Wind Turbine

Hazards and Rescue Operations

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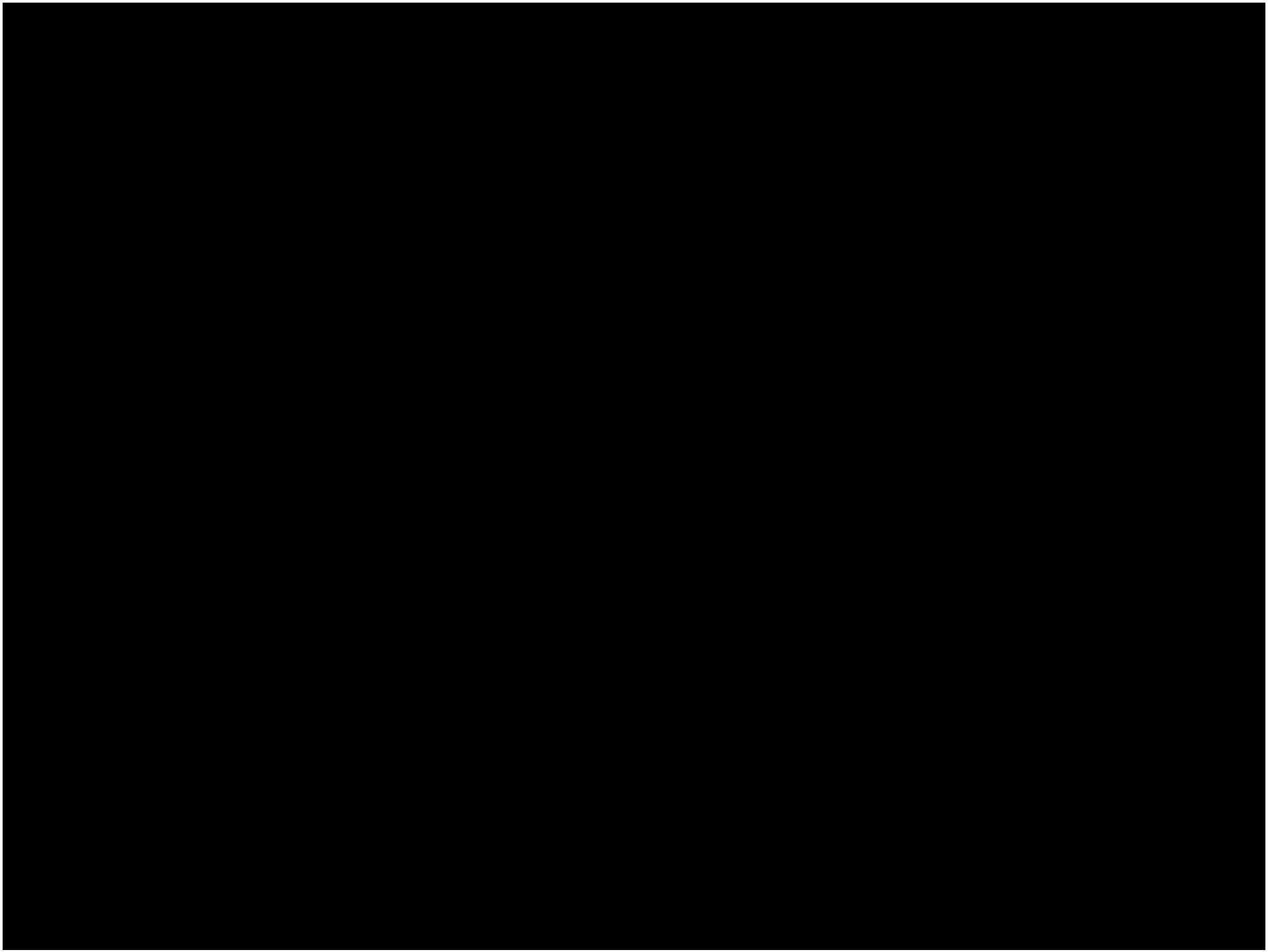
Charley Shimanski

ICAR Joint AIR-TER Commissions
October 2018 – Chamonix, France



Wind Turbine Hazards and Rescue Operations

PART 1

The Wind Turbine Industry

PART 2

Terrestrial Rescue

PART 3

Helicopter Rescue

Wind Turbine Hazards and Rescue Operations

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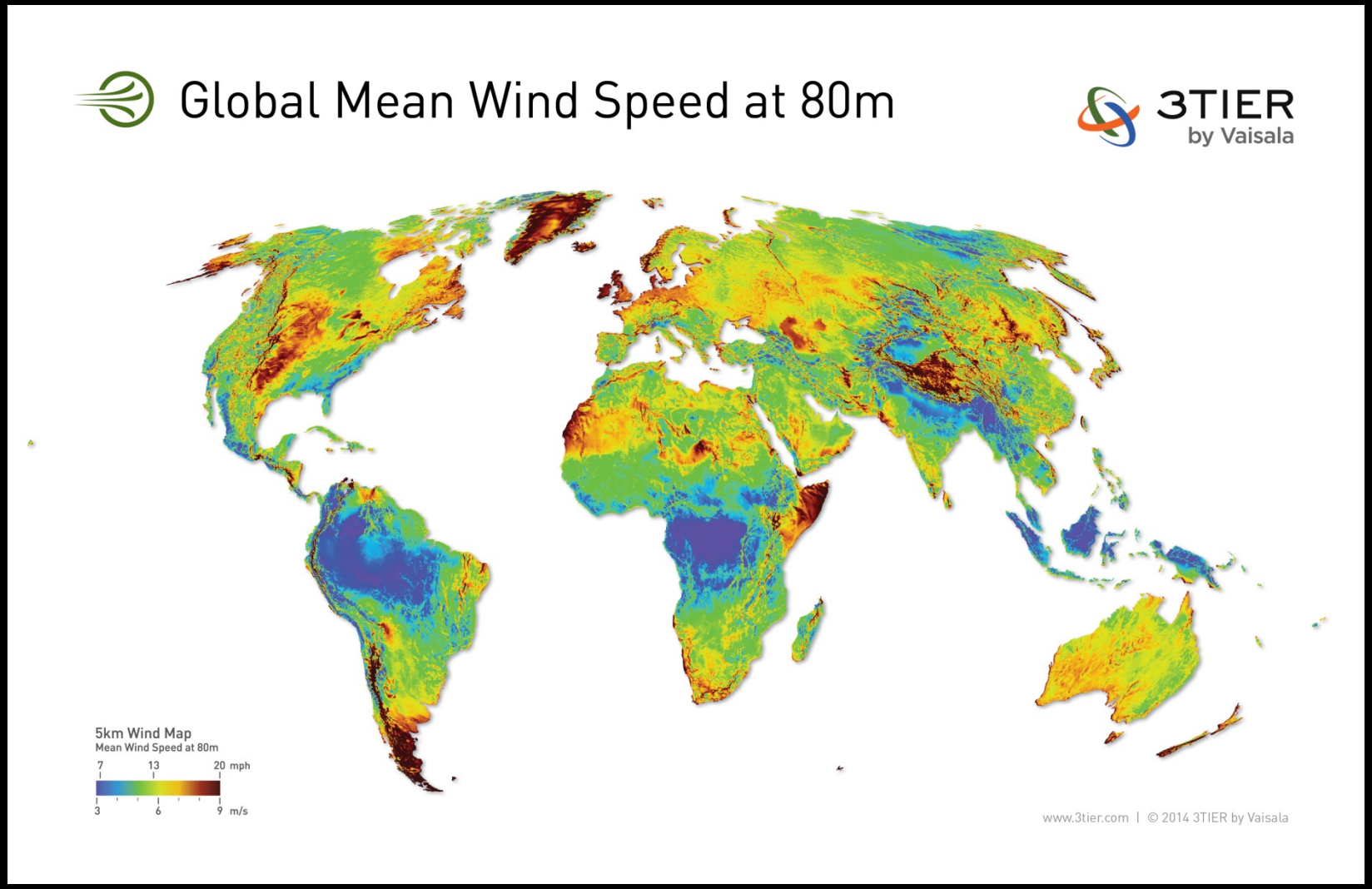
Wind Turbine Height

- Often rising over 150 meters (500 feet)
- Tallest is 220 meters (722 feet)
- Future turbines will be even taller.

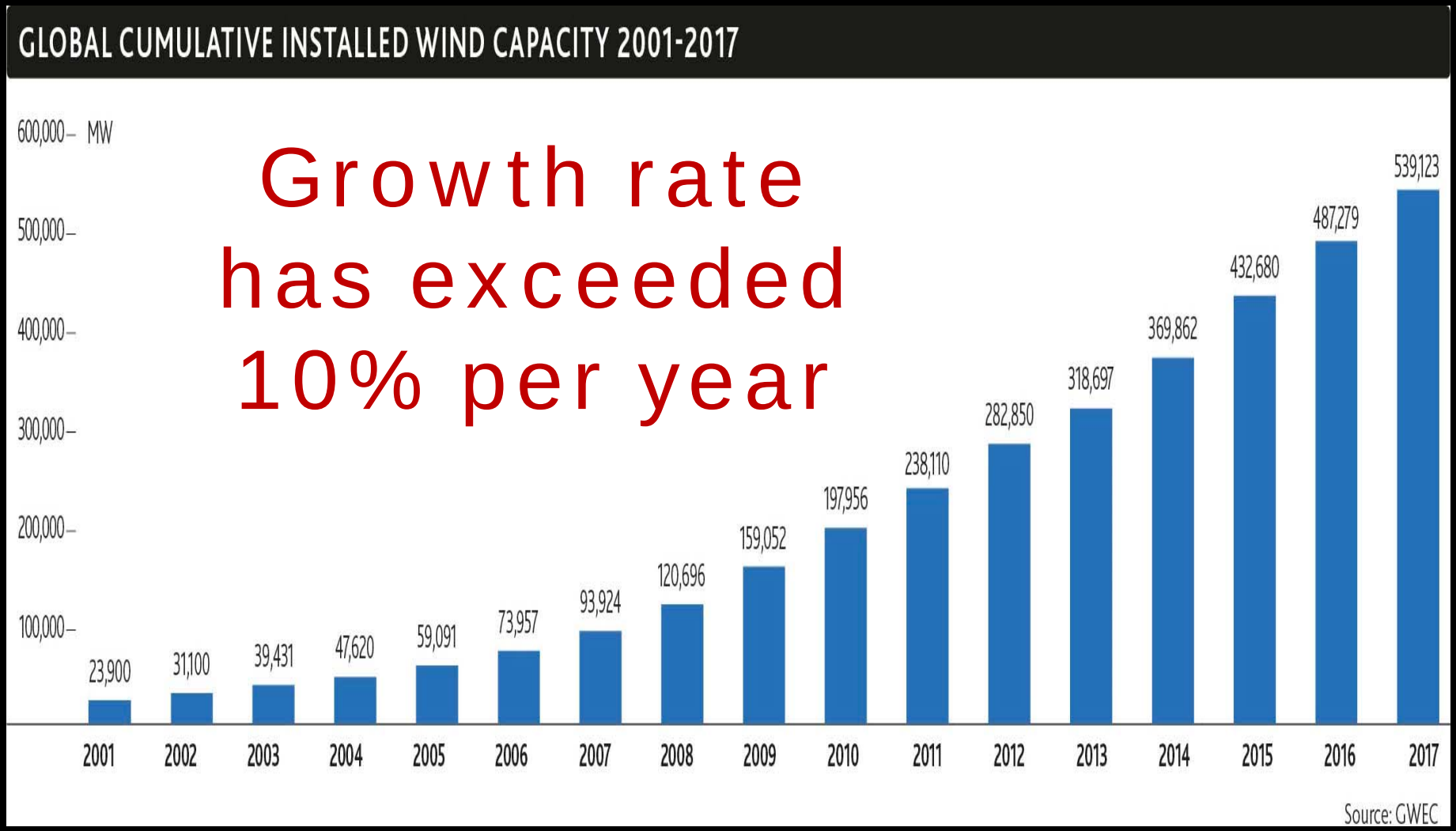
The Wind Power Industry

- Wind power is present in 90+ countries.
- Germany, UK, France, Belgium, Ireland, India all set new records
- China is the global leader

