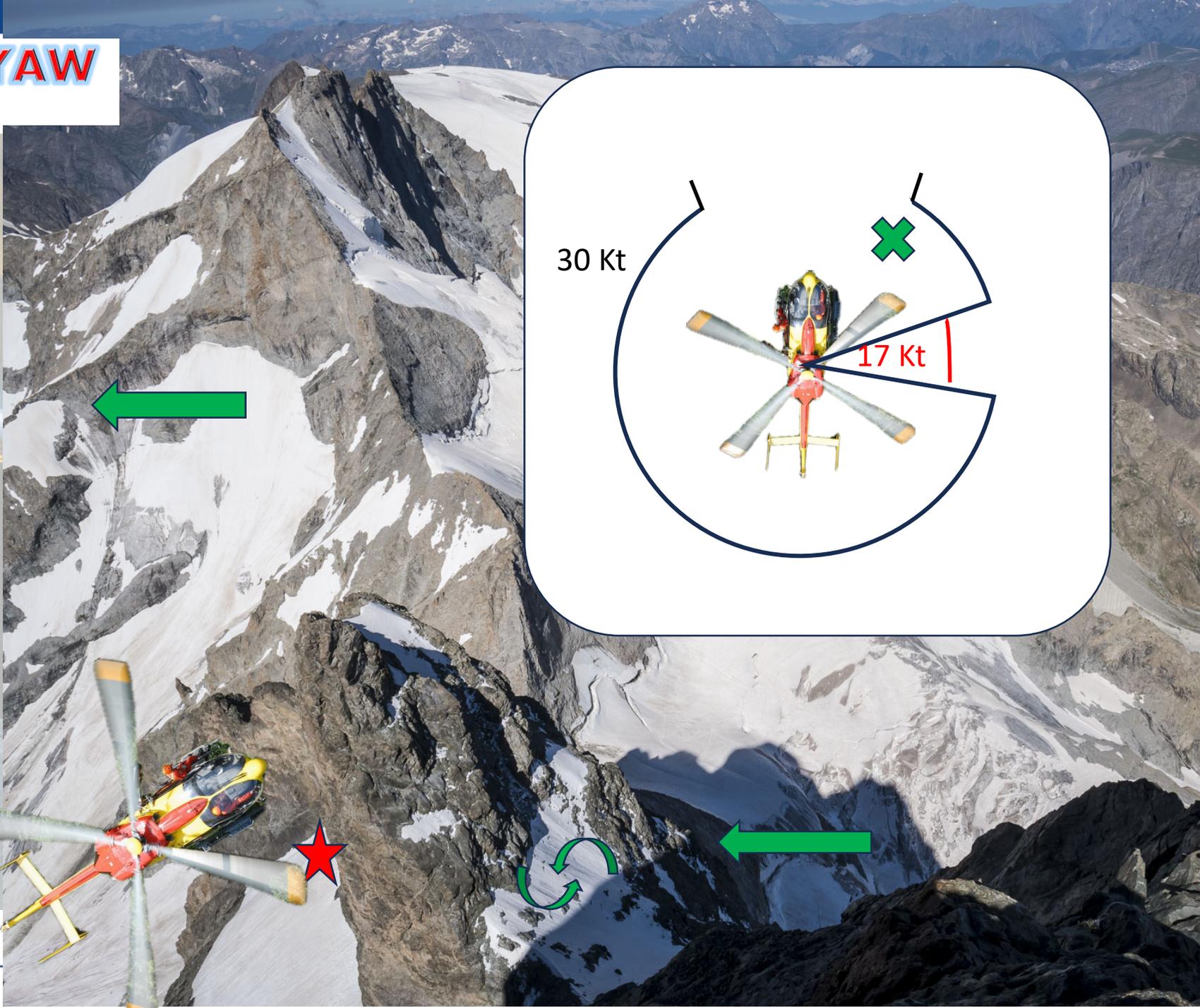
# UNANTICIPATED YAW

## HOVERING