Industry Growth

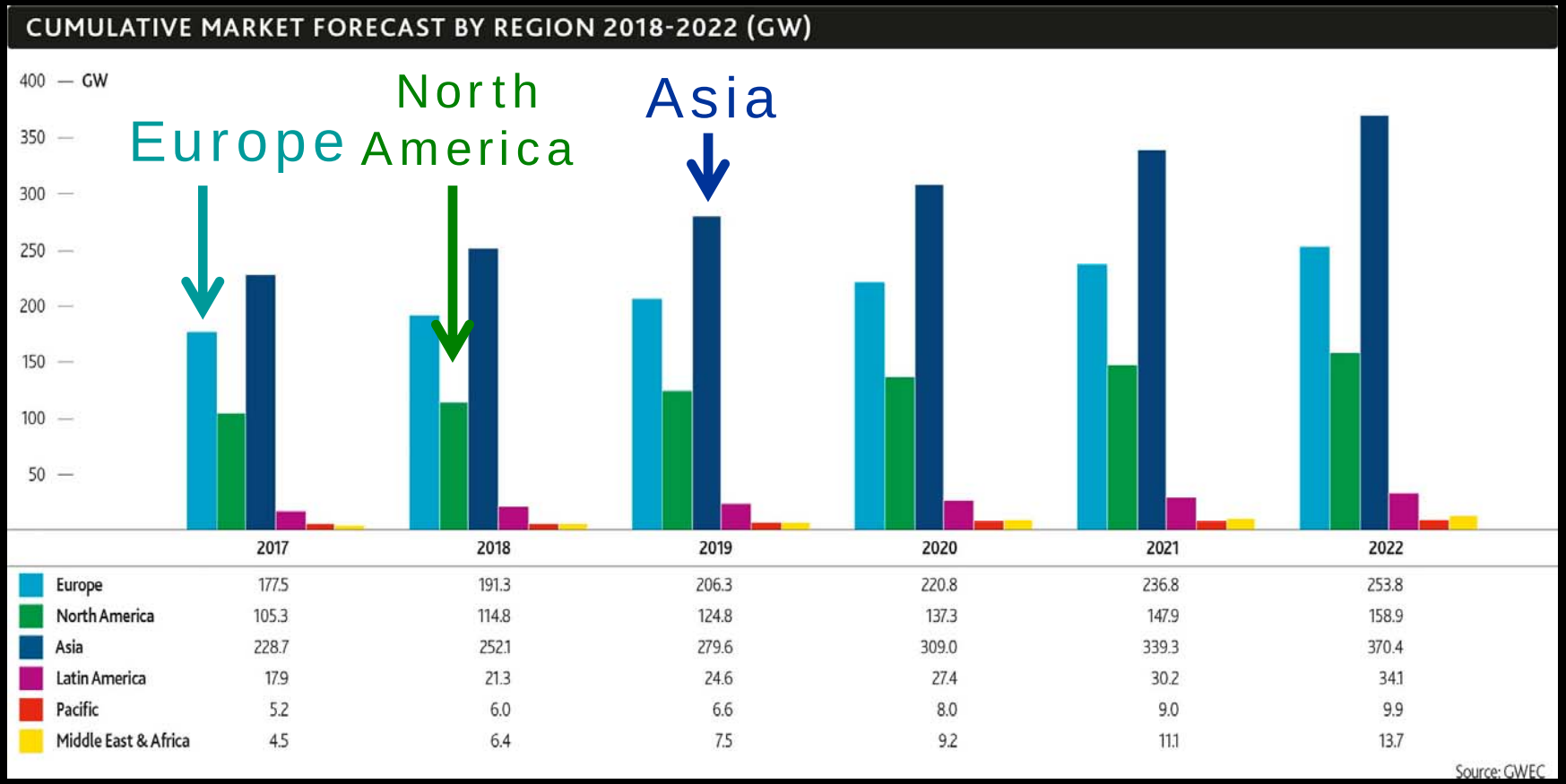


Industry Growth



Industry Growth

Europe +43%, North America +55%, Asia +62%,



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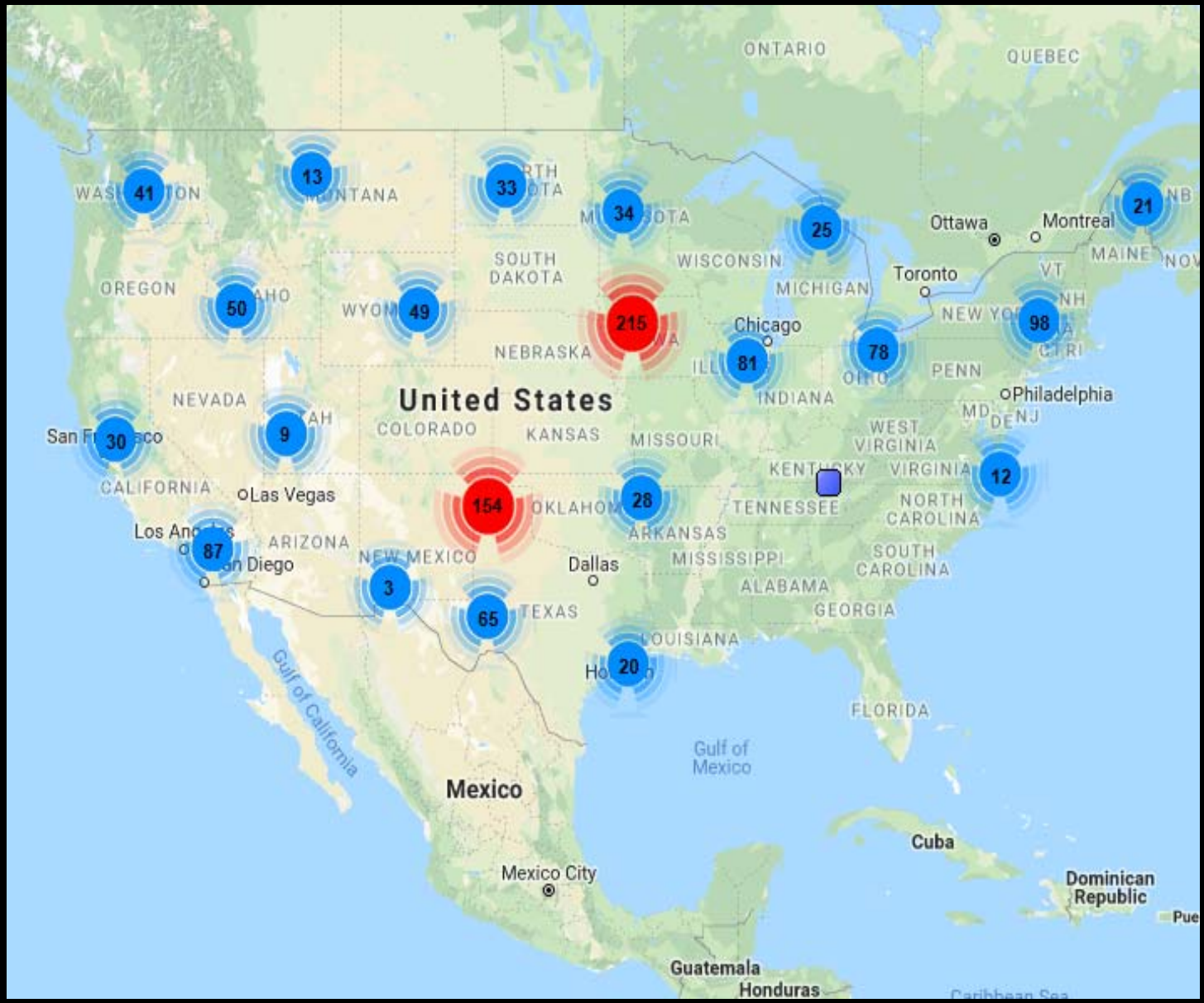
Europe	177.5	191.3	206.3	220.8	236.8	253.8
North America	105.3	114.8	124.8	137.3	147.9	158.9
Asia	228.7	252.1	279.6	309.0	339.3	370.4
Latin America	17.9	21.3	24.6	27.4	30.2	34.1
Pacific	5.2	6.0	6.6	8.0	9.0	9.9
Middle East & Africa	4.5	6.4	7.5	9.2	11.1	13.7

Source: GWEC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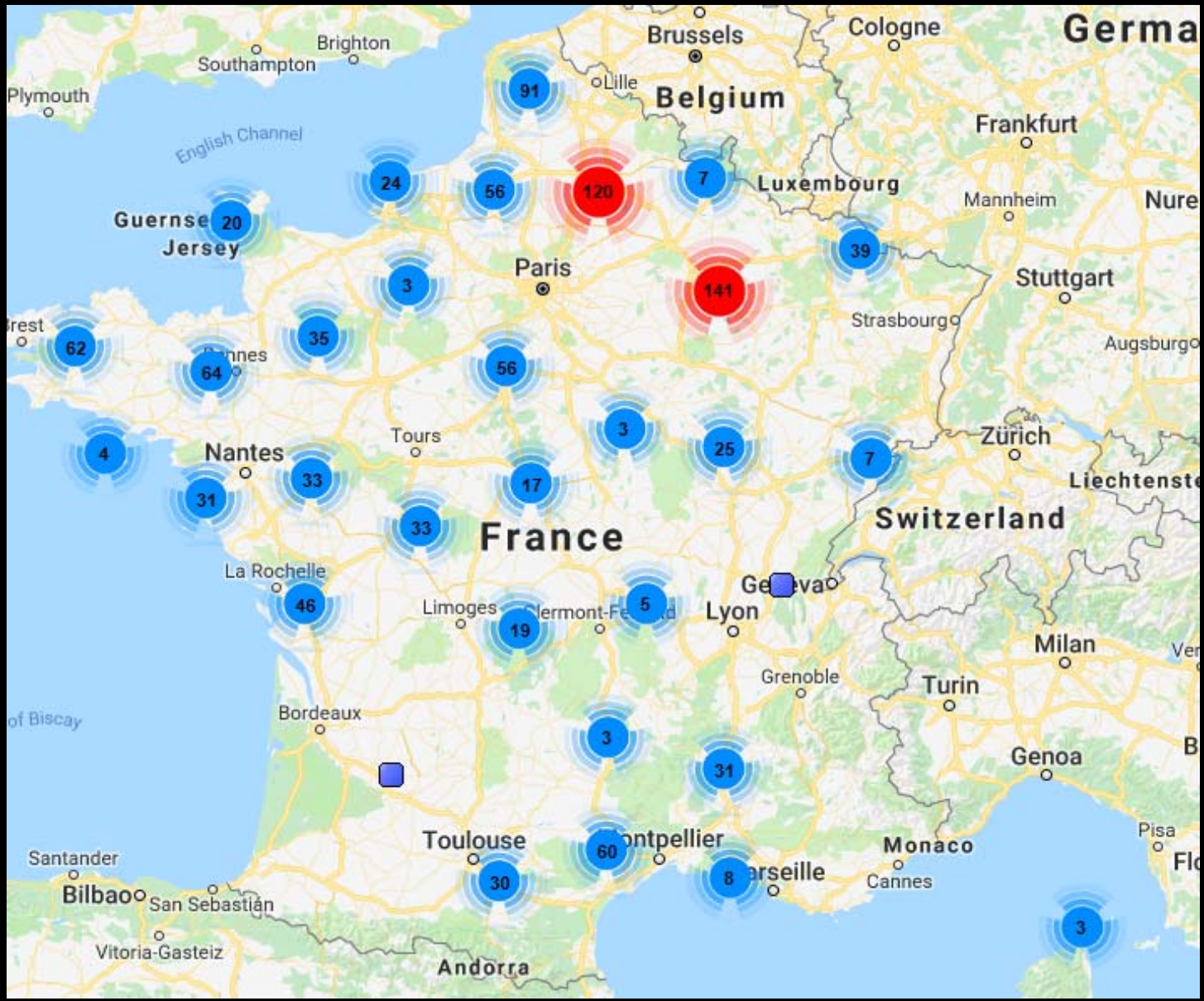
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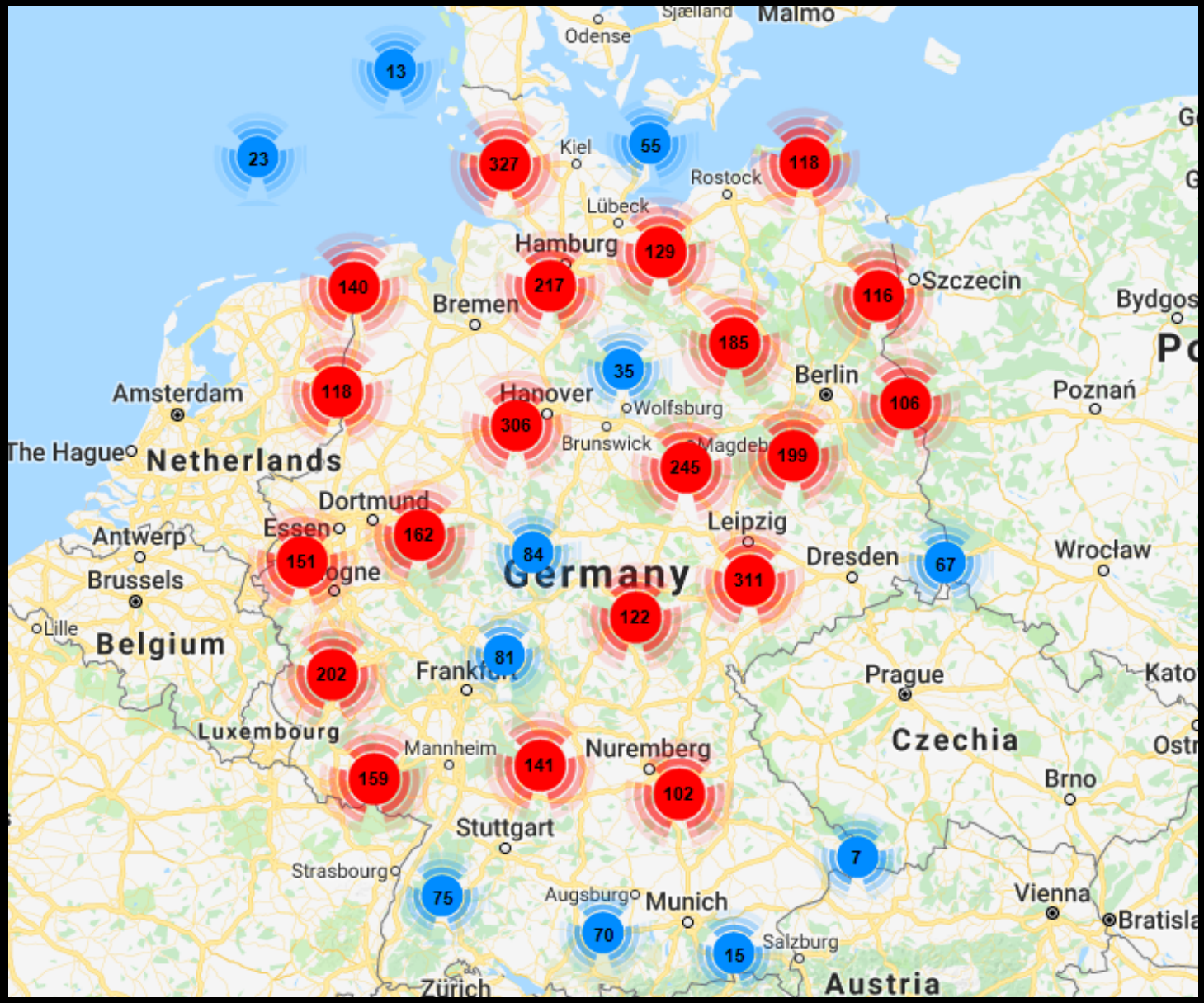
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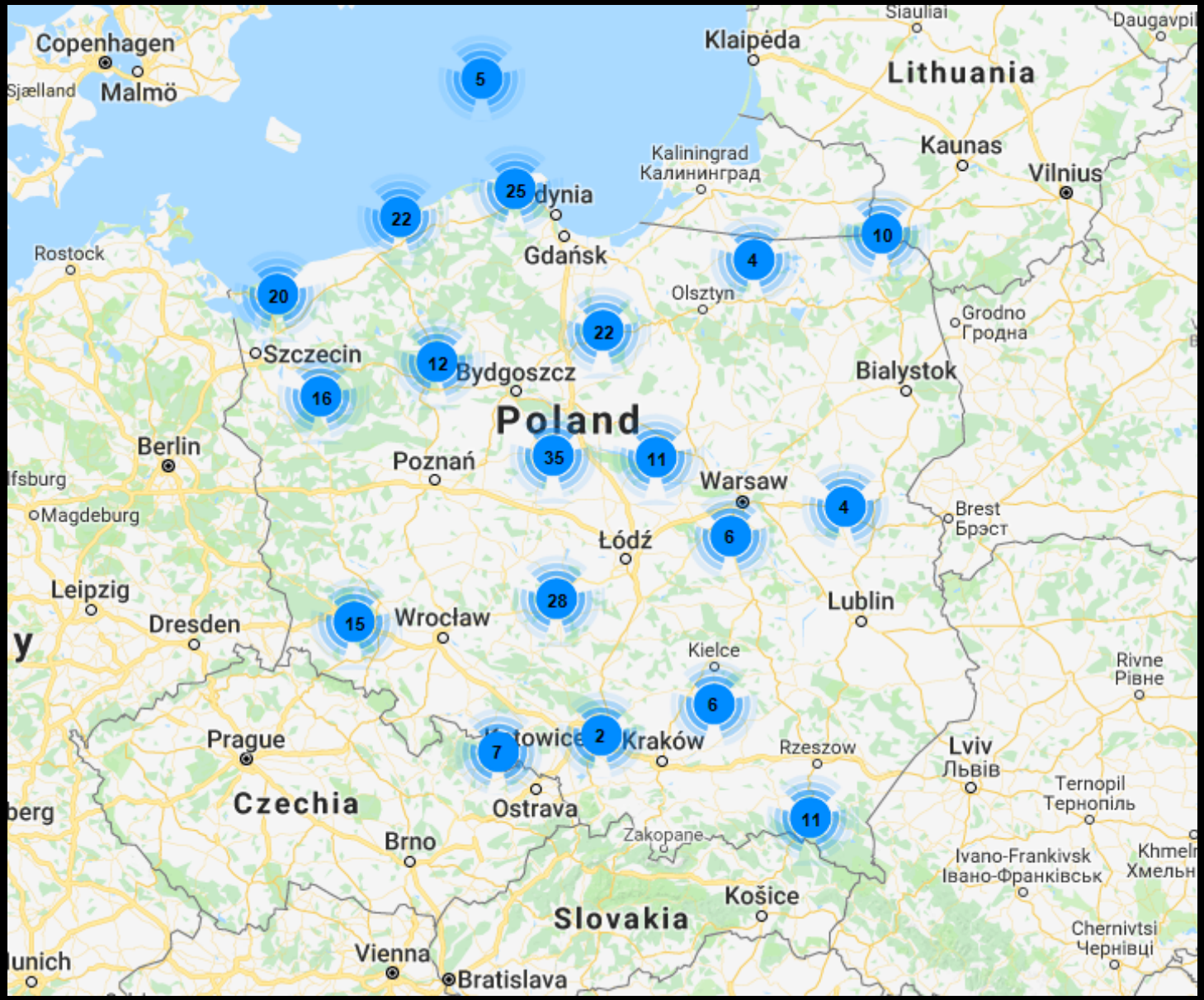
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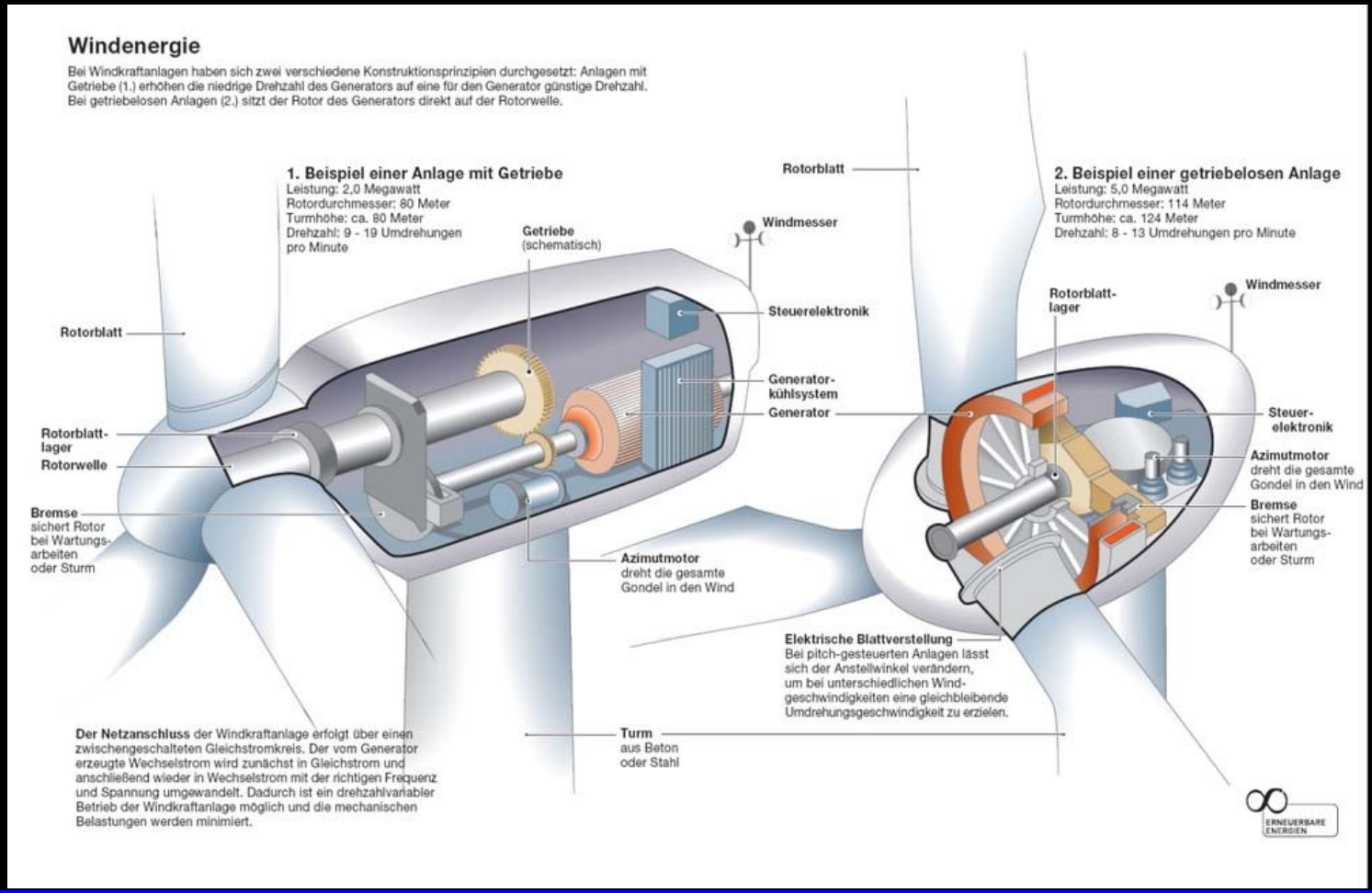
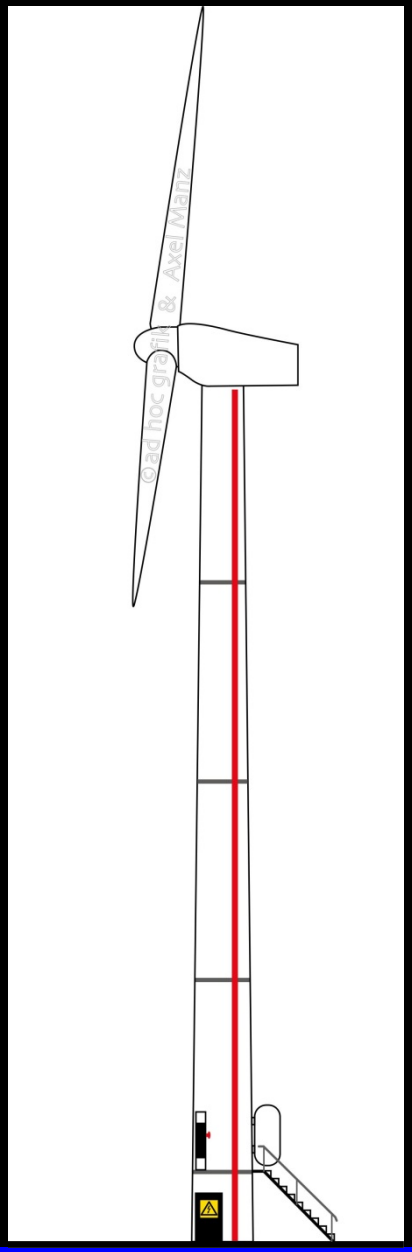
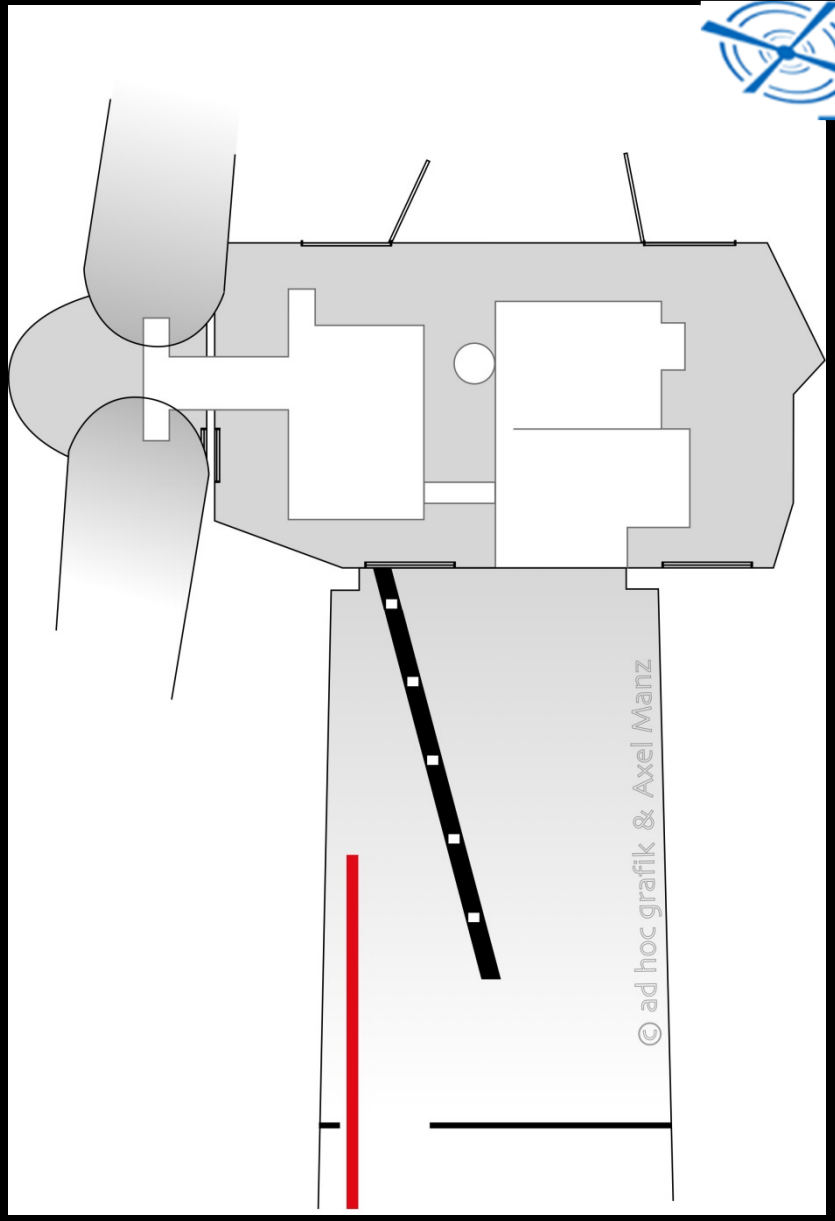
Common nacelle types