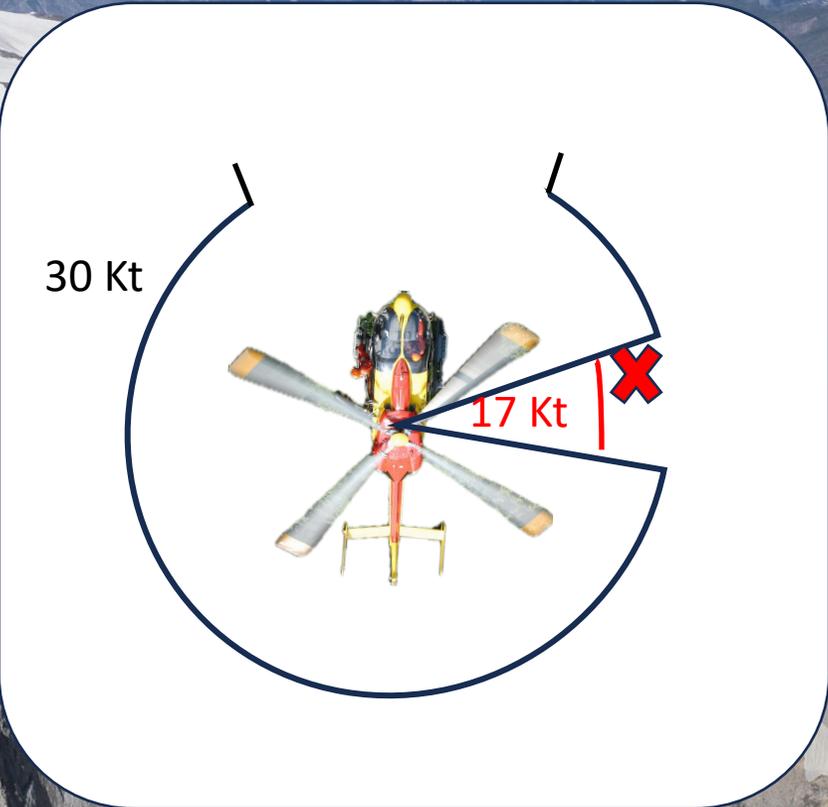
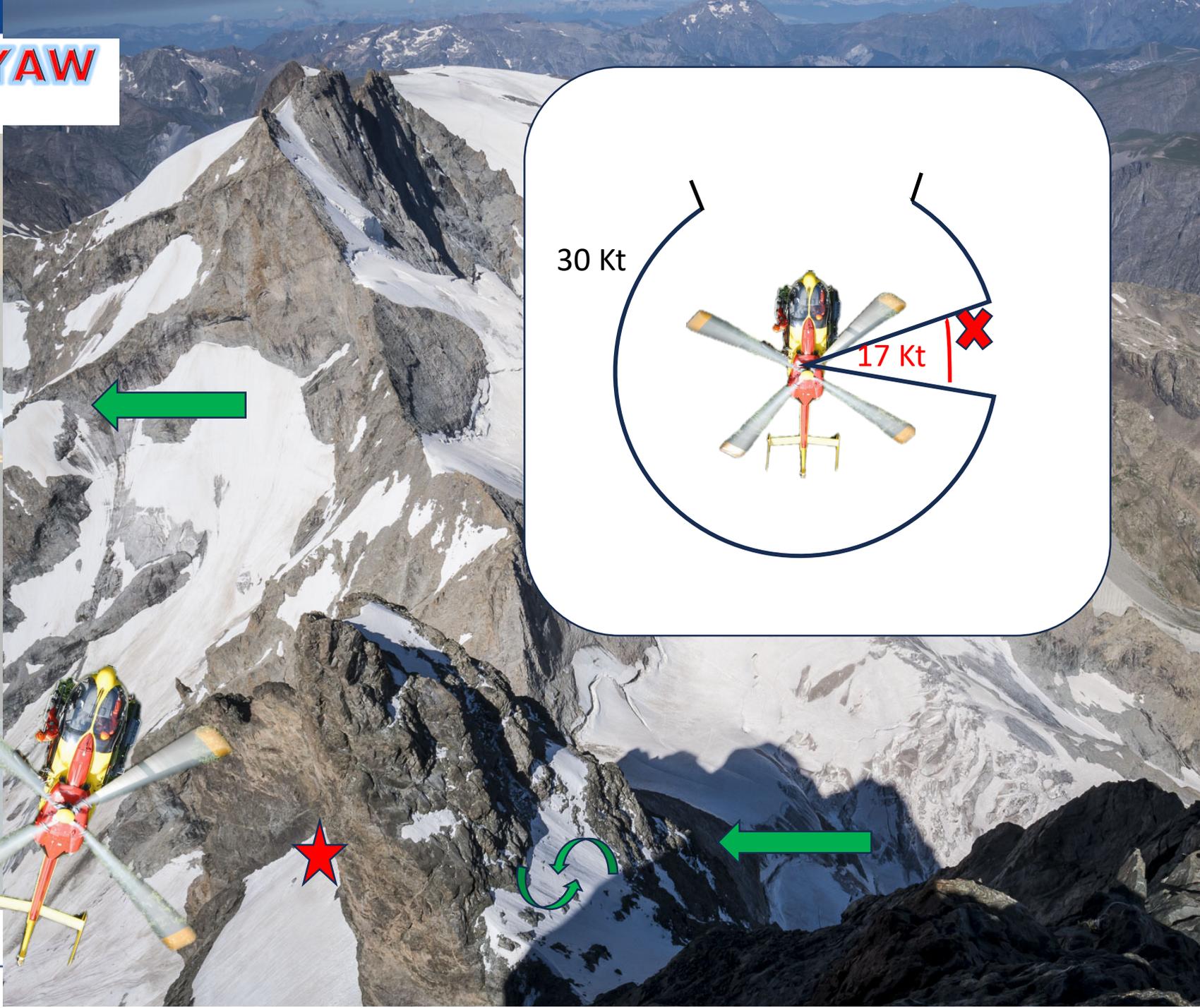
## VALIDATION « HOVERING »



# UNANTICIPATED YAW

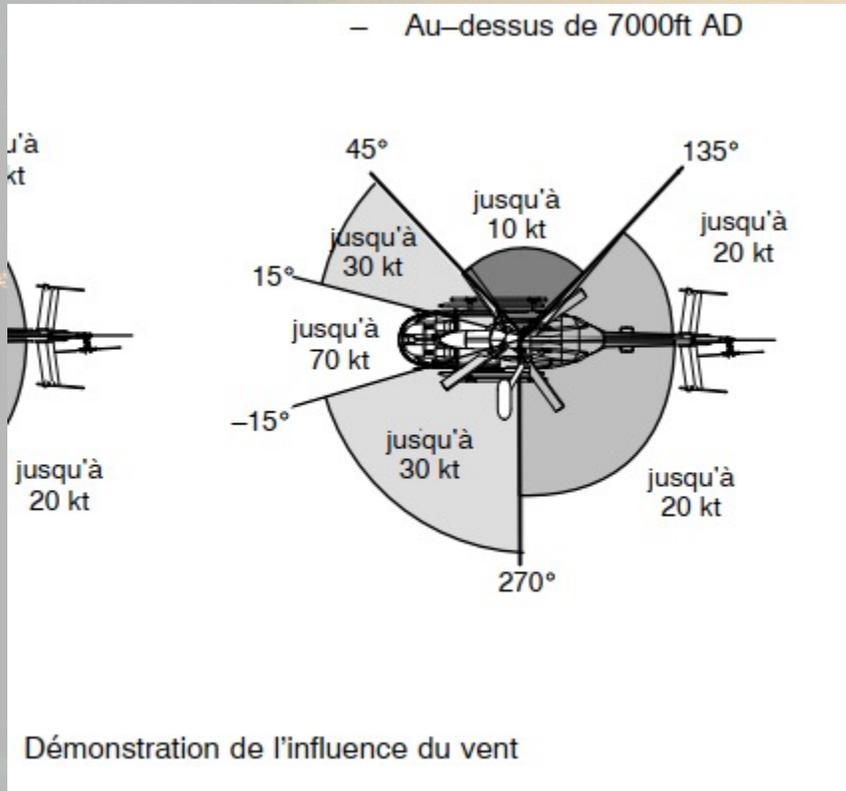


# UNANTICIPATED YAW



# UNANTICIPATED YAW

## HIGH ALTITUDE HOISTING