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Tower, platforms, hatches and openings

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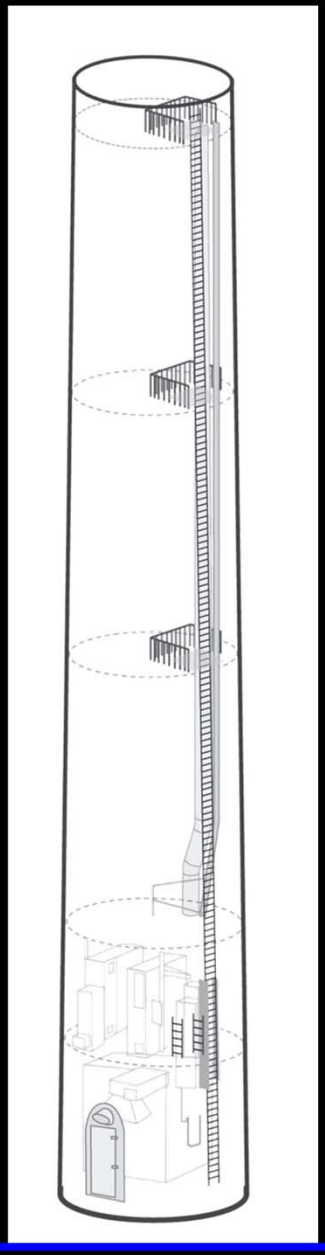

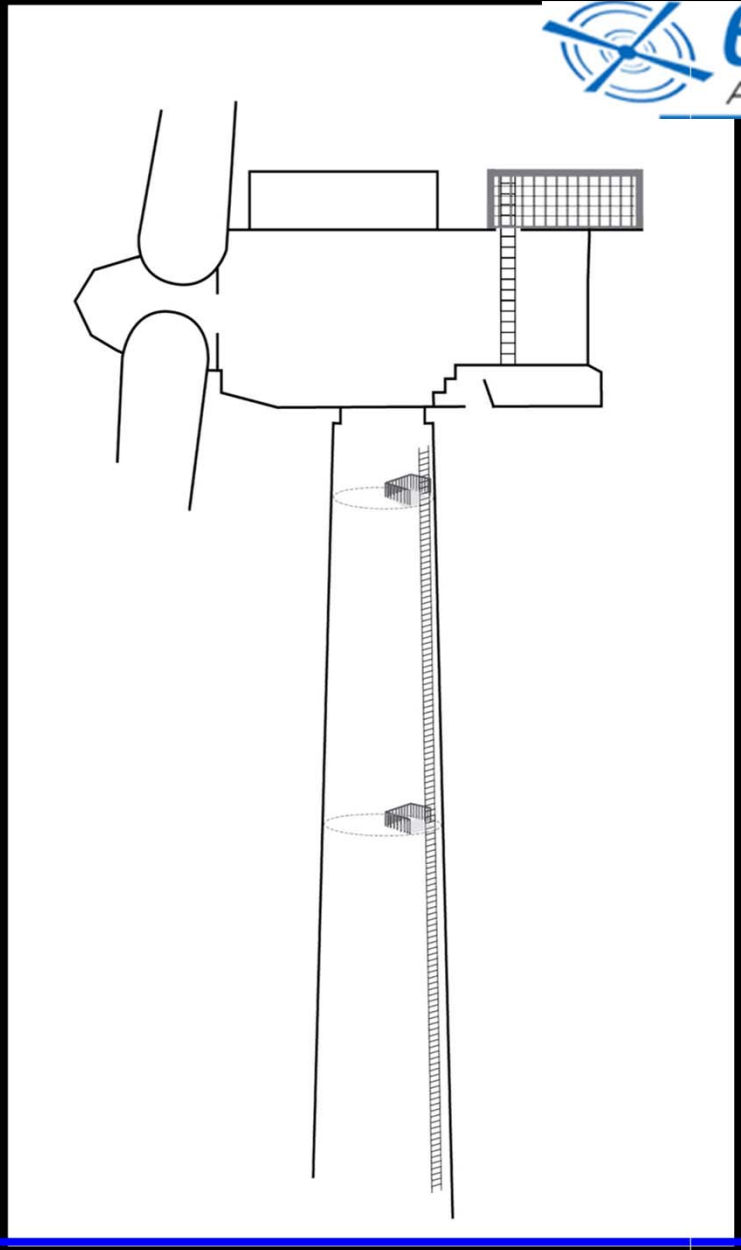

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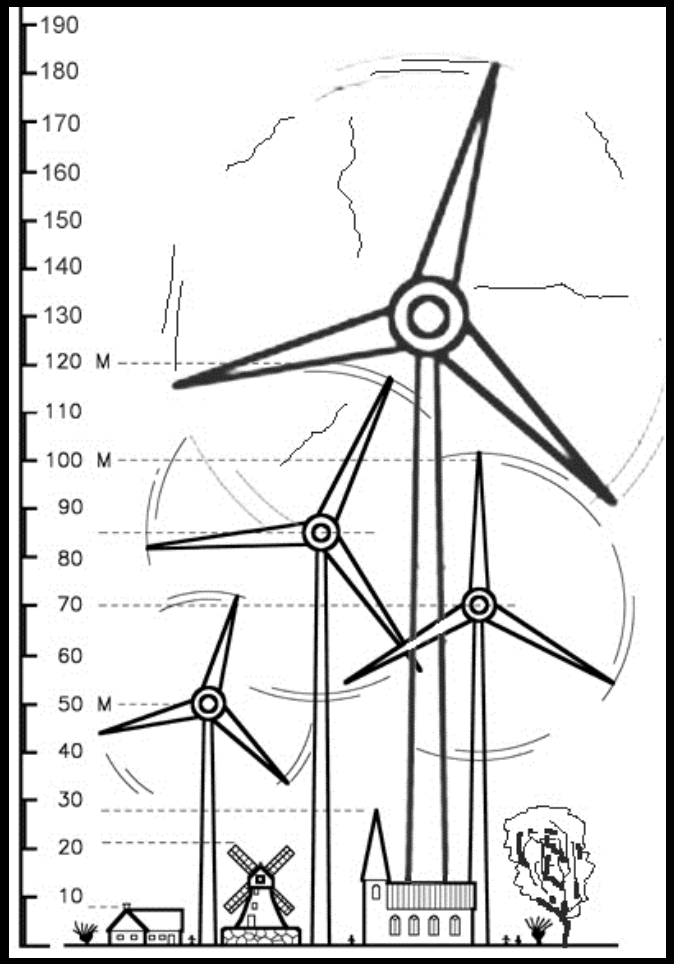
Common heights



Common shaft heights:

- Old: 90m-100m
- Actual: 130m-140m
- Ongoing: 160m-200m

Surprise:

- Ropes shrink in use
- “windsag“

Conclusion: rope length

- Min. shaft height + 15%

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Access problems

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Examples of real rescues

SCHWER VERLETZT

Arbeiter stürzt von Windrad

Lichtenau – Er stürzte acht Meter in die Tiefe. Ärzte kämpfen um sein Leben. Horror-Unfall in einer Windkraftanlage bei Lichtenau!

Zwei Techniker (55, 26) waren vormittags in den Turm der 80 Meter hohen Anlage gestiegen, mussten Wartungsarbeiten vornehmen. Beim Abstieg passierte es. Während der ältere der beiden Männer schon fast festen Boden erreicht hatte, befand sich sein Kollege kurz unterhalb der zweiten Plattform. In 30 Meter Höhe verlor er an einer Leiter plötzlich den Halt, stürzte acht Meter tief, schlug hart auf einer weiteren Etage des Turms auf. Er erlitt zahlreiche Brüche und schwerste innere Verletzungen.

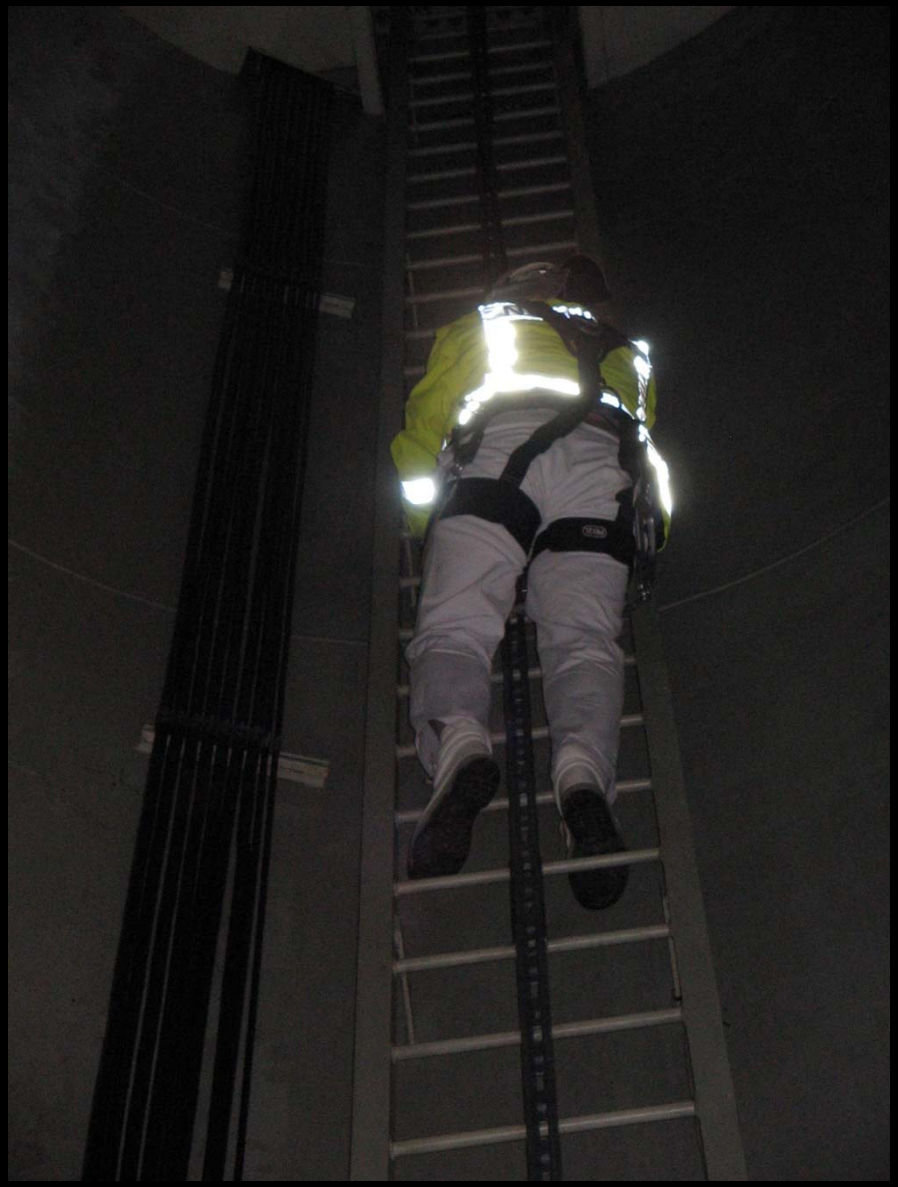
Die Feuerwehr Altenbeken-Buke kam mit Höhenrettern, die den Techniker nach einer Stunde aus dem Turm holten. Per Hubschrauber wurde er in eine Bielefelder Spezialklinik gebracht. Unfallursache könnte ein Defekt am Sicherungssystem gewesen sein. Die Polizei und das Amt für Arbeitsschutz ermitteln.