BK 117 C2



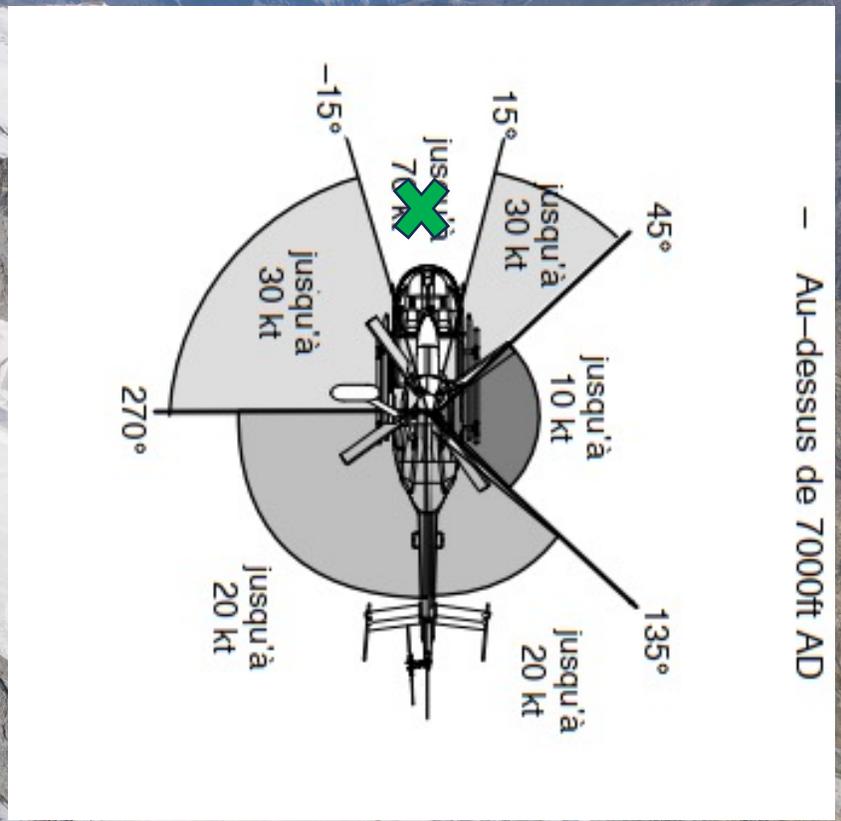
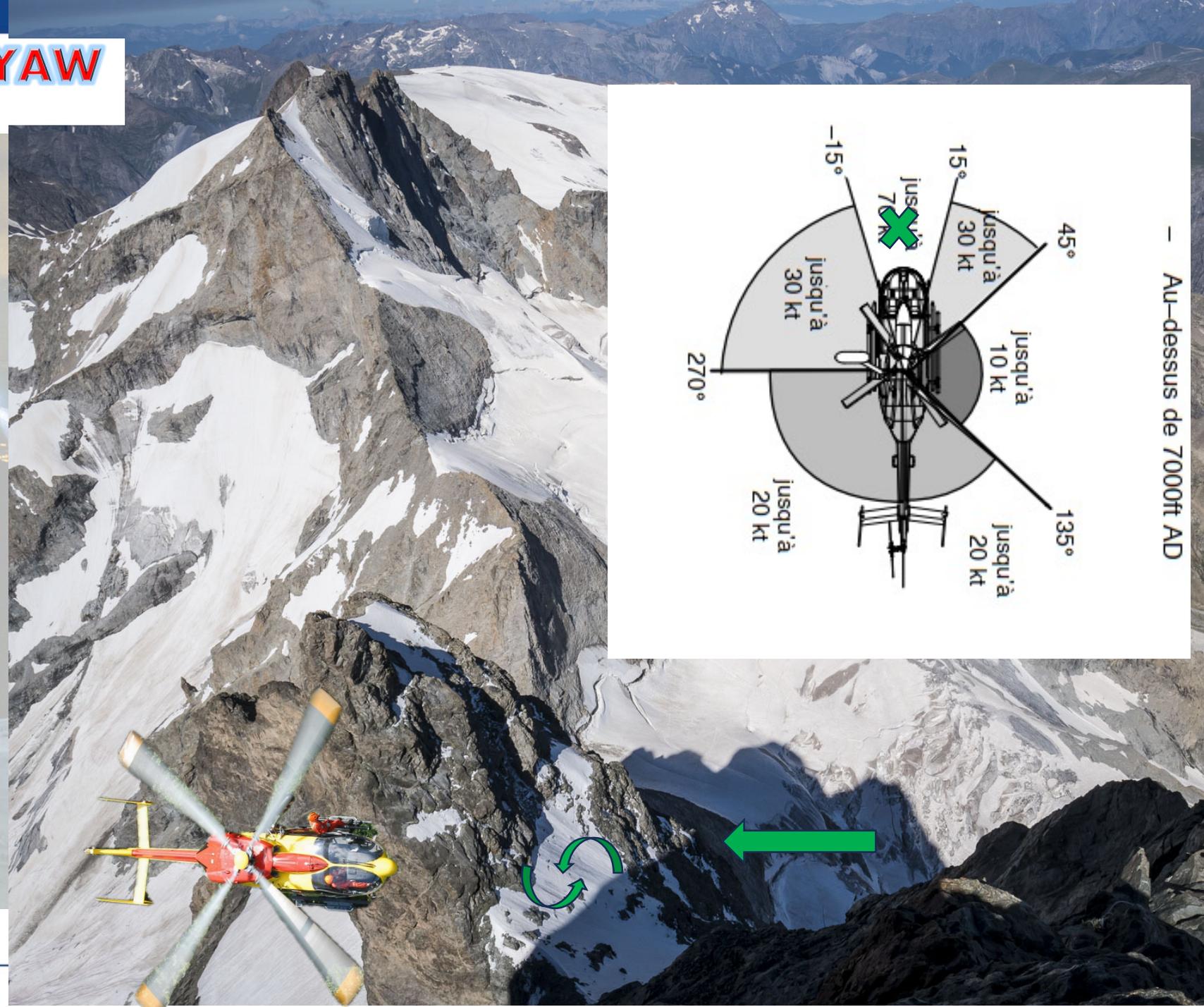
⇒ LH Hoist deployed  
⇒ Maximum load

**10 Kt = 5 + 5 !**

# UNANTICIPATED YAW

## Vertical lift off

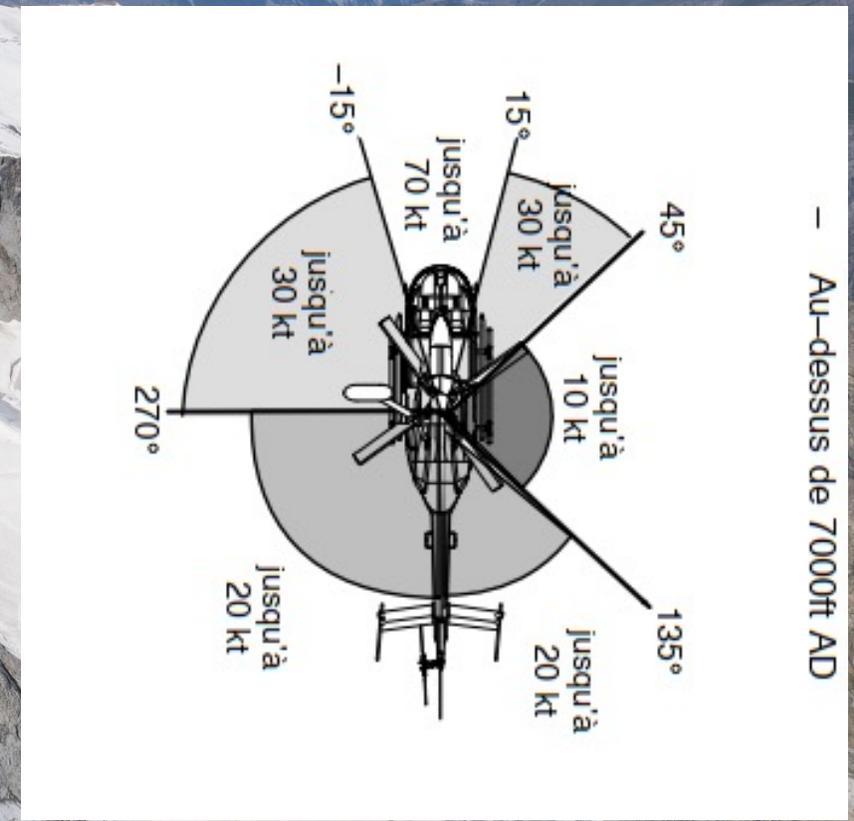
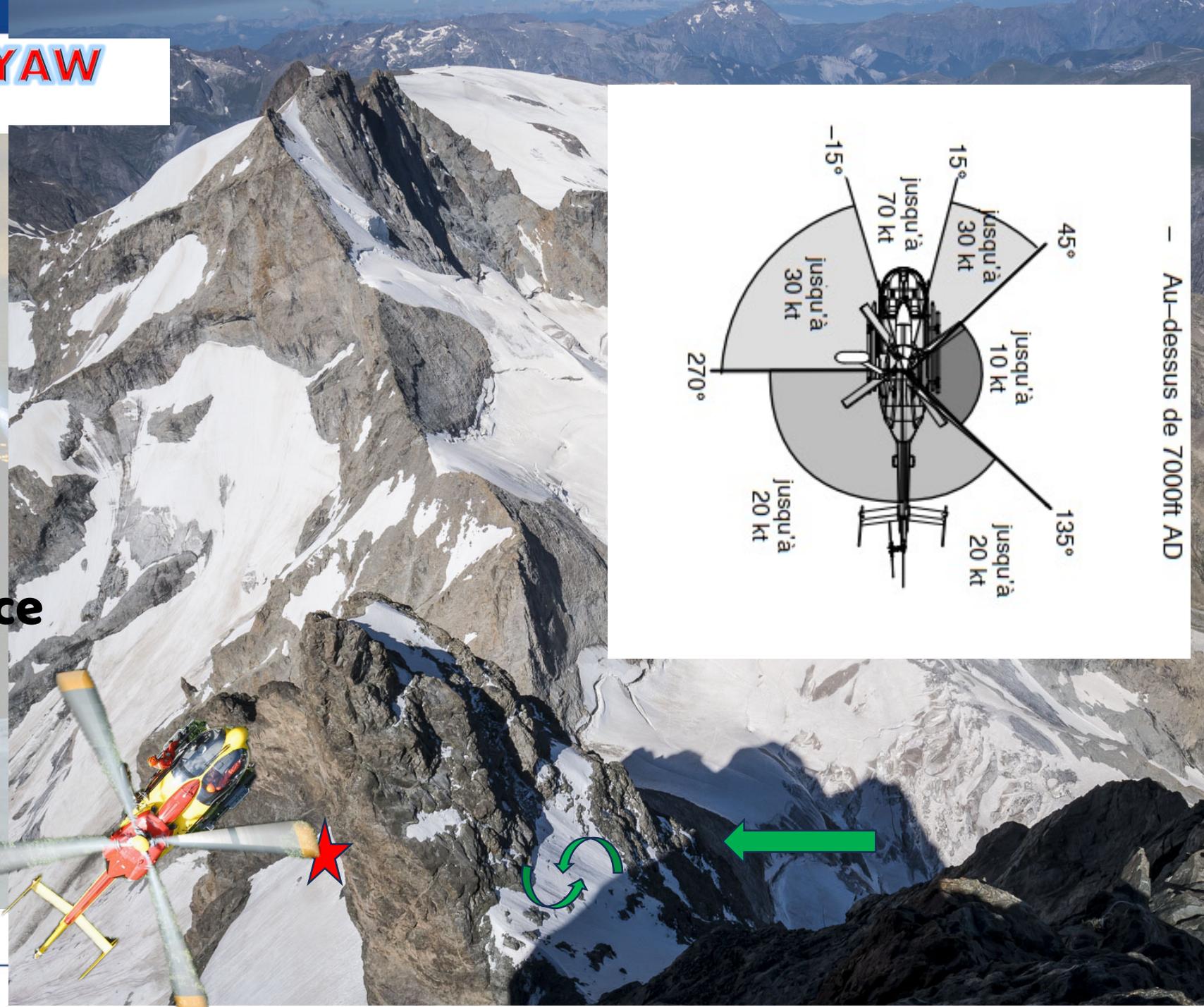
- ⇒ More COLL Pitch
- available ?
- yaw control
- references
- rescuers' safety