kw

Rettunghubschrauber Christof 13 flog den schwer verletzten Arbeiter in eine Klinik

Abgestürzt: Nach Wartungsarbeiten verlor ein Techniker (26) im Turm der Windkraftanlage den Halt, fiel acht Meter tief

- Lichtenau-Asseln (NRW)
- 2007



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Emergency doctor climbed up with top belay

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25m platform

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Passing hatch, casualty becomes unconscious

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Passing hatch

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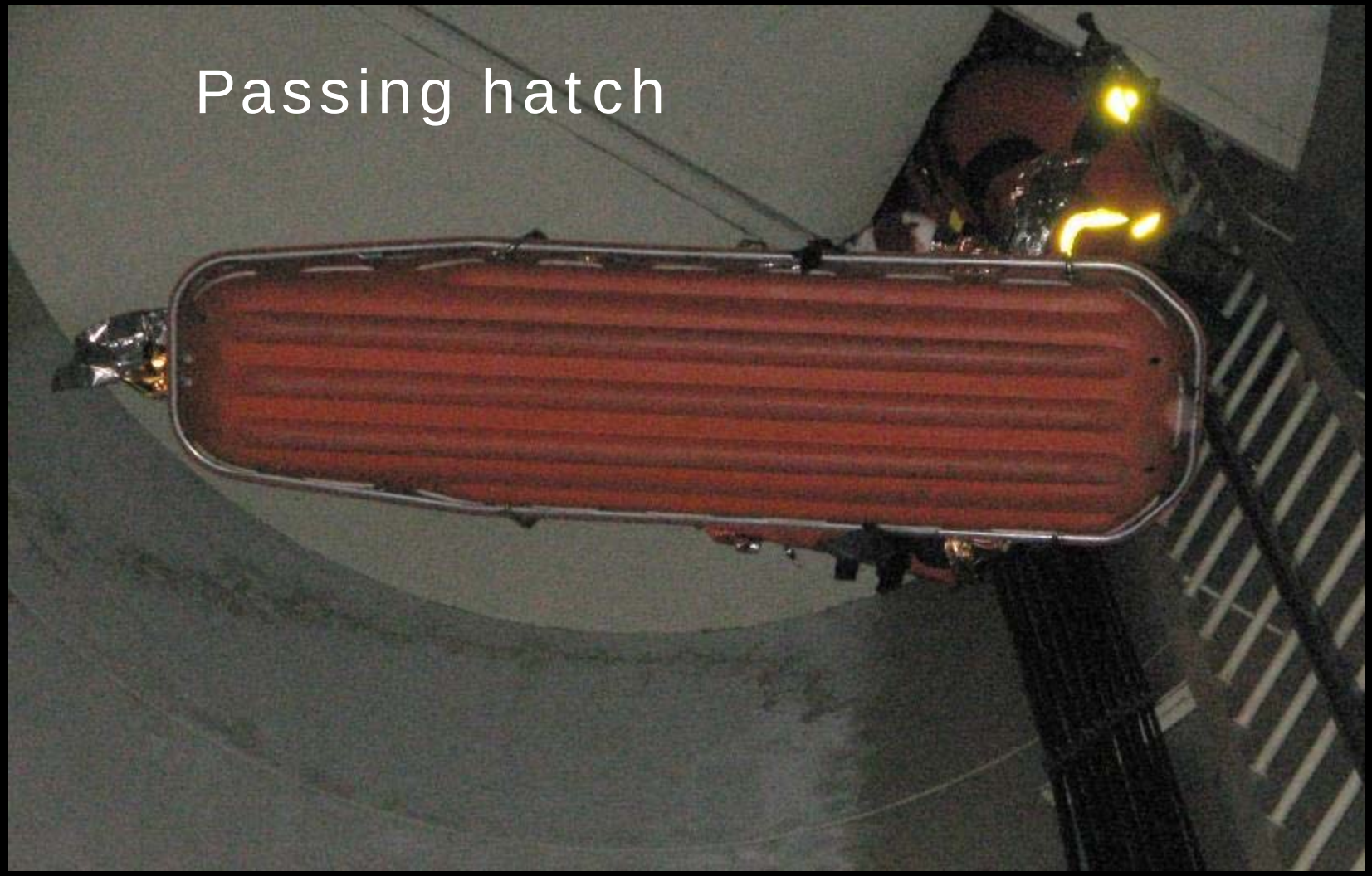
Passing hatch



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Passing hatch, casualty becomes unconscious

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Accident investigation

Fallarrest rail onsite

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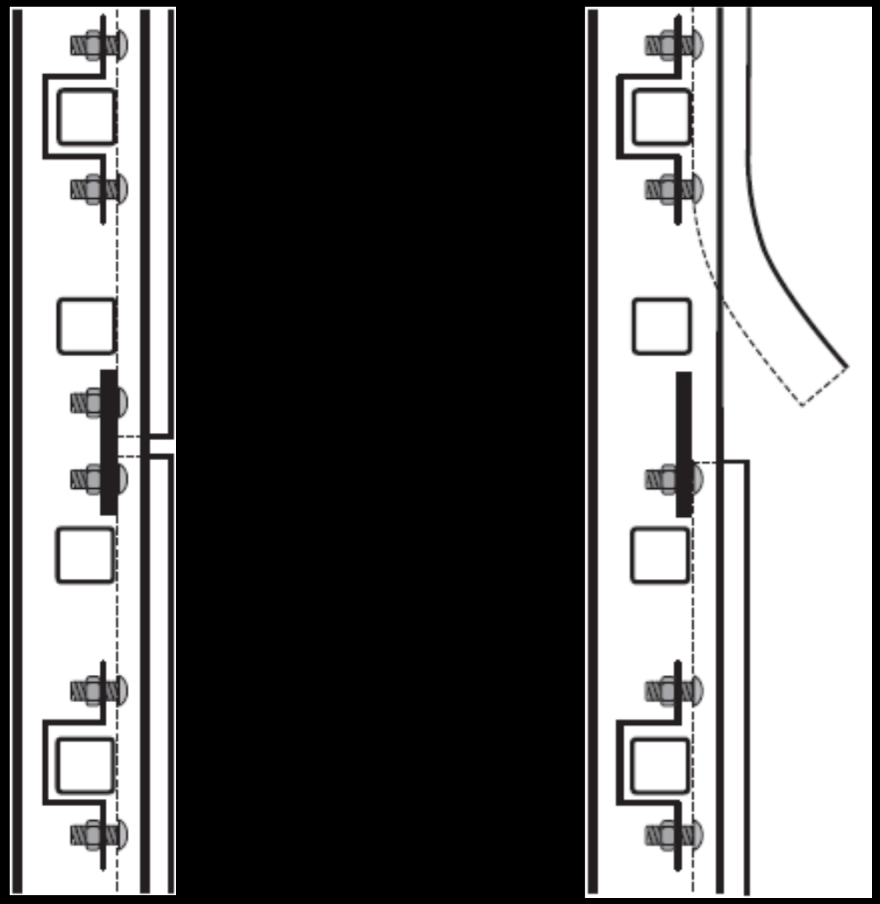


Missing screw on fall arrest rail connector

Operation after pinched hand

Operation after pinched hand

Debrief

- Slightly injured, hand was pinched
- Coworker contacted the rescue team and informed about the need for only a wrench
- No fall arrest rail sliders onsite → 80m lead climb with shock absorbers (about 20 min)
- Casualty unable to act himself, just lowering (rescue triangle) with attendent

Elevator

Spotted:

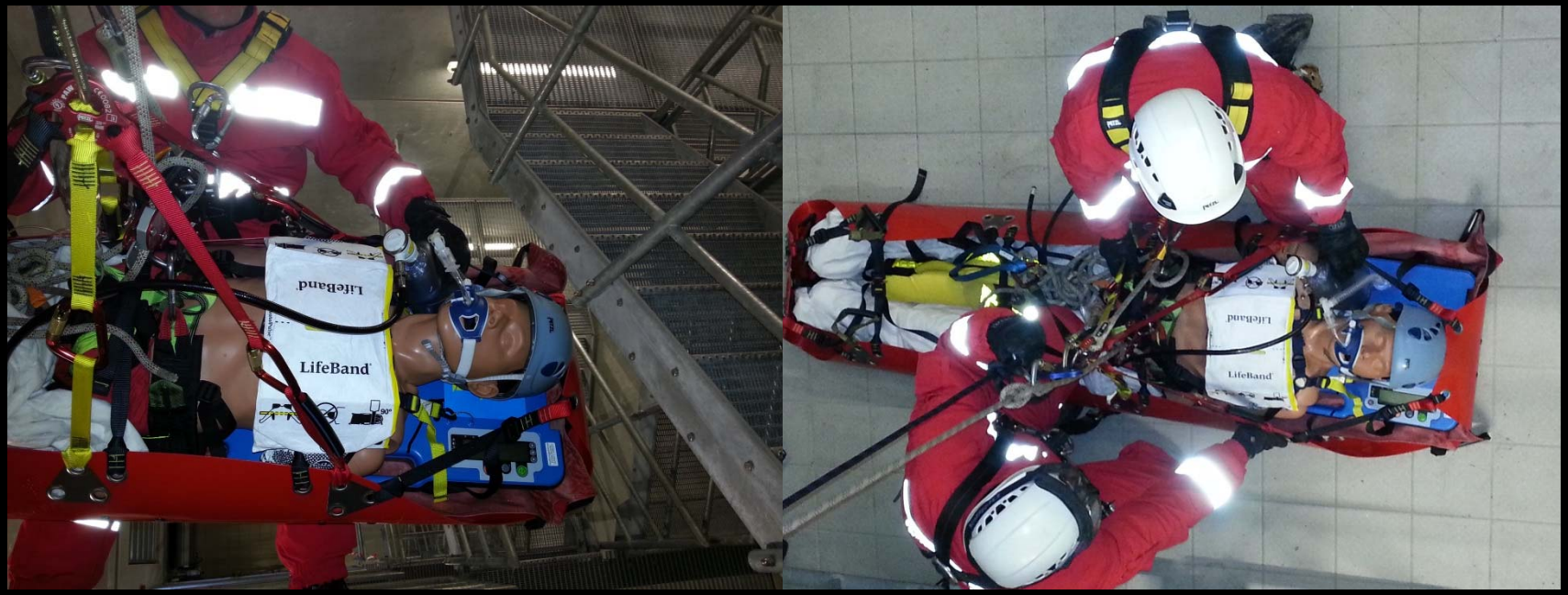
- Mostly upstairs
- >10min to get down
- 136m climb with fall arrest sliders around 15min
- Make a decision
  - Elevator vs. climb

Cardiac Arrest, winch rescue in PPE Harness

Photo source: Internet

Prospective analysis regarding rescue devices

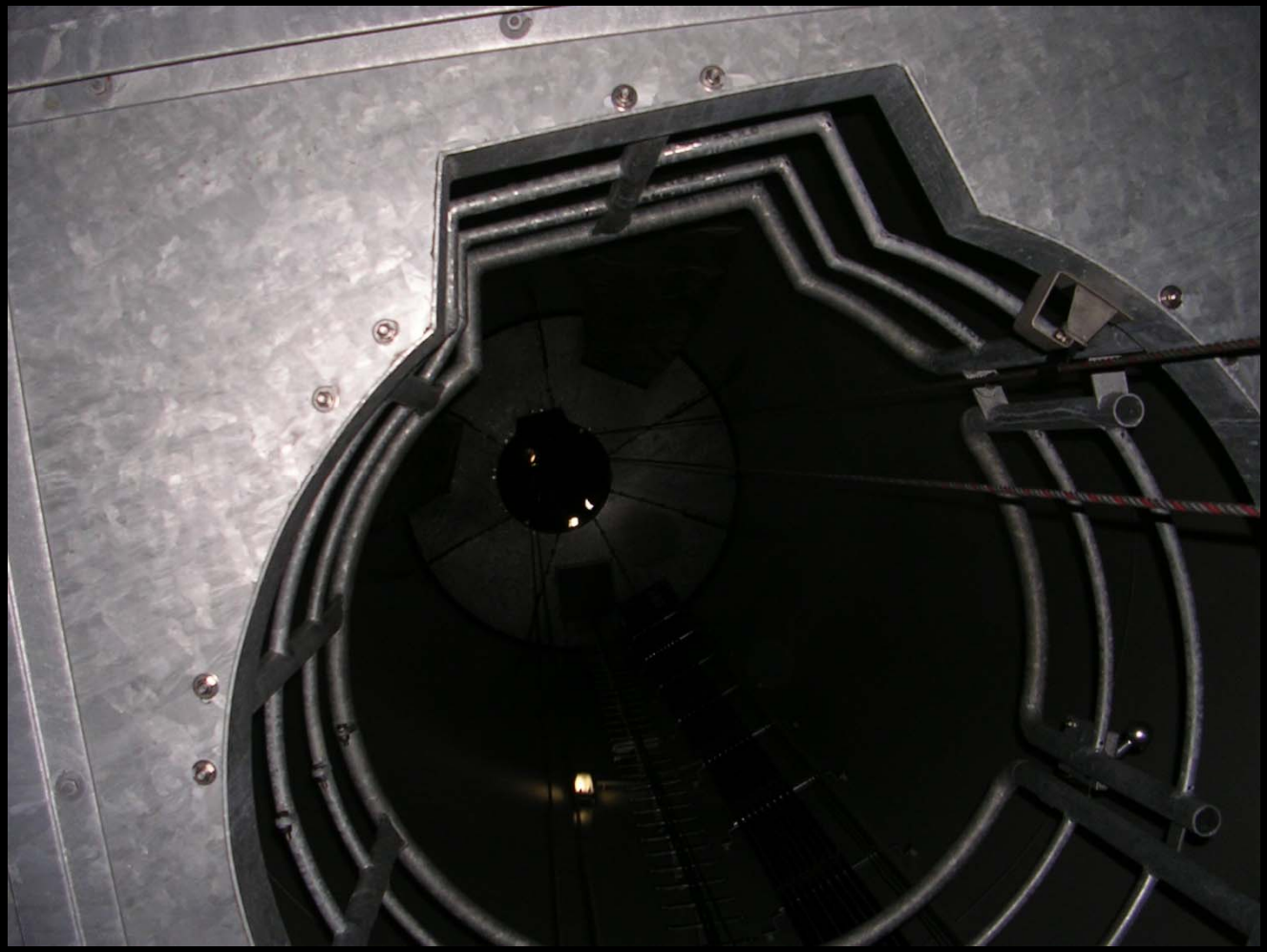
Special medical demands



Rescue under CPR

Difficulties with casualty pathway

Passing hatch single time



Passing hatches multiple times

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Passing hatches multiple times

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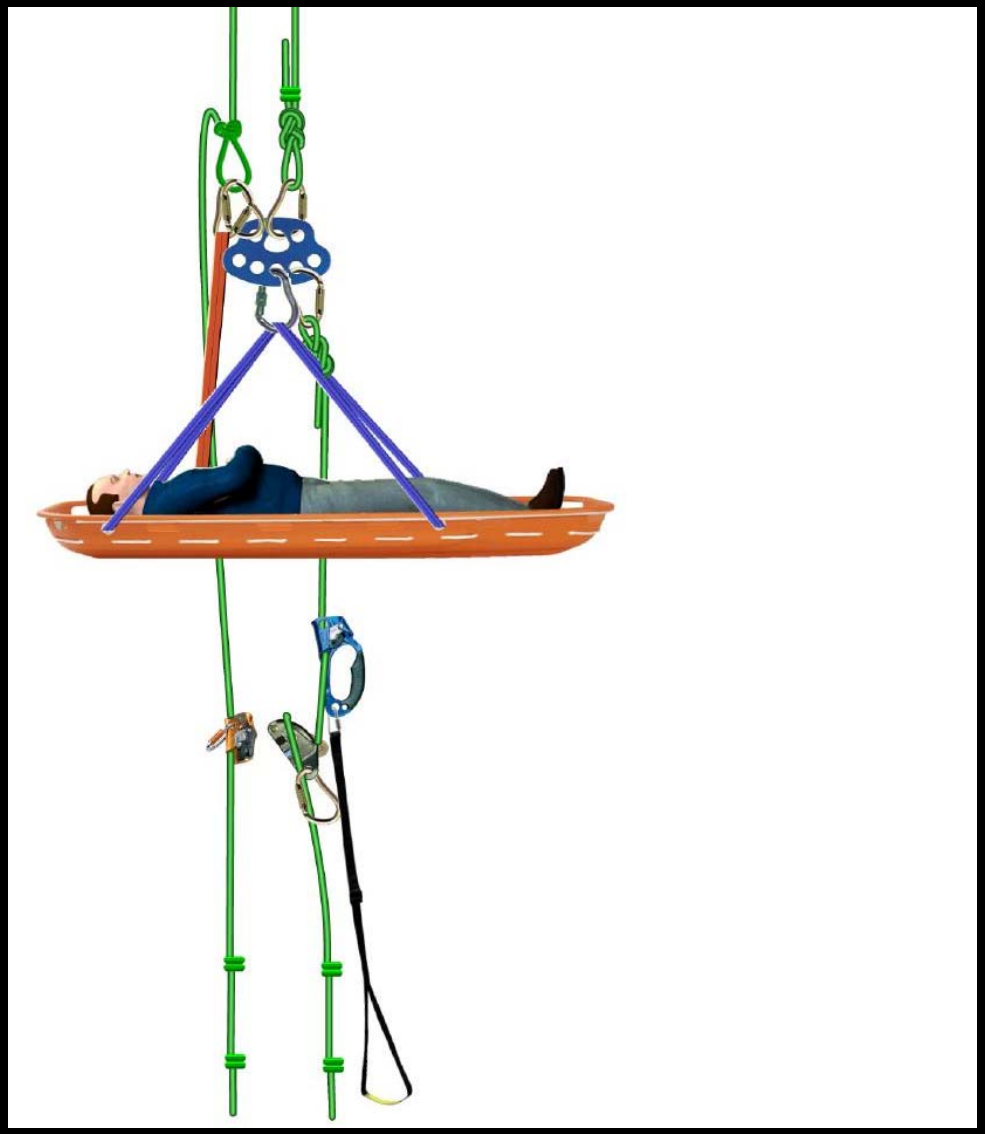