# 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**

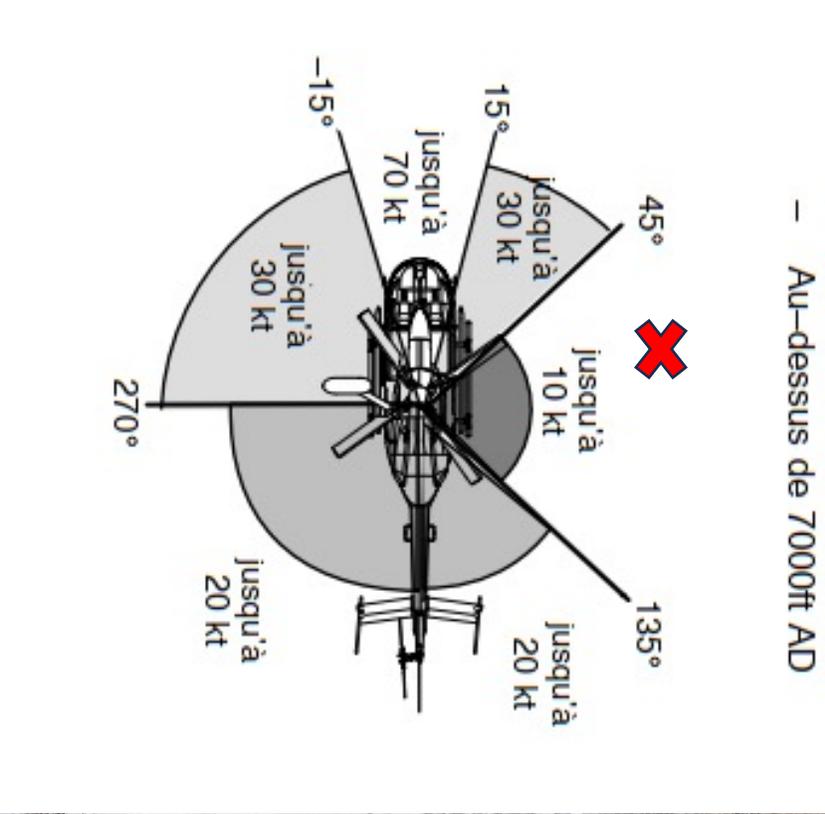
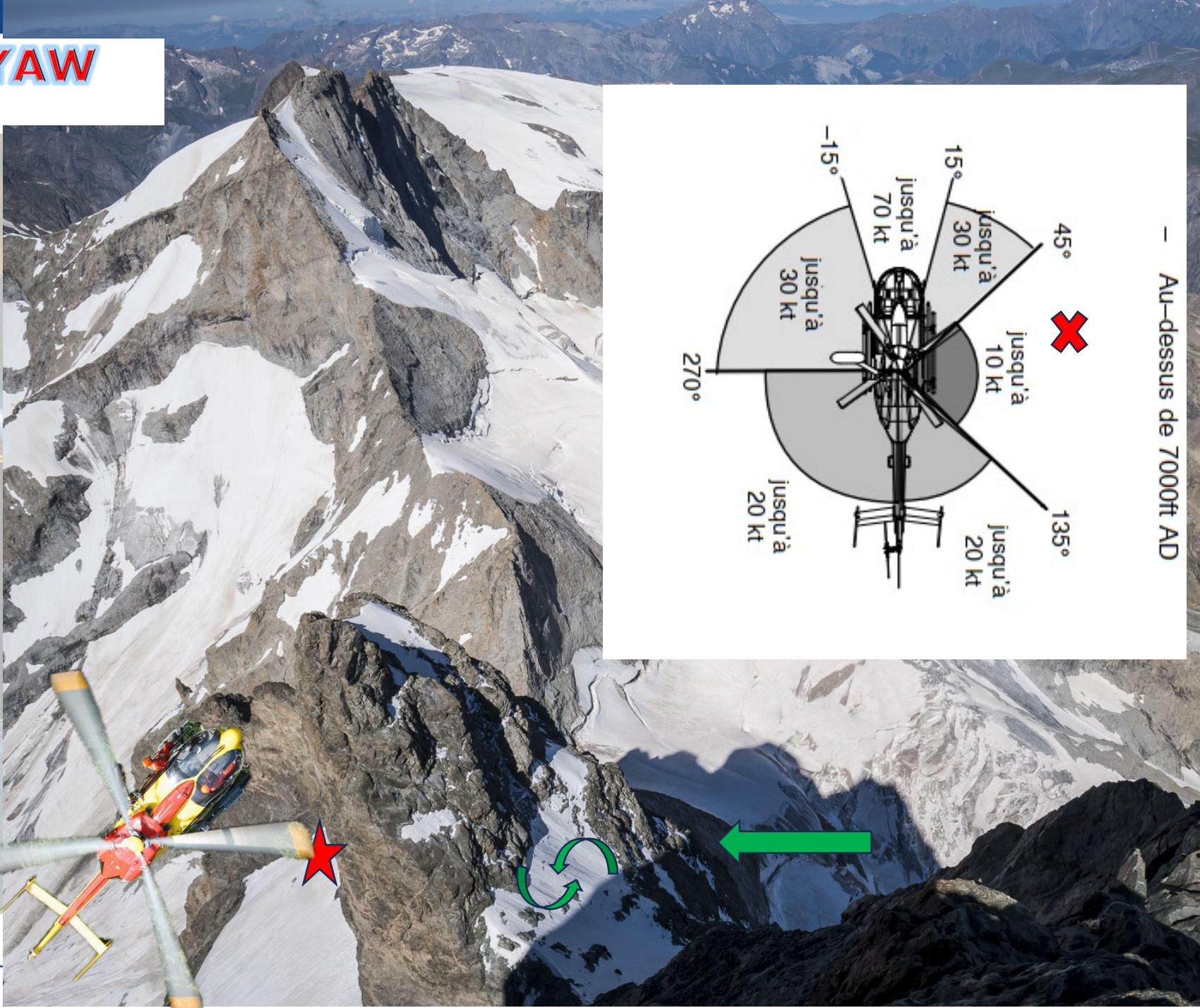
- Flight controls entries
- Hoist load - safe trajectory