Definition: Rescue central point

- Passive lowering with attendant
- Attendant hands free
- Compact setup required

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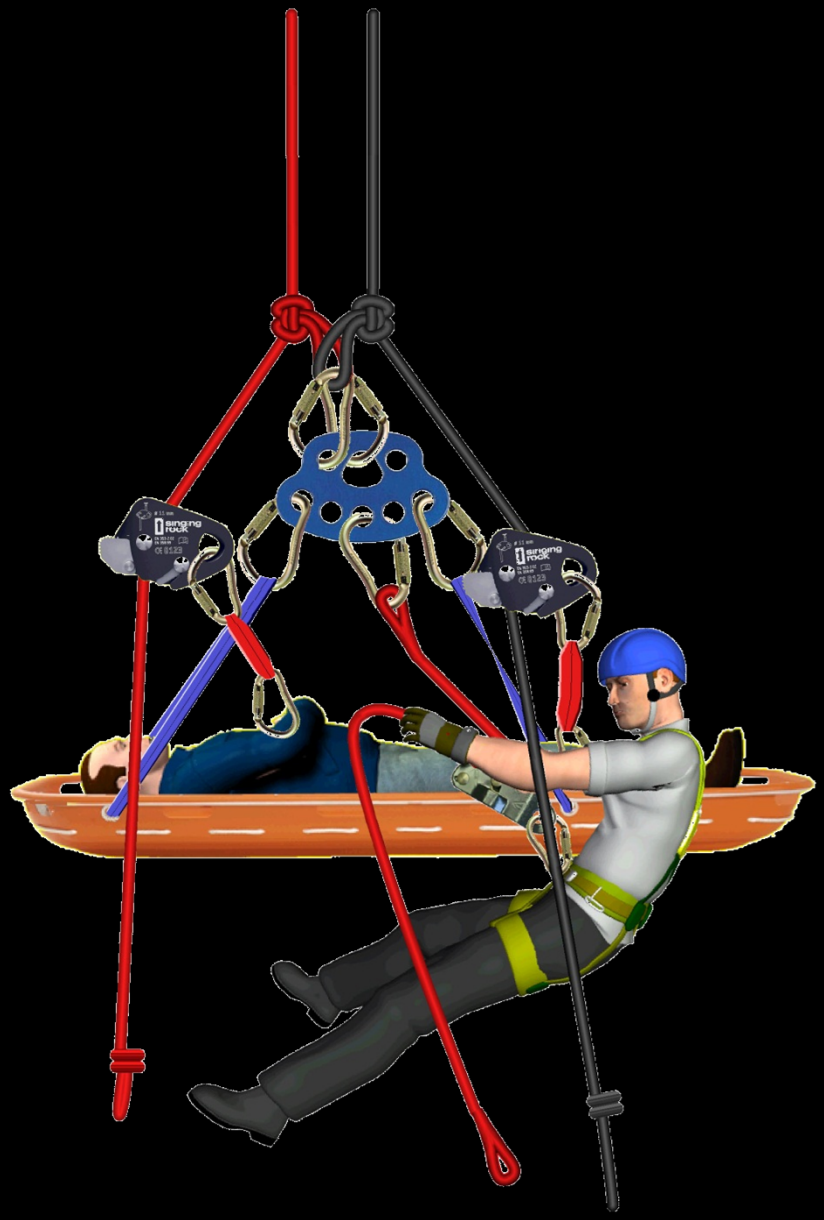

Butterfly, two ropes

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Compact setup

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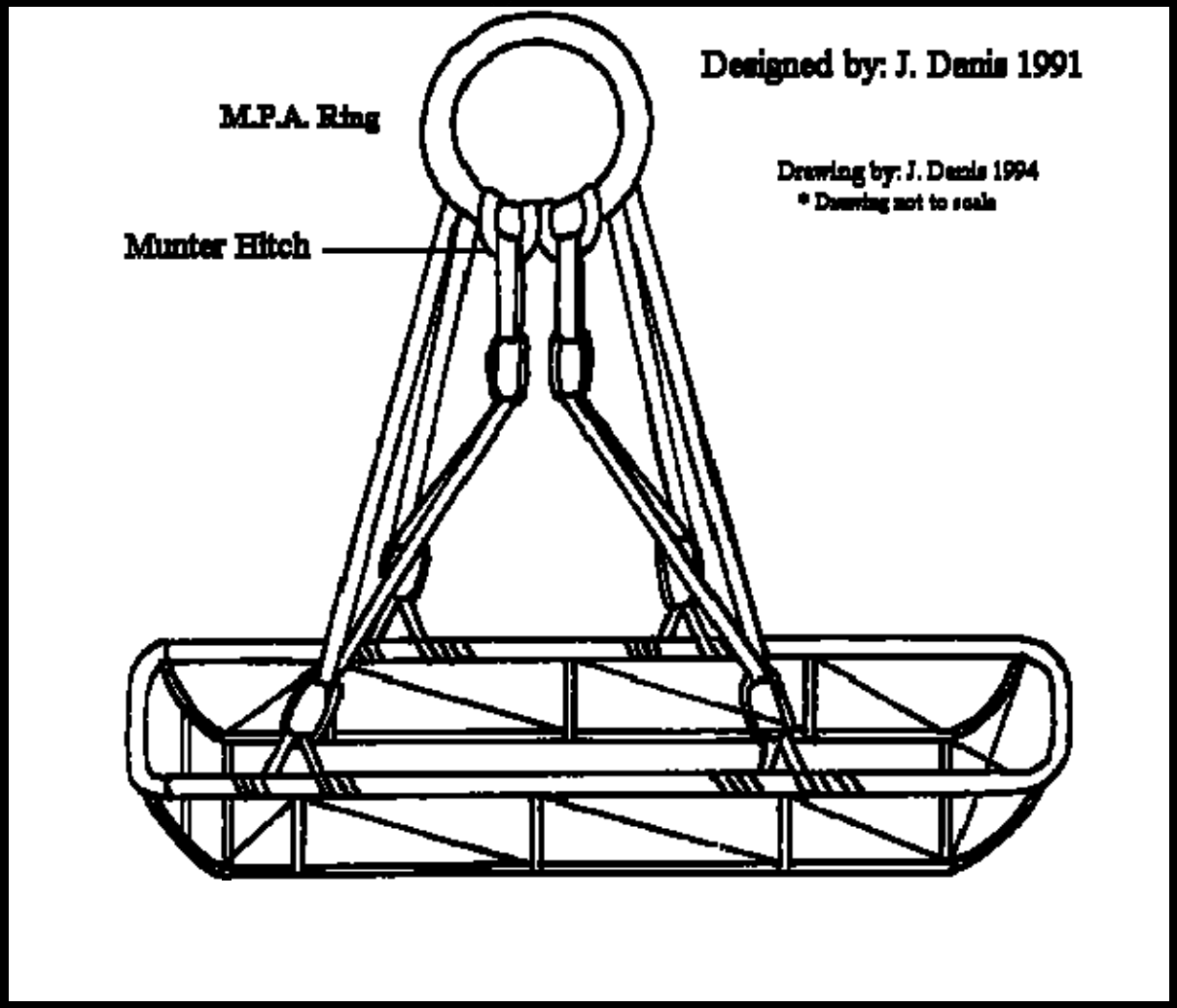

Changeover stretcher orientation

Nearby accident Grimpday 2011

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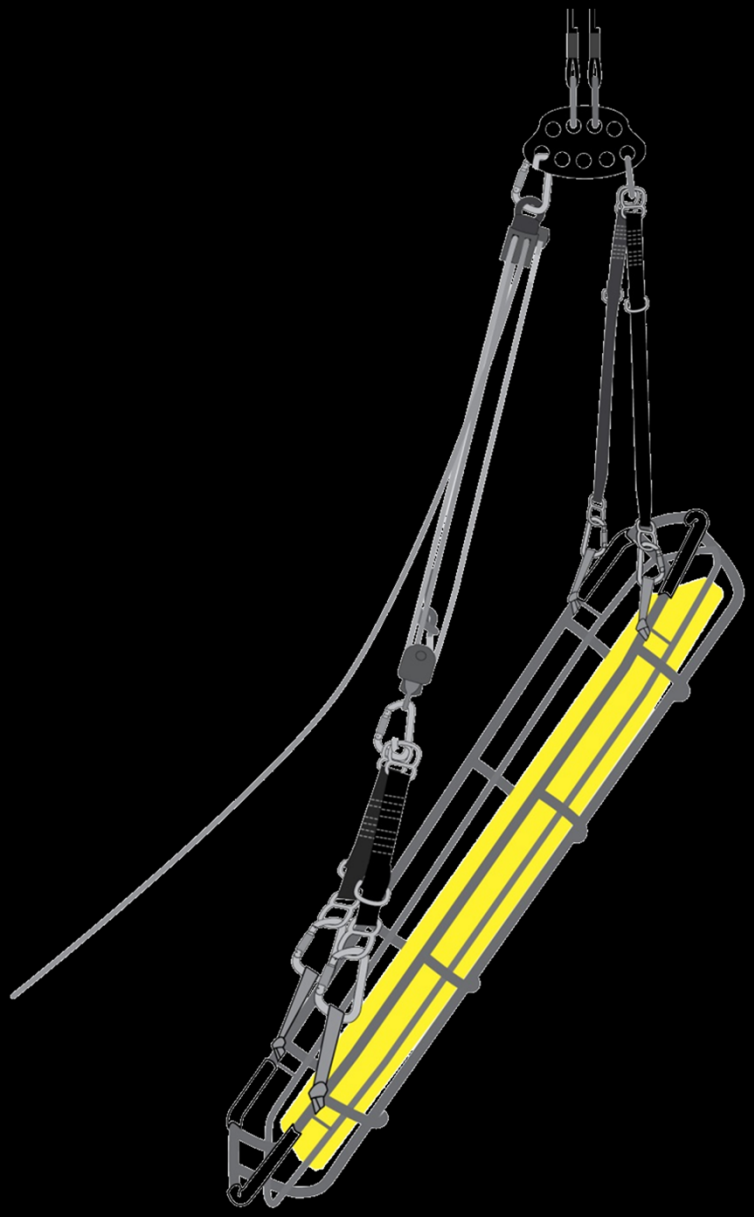
Nearby accident Grimpday 2011



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Solution with basket stretcher and Aztek

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Solution with basket stretcher and Aztek

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Problems with aluminium frame plastic litters

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Solution with Skedco and Aztek

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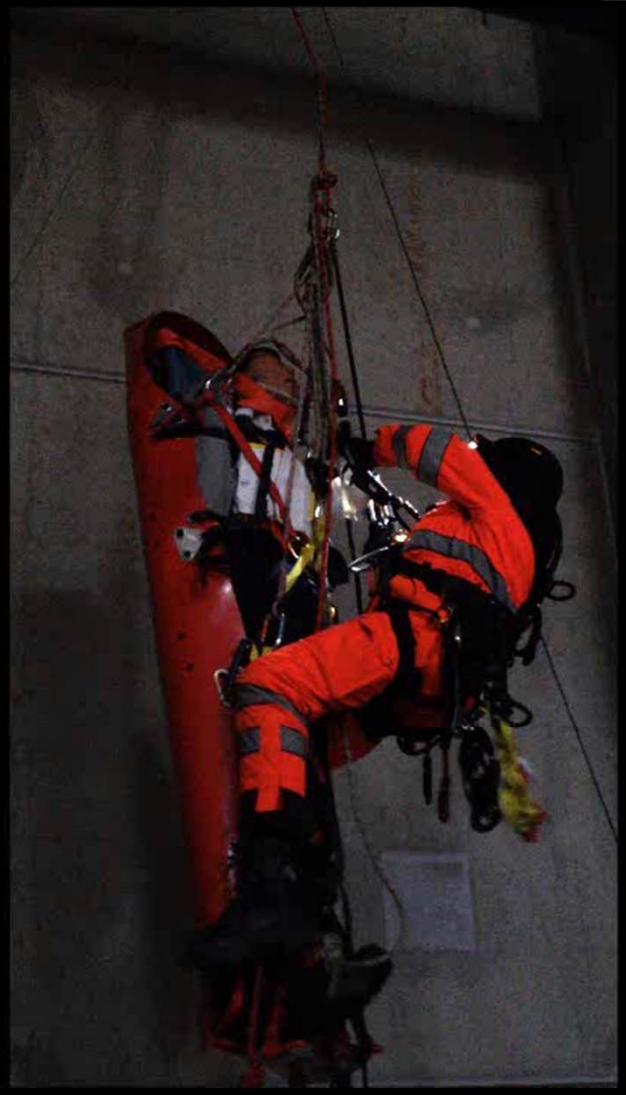
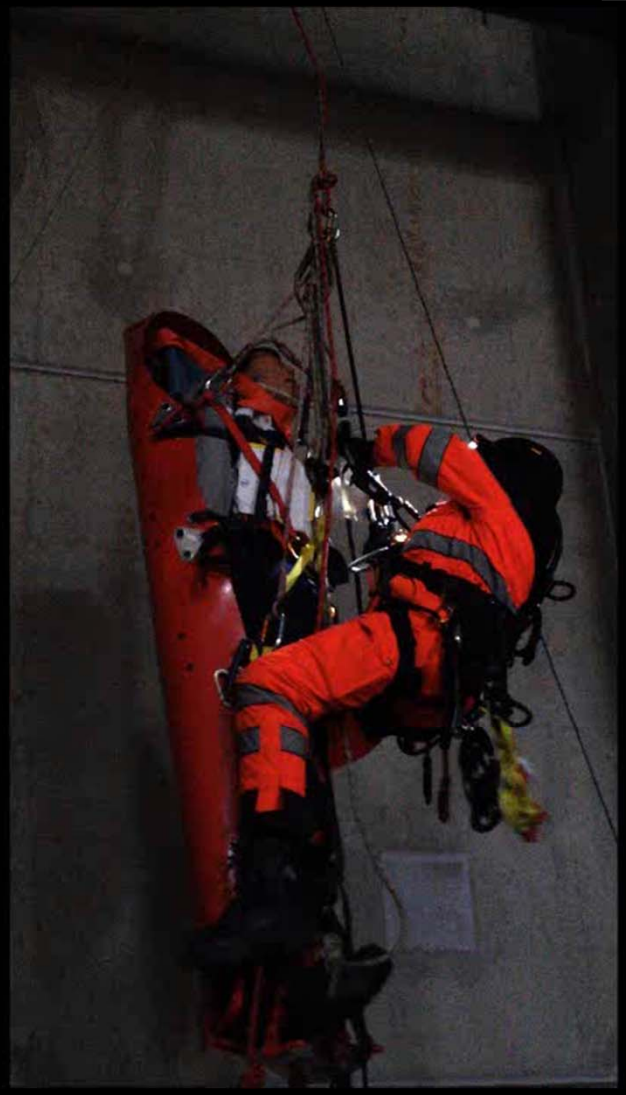
Problems



Rollup,
Balance,
automatic
CPR



Rollup,
Balance,
automatic
CPR

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Hatch nacelle, Rollup balance

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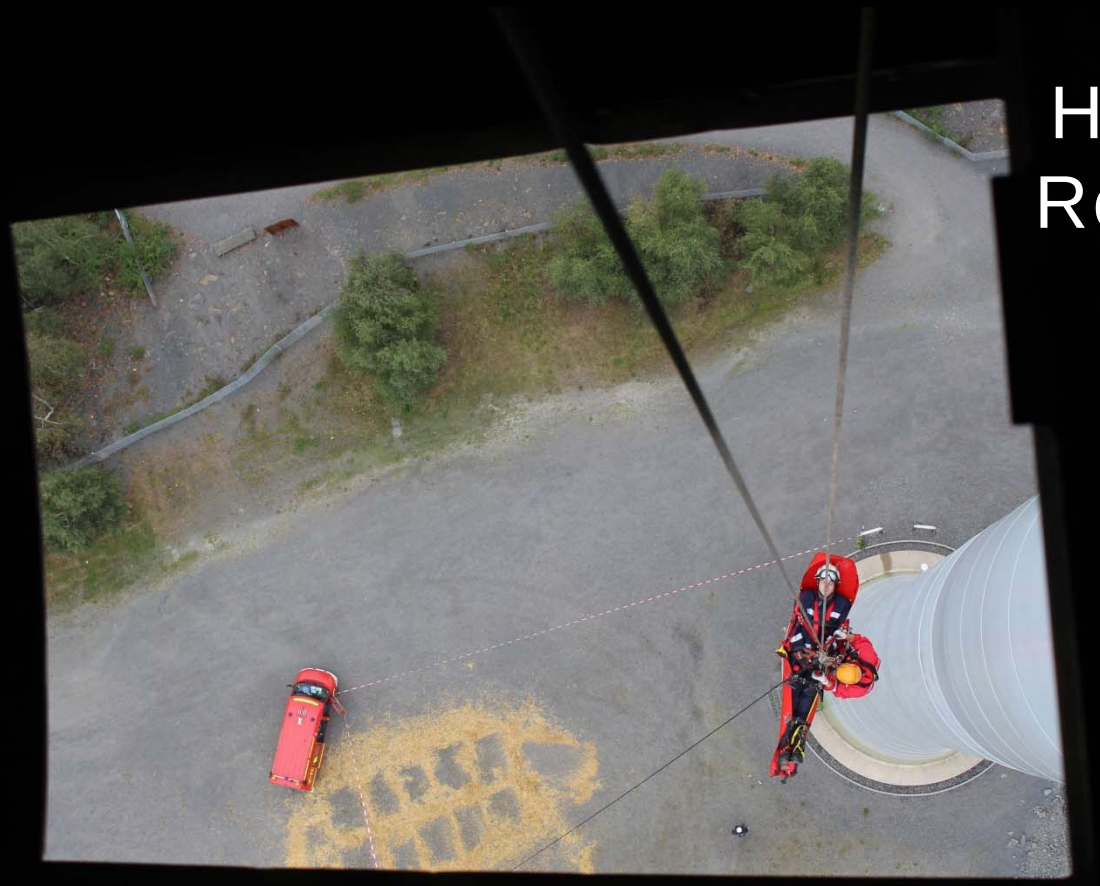
Hatch nacelle, Rollup balance



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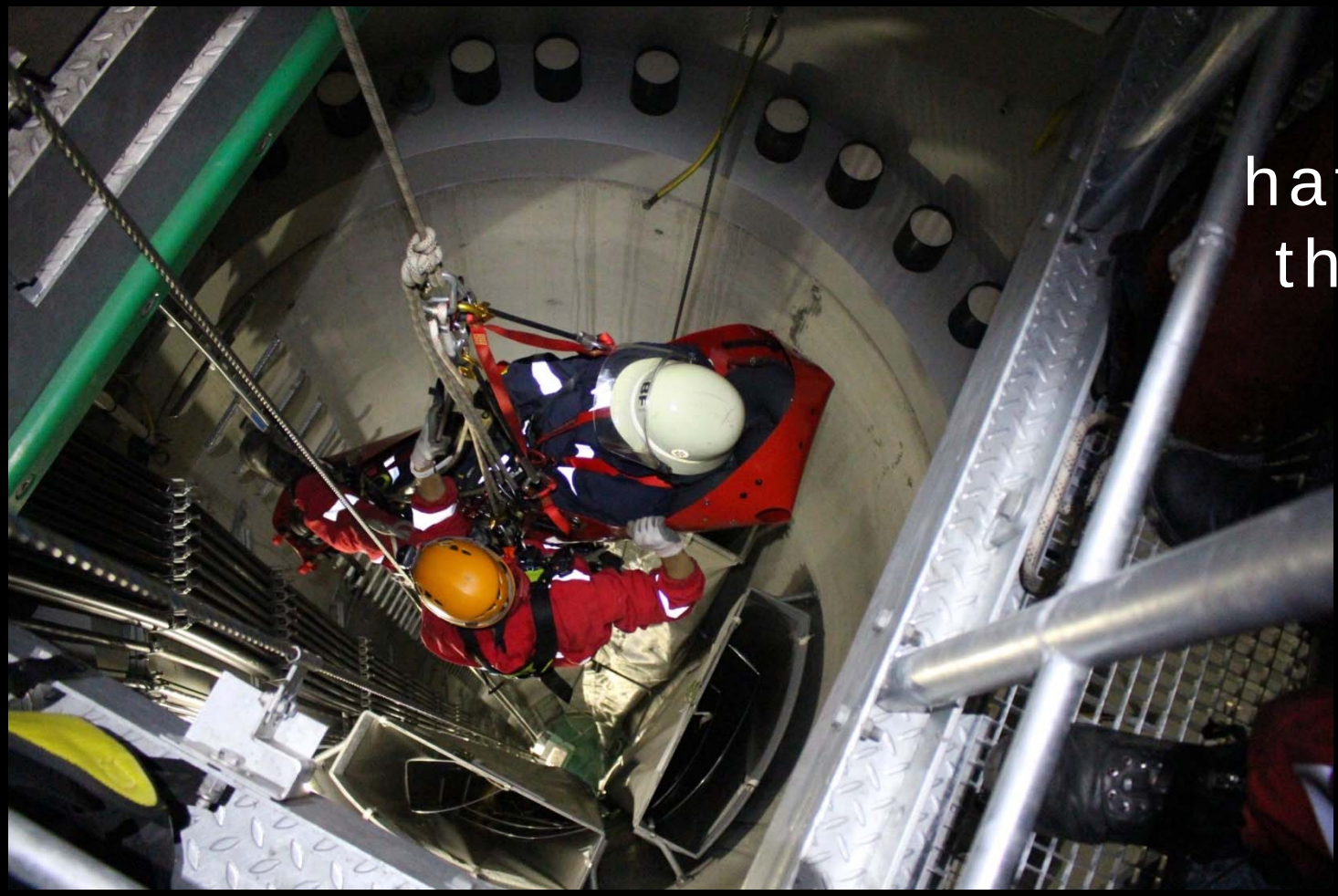
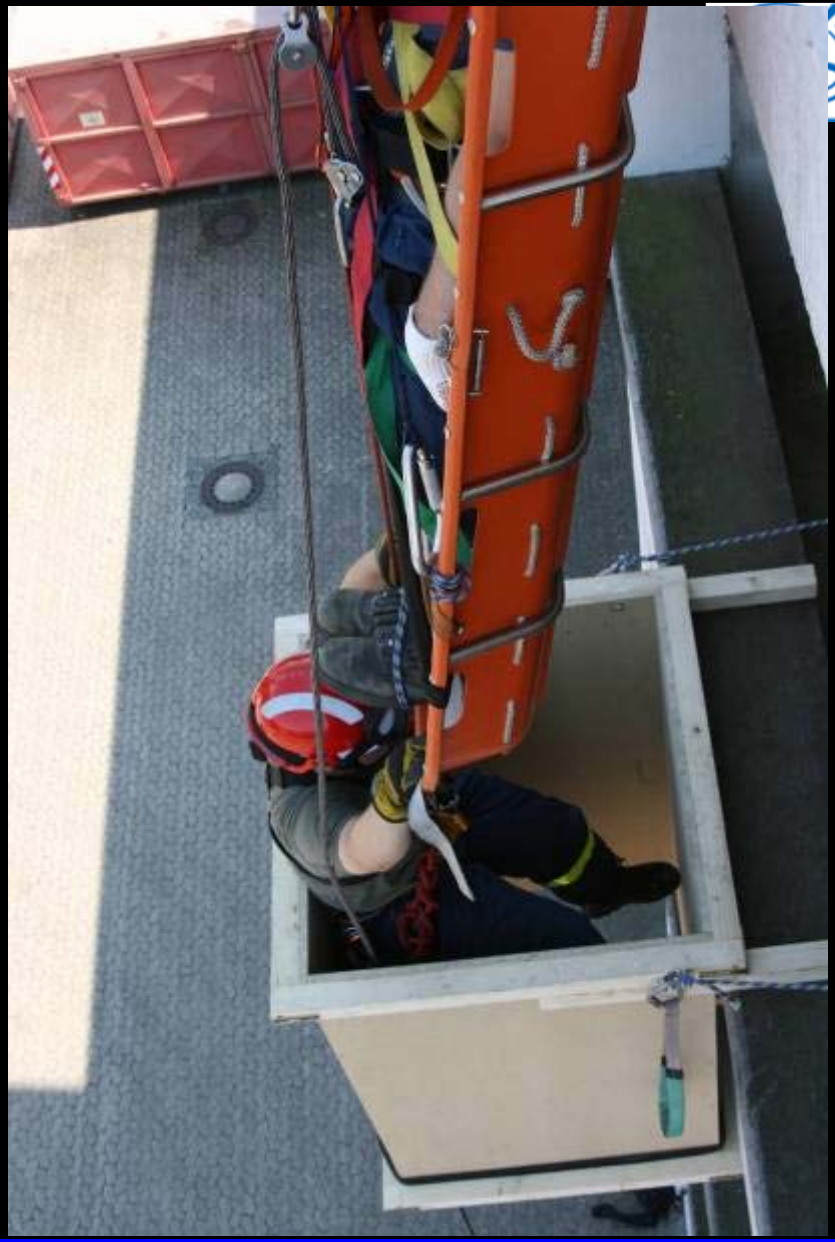


Passing hatches in the tower



Training box

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Rotating Incident

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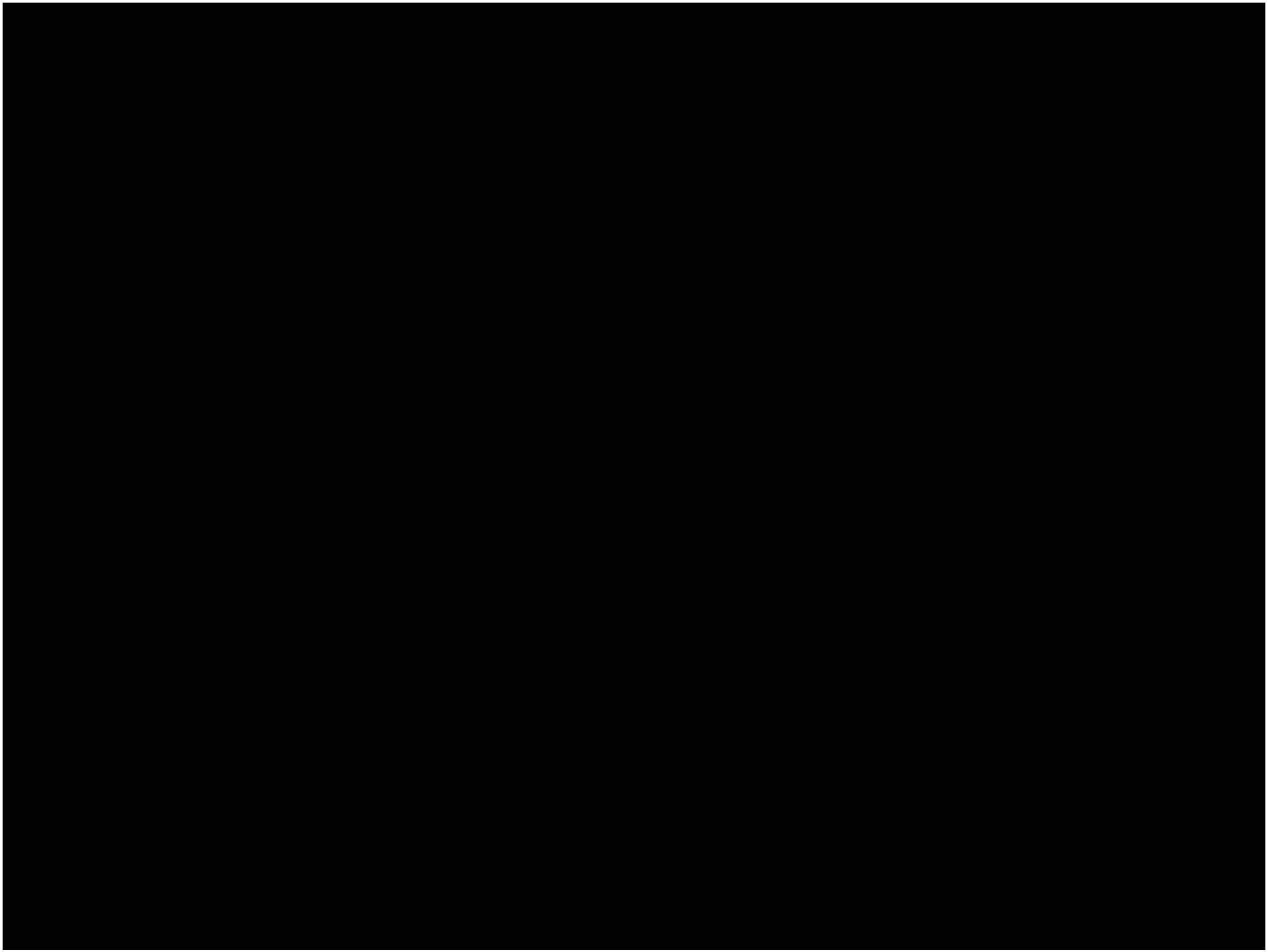


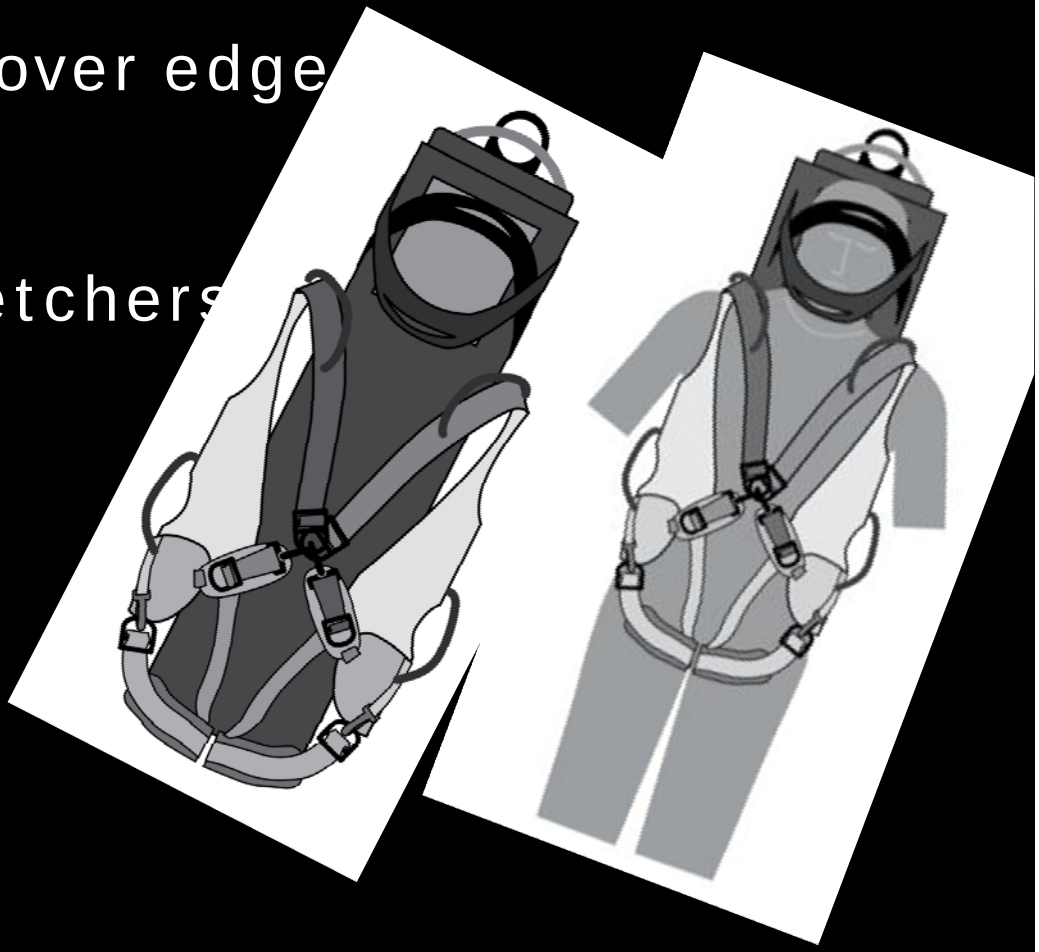
Rescue out of the hub/blade

Hub/blade rescue

- Rescue out of the hub can require Confined Space Rescue (CSR) Operations
  - Maybe toxic atmosphere
  - Detailed look on accident mechanism
    - Worker unconscious → high alert
    - Due to time
      - Rescue vs. Recovery
- Actually no experience with CSR operation on wind turbines
- CSR Operation not very common in Europe
  - This needs to be improved

Spec-Pak

- Ridgity for dragging over edge
- Vertical use
- Semi vertical use
- Compatible with stretchers




Hub/blade
rescue

Hub/blade rescue

Hub/blade rescue

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Hub/blade rescue

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Terrestrial Support for Air Rescue (Onshore)

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Air Rescue Onshore

Photo source: Internet

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Air Rescue (Offshore) North/baltic sea