**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:

- Hoist Lift off:

**NORMAL SITUATION**

The pilot modifies and increases relative wind

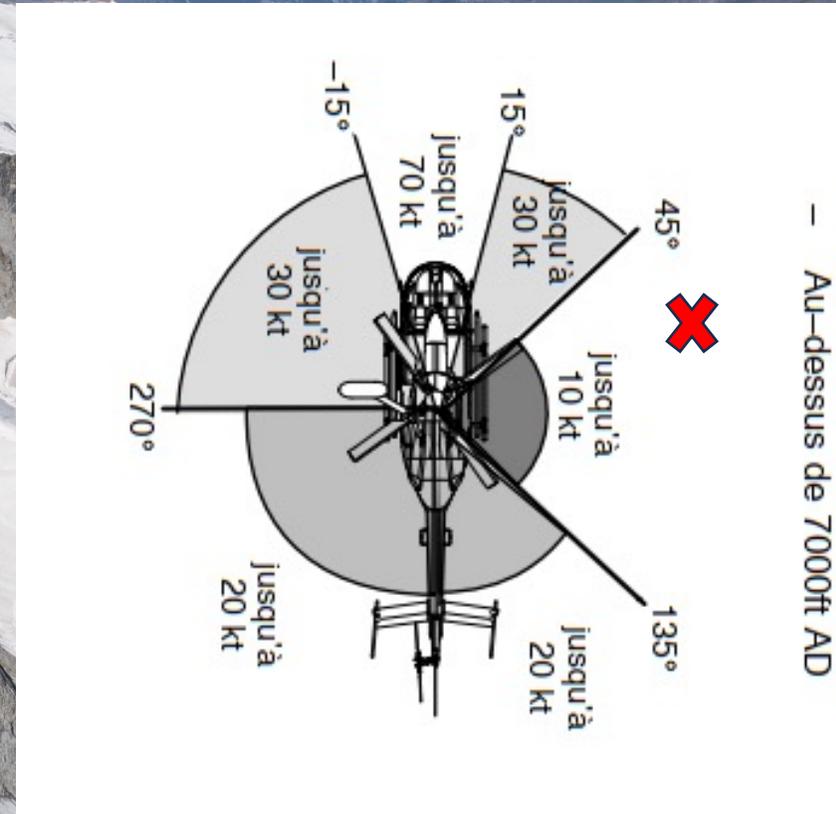
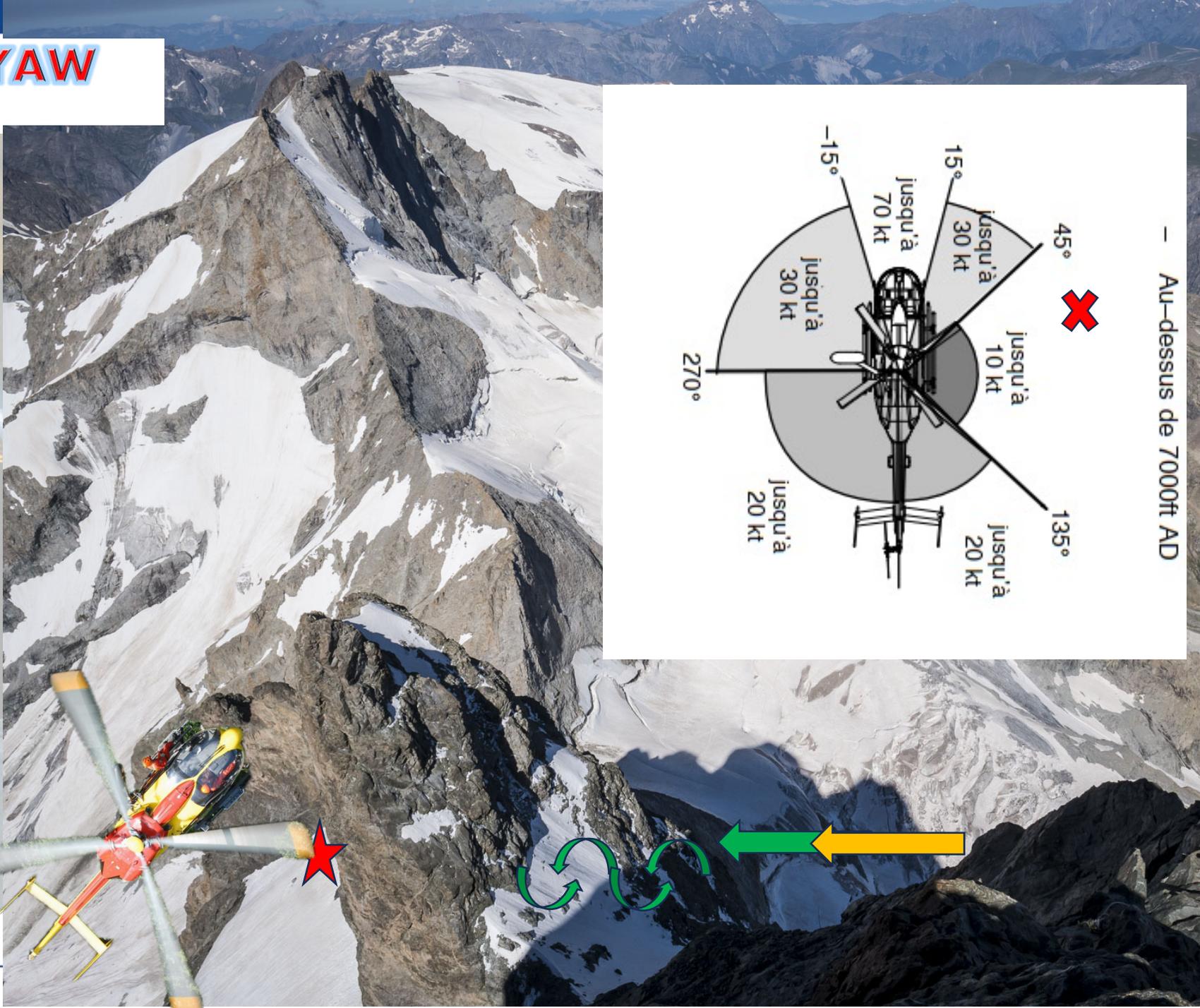