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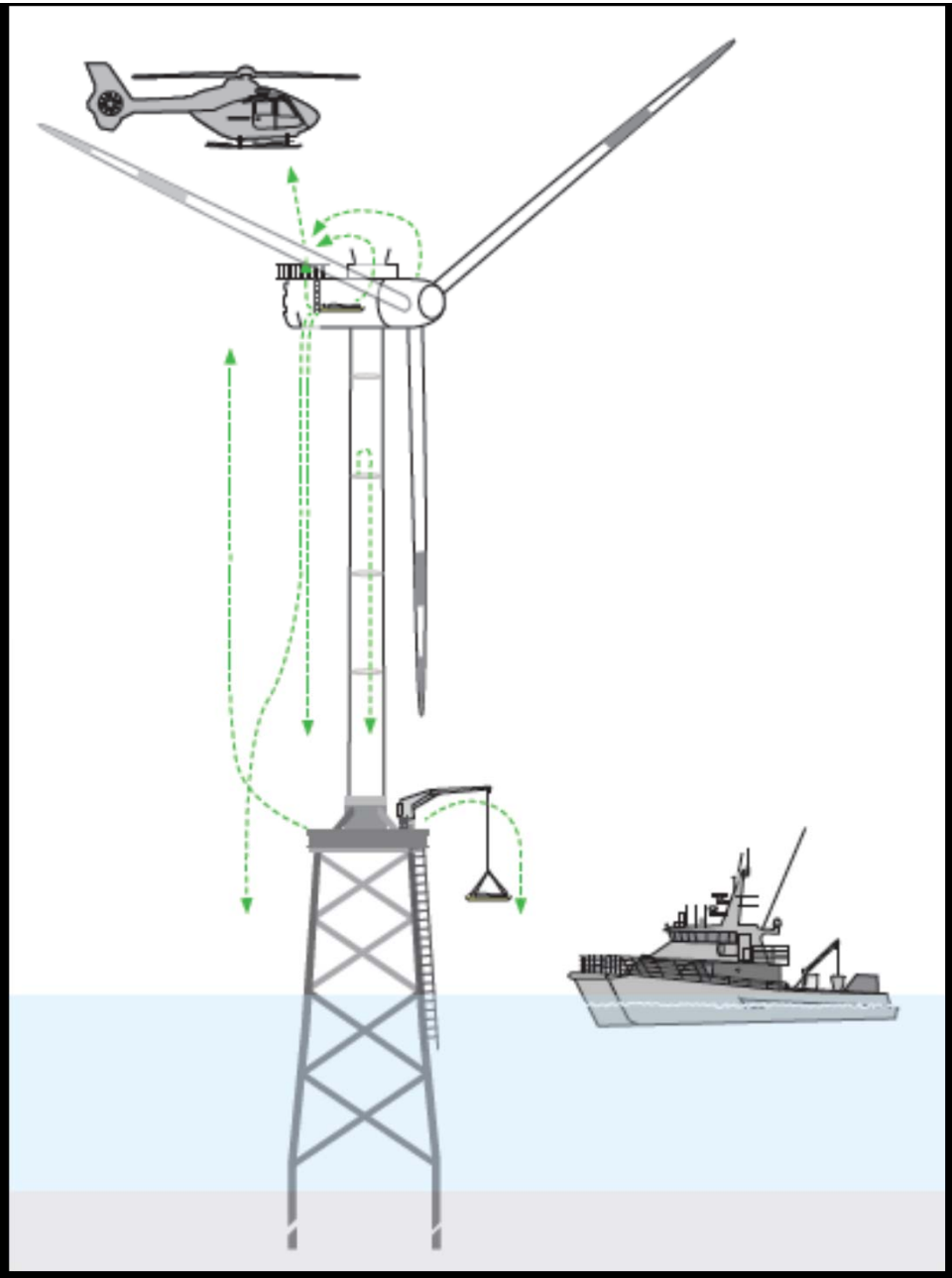
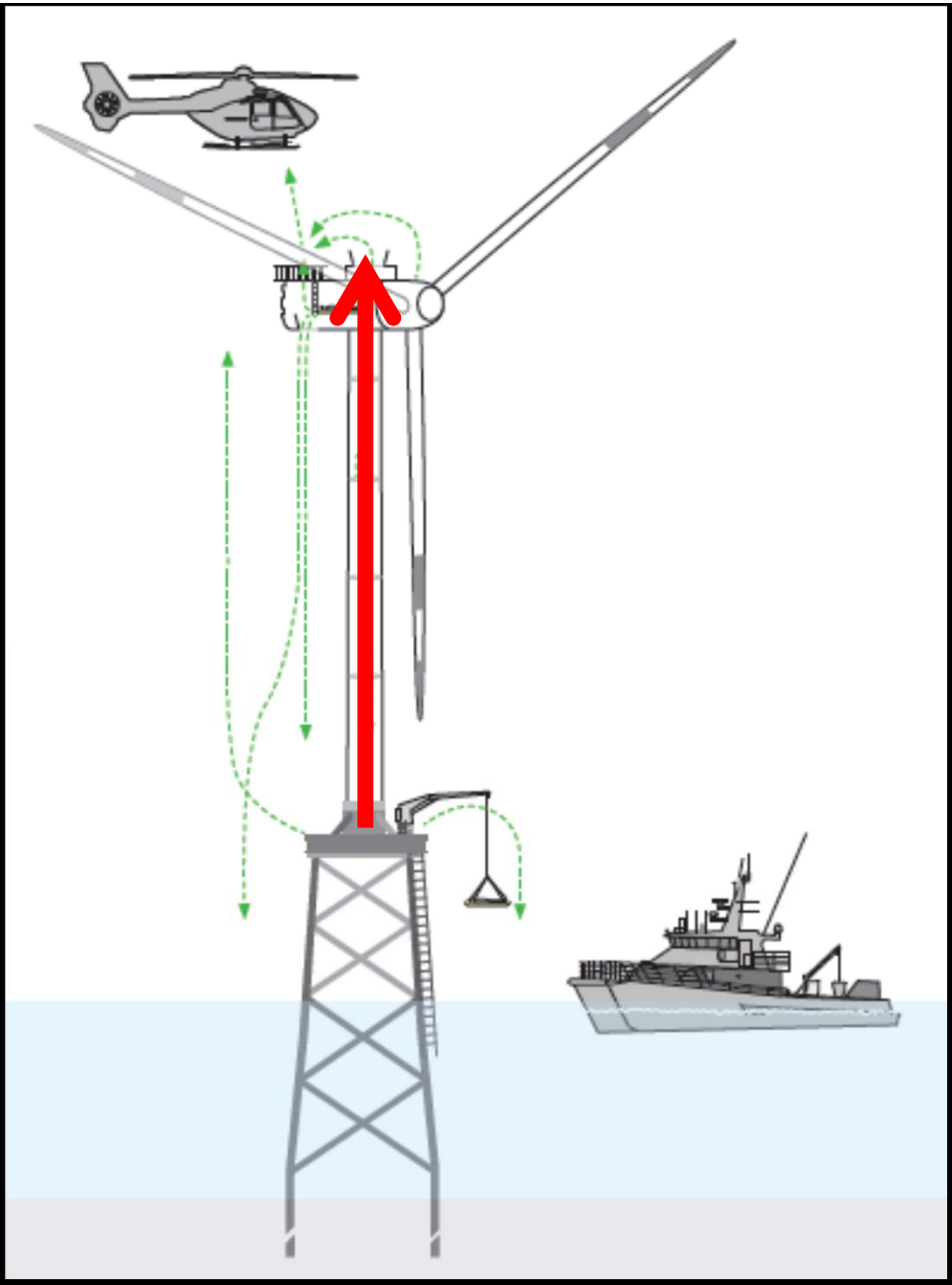


- Nacelle → water
  - (Evac in case of fire)
- Nacelle→Heli hoist
- Hub→Heli hoist
- Tower→Transition piece
- Transition piece → ship
- Tower/transition piece → helicopter



- Long lifts required
- Comparison winch rope reel style vs. capstan style
- Conclusion only capstan style winch
- Winch operation indoor, risk assesment prohibits usage of gas powered winch
- Winches can shut down
  - Technical problems
  - Problems with rechargeable battery
    - Empty
    - cold

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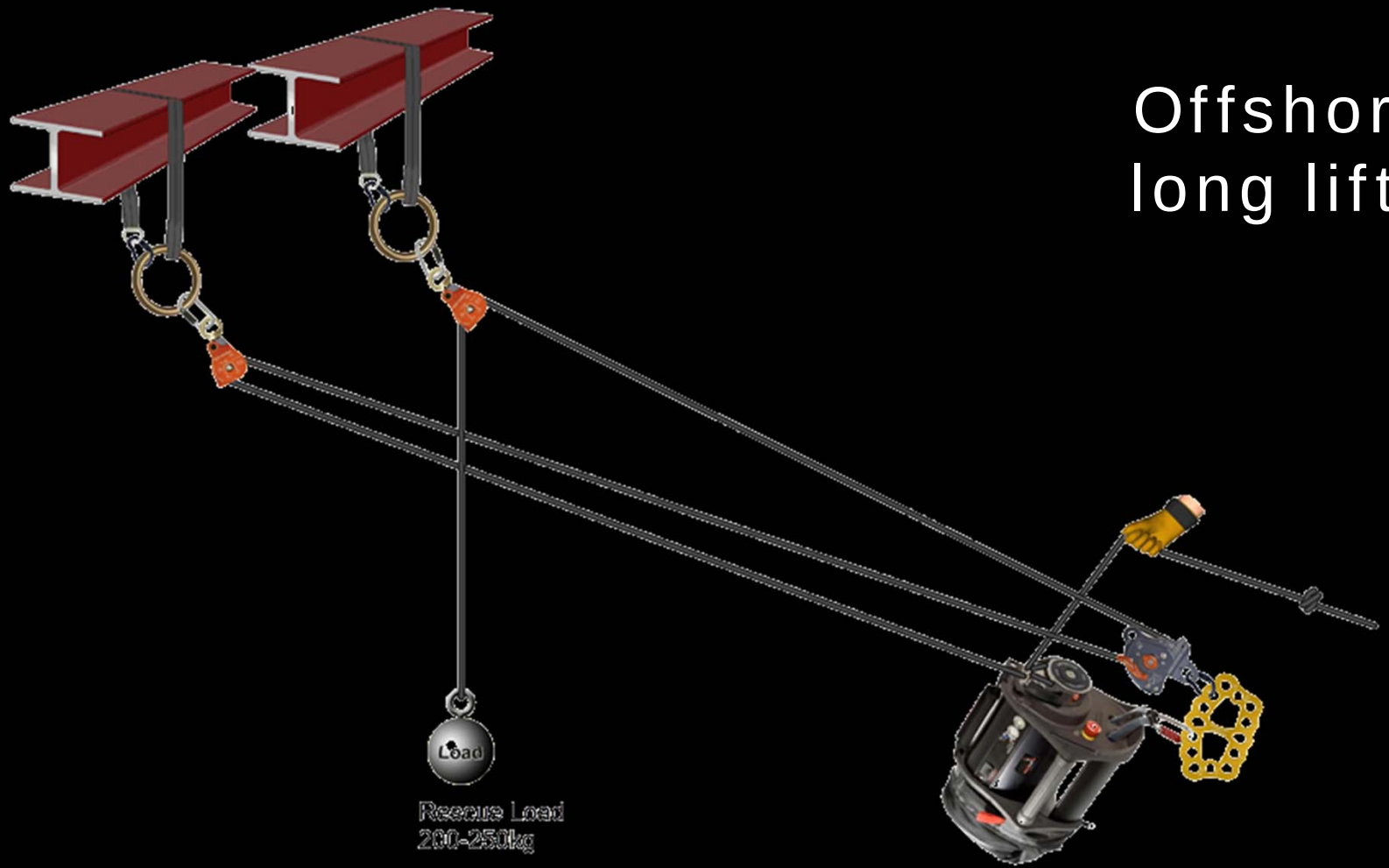
Offshore long lifts



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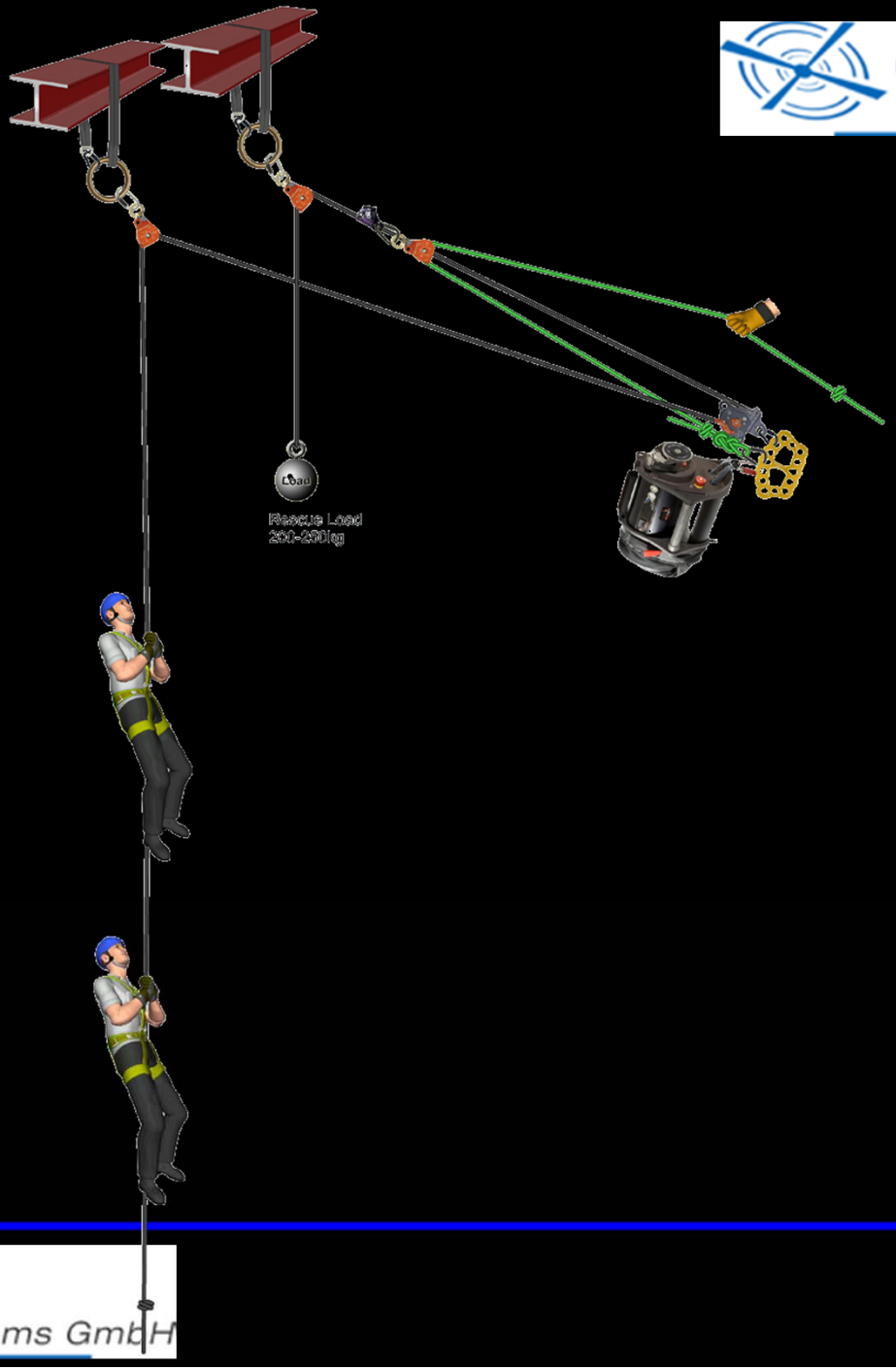