- Relative wind can be modified by « Mother nature »!



**We can be thrown beyond limitations !**

# UNANTICIPATED YAW



# UNANTICIPATED YAW

## MOUNTAIN RESCUE OPERATIONS UNANTICIPATED 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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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

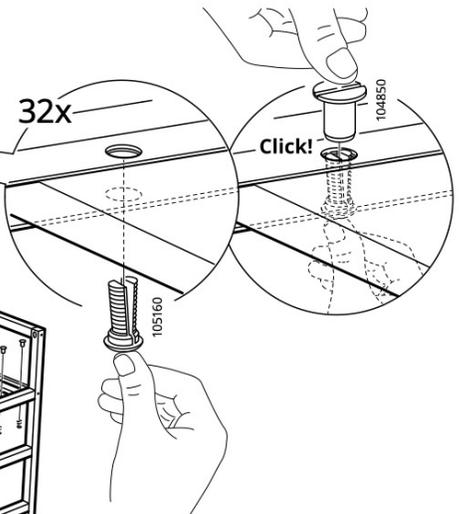
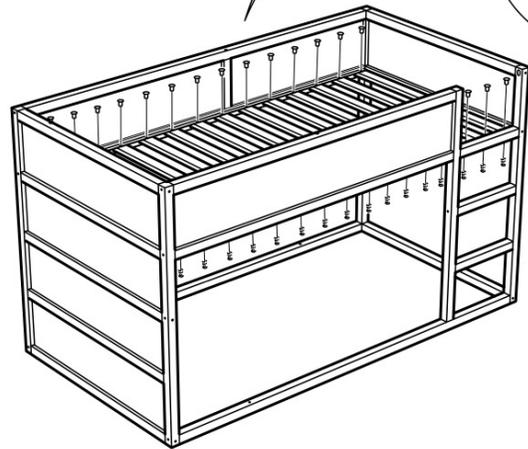
## MOUNTAIN RESCUE - HOW TO DEAL WITH UNANTICIPATED YAW ?

**TRAINING**

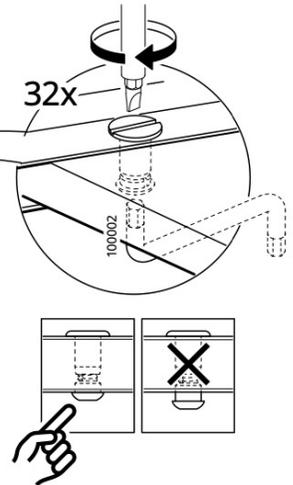
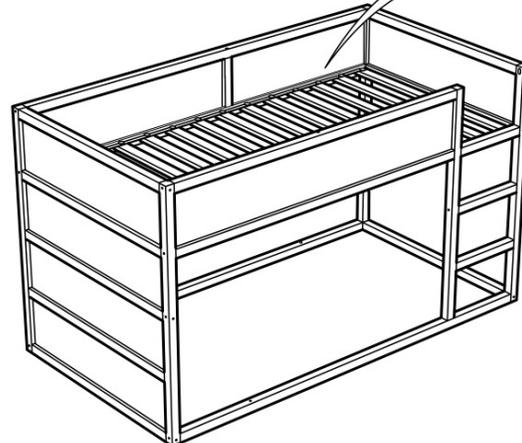
**SOPs**

**+ SPECIAL SKILLS**

26



**SOPs**



ATT

chal  
betw

S

sbta



**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 life !**



**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 !*





# 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**



## 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

The ICAIR logo features a green mountain peak with a white cross on top, positioned above the letters 'ICAR' in a bold, black, sans-serif font. Below the logo, the full name 'International Commission for Alpine Rescue' is written in a smaller, black, sans-serif font. The entire logo and text are enclosed in a red rectangular border.

**THANK YOU !**