Offshore long lifts

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Offshore winch issue

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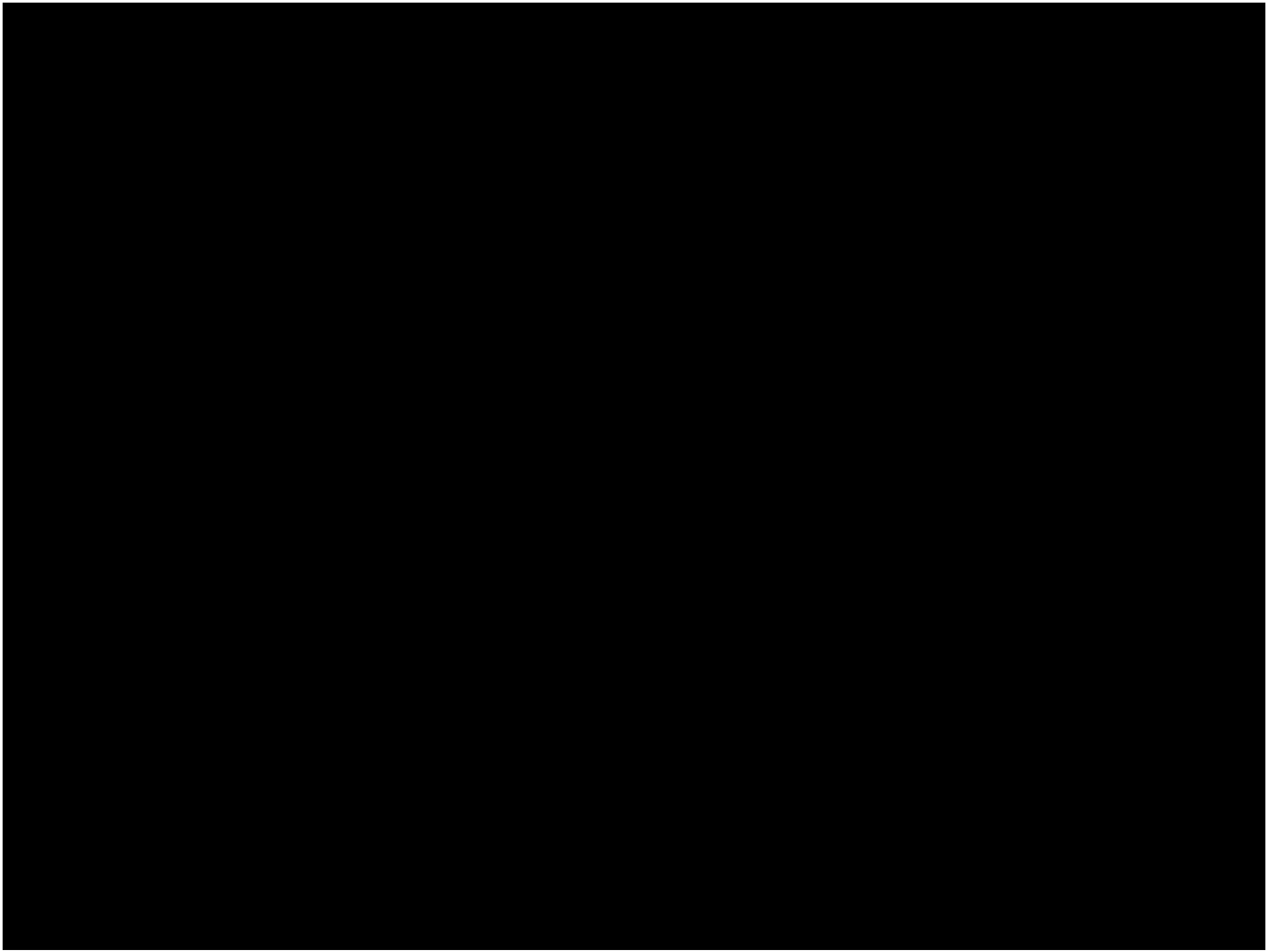
Industry Promotion of helicopters

The offshore wind turbine industry is promoting helicopters as an asset – recognizing the utility of aircraft during high seas

Making waves in the industry



Offshore Wind Energy

The offshore wind energy industry is forecasted to experience significant growth over the coming years. To meet these new requirements, more and more wind farm operators are turning to helicopters, which offer a reliable, cost-effective solution, from construction to maintenance

Cost-effectiveness and flexibility

Fewer power outages – No loss of revenue

H175 — 150 Knots

H145 — 130 Knots

25 Knots

H135

Cost-effective access to wind farms close to shore

272 kg external hoist lift capability

H145

High-performance, multirole helicopter for crew transfer and hoisting

Emergency floatation gear

H160

The innovative medium helicopter for hoisting and crew transfer, up to 10/12 passengers

H175

The modern and cost-effective medium-helicopter solution for long range crew transfer, up to 16 passengers

External hoist

Oversized bubble windows for better observation

Helionix® ON BOARD

- Automatic flight control system
- Centralisation of all helicopter systems
- Cutting-edge human-machine interface (HMI)
- Enhanced situation awareness

The helicopter advantage

With a predicted rise in the number and size of offshore turbines, and their distance from land, wind farm operators are increasingly faced with important challenges concerning transportation, rescue and maintenance operations

- Safe and easy access to wind turbines
- Rapid response time
- No sea sickness
- A longer window of time to work
- Reduced CO_2 emissions

AIRBUS

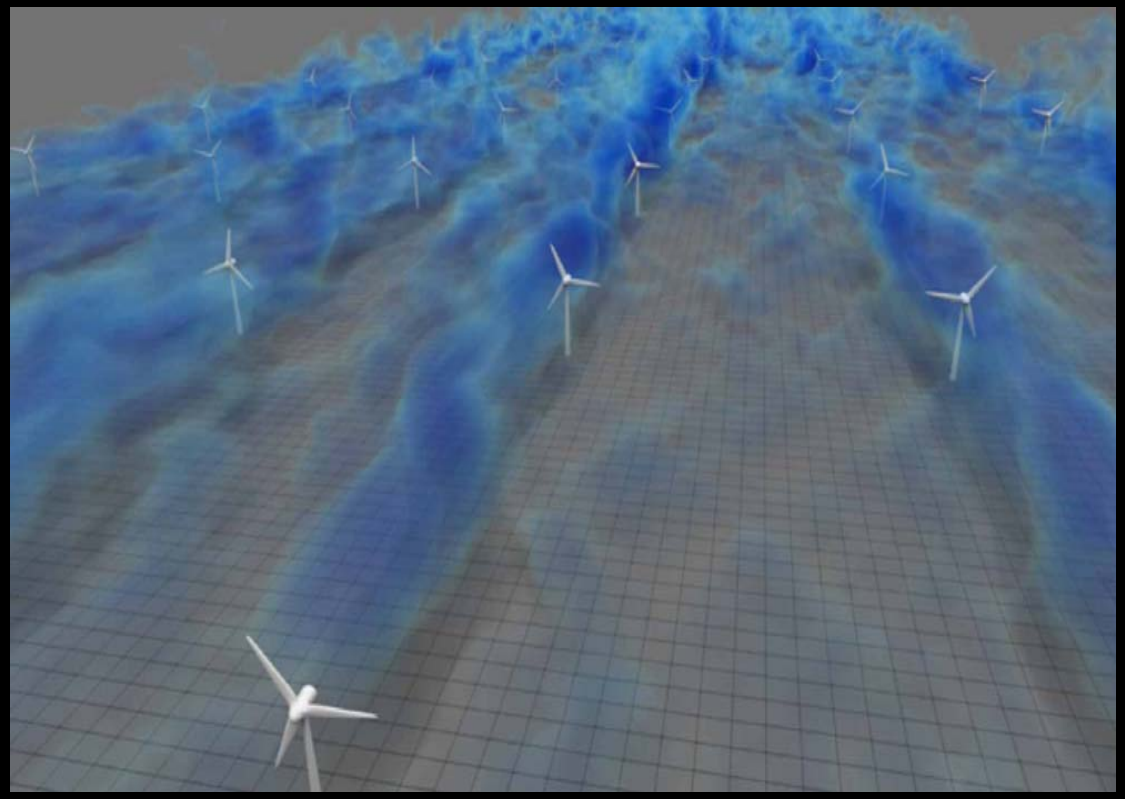
Source: Airbus
Infographic: beatrizsantacruz.com ©

Helicopter fleets projected to triple in size in 5 years

- In support of *worker transport*
- In support of *search and rescue*

HAZARD IN *FLIGHT* OPERATIONS #1:

Wake vortices and turbulent flow *behind* a Wind Turbine



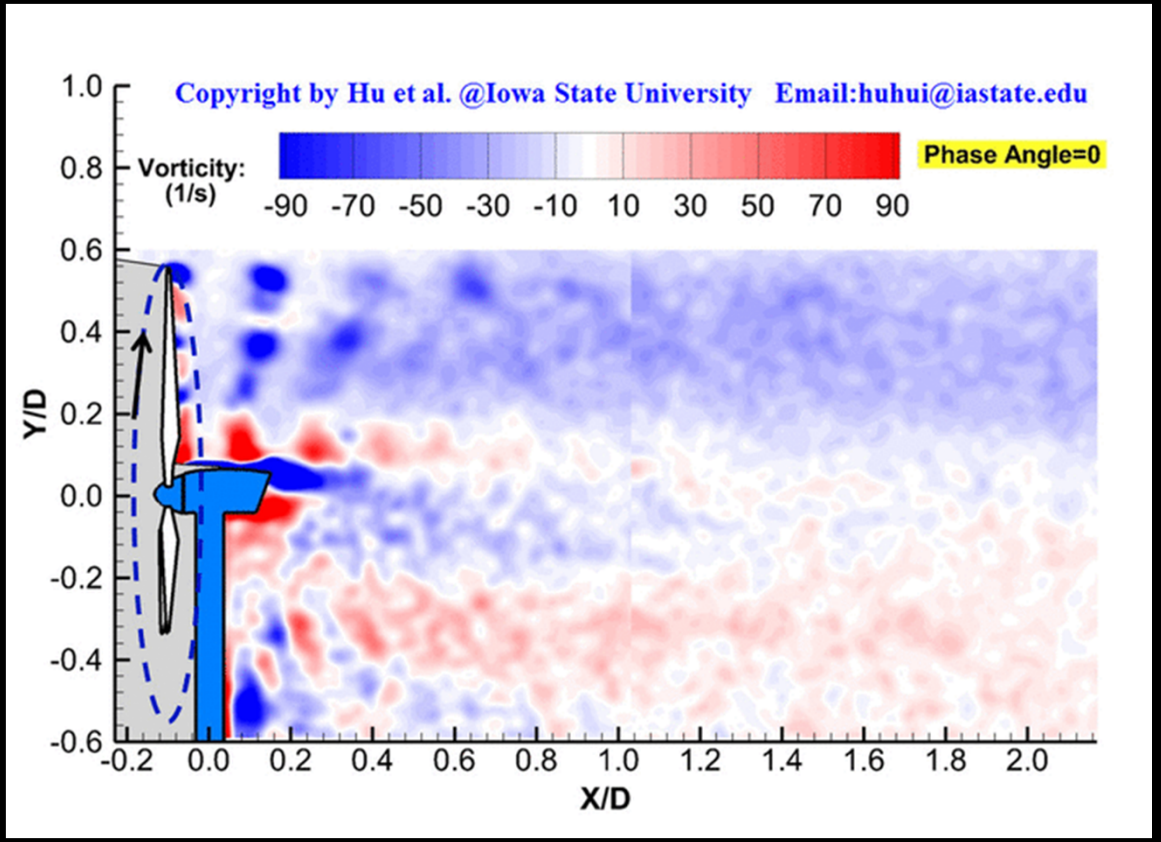
© David Bock (National Center for Supercomputing Applications)
Journal of Renewable and Sustainable Energy,

Helicopters may be affected by turbulence behind turbines.

HAZARD IN *FLIGHT* OPERATIONS #1:

Wake vortices and turbulent flow *behind* a Wind Turbine

...as much as *5 times the rotor diameter*.



HAZARD IN *FLIGHT* OPERATIONS #2:

Meteorological Evaluation Towers (aka “Measurement Tower”)

- Very difficult to see
  - 50-125 meters tall
  - Installed hours
- In the USA, many METs fall below the 60 meter federal law for markings.

HAZARD IN *FLIGHT* OPERATIONS #3:

Radar Signals

A wind turbine farm can cause problems with radar signals:

- *Weather radar*
  - Turbine shows as a “false echo” and can hide thunderstorms behind it
- *Air Traffic Control Radar*
  - Can create false targets and hide real targets.

HAZARD IN *FLIGHT* OPERATIONS #3:
Radar Signals

- In Europe, Eurocontrol designates requirements on planned wind turbines.
- The U.S. has determined 4 zones of impact (significant impact to unlikely impact).

HAZARD IN *RESCUE* OPERATIONS #1:
Weather Limitations

- Fog and clouds, heavy winds, stormy conditions are common
- Requires three rescue options:
  - Helicopter
  - Sea vessel
  - Combination (bring casualty to a vessel, ride the vessel outside the park and pickup from the vessel)

HAZARD IN *RESCUE* OPERATIONS #1:
Poor Visual Reference

- Pilots have poor visual reference when near vessels
  - Big vessels mean easy reference
  - Small vessels mean poor reference

HAZARD IN *RESCUE* OPERATIONS #1:
Rescue from Transition Piece

- Always have a “Plan B”
- ONLY if rescuers are not able to:
  - Raise the patient to the top of the turbine or
  - Lower the casualty to a vessel

HAZARD IN *RESCUE* OPERATIONS #1:

Rescue from Transition Piece

- The one key hazard on the transition piece is that you are not able to abort the lift as soon as you lift the patient / rescuer over the railing.
- For the flight crew, keep focus on the parameters specified in the SOP, this is important to keep the fleet angle of the hoist cable within the limitations of the manufacturer
- Medics must keep an eye on pre-lift preparation, including positioning of the rescue bag and rope management on the ground

HAZARD IN *RESCUE* OPERATIONS #1:
Rotor Brake must be LOCKED

- The rotor of the wind turbine has to be on brake/"locked”
  - Offshore - indicated via signal lamp on the turbines top.
  - Onshore - NO signal light, you must seek status
    - From the team onsite
    - Or the operation control center of the windfarm

Helicopter Rescue Operations

Offshore, the easiest exit point is the top of the nacelle.

Anti-rotation is critical - Rotation can lead to rotation trauma, or unconsciousness

Helicopter Rescue Operations

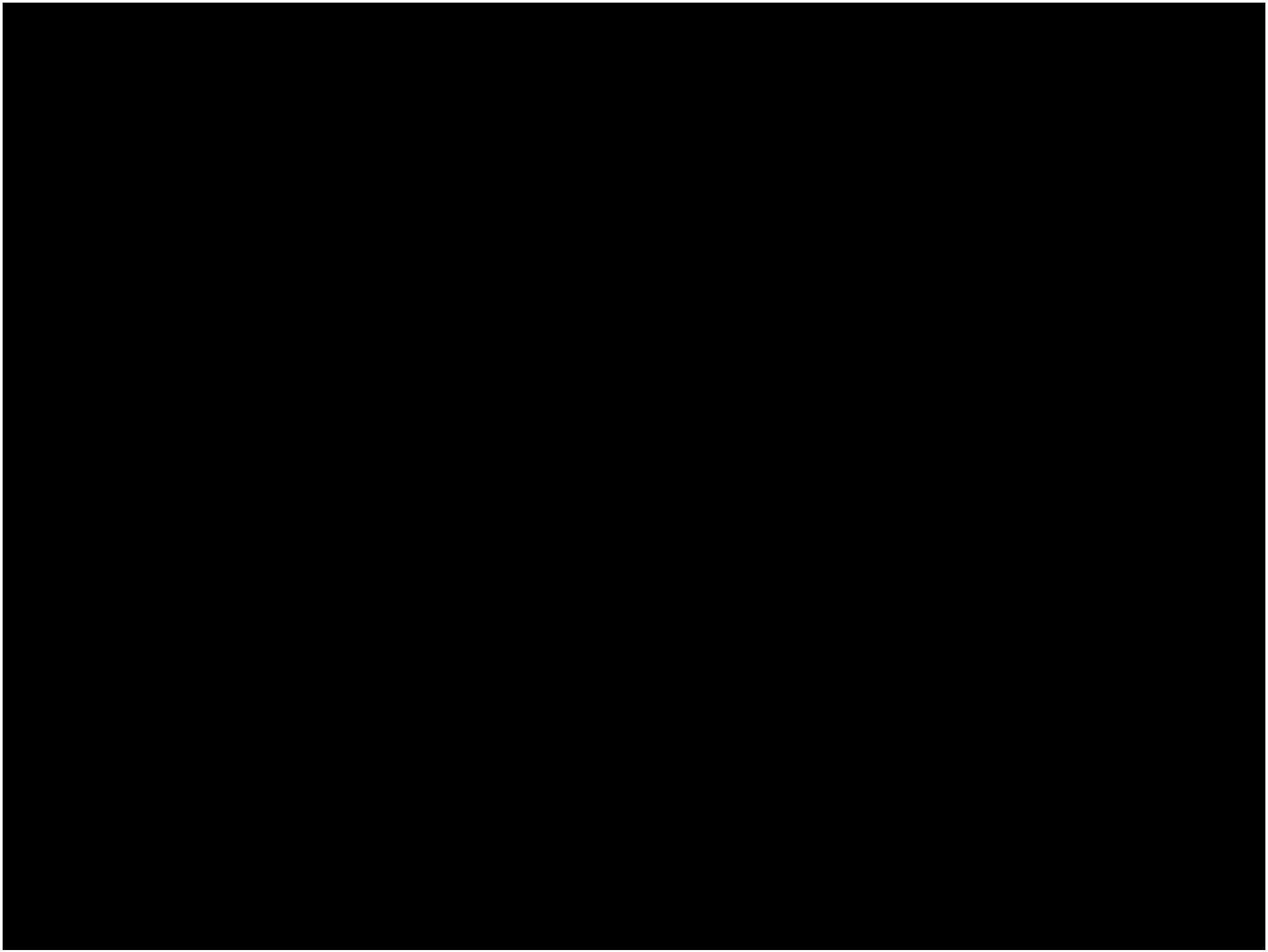
© Wiking Helicopters

Dangers of tag lines

- Risk of the tag line being snagged in the railing, and not releasing via break away link.

Example of Anti-Rotation Rudder

Video courtesy Wiking Helicopters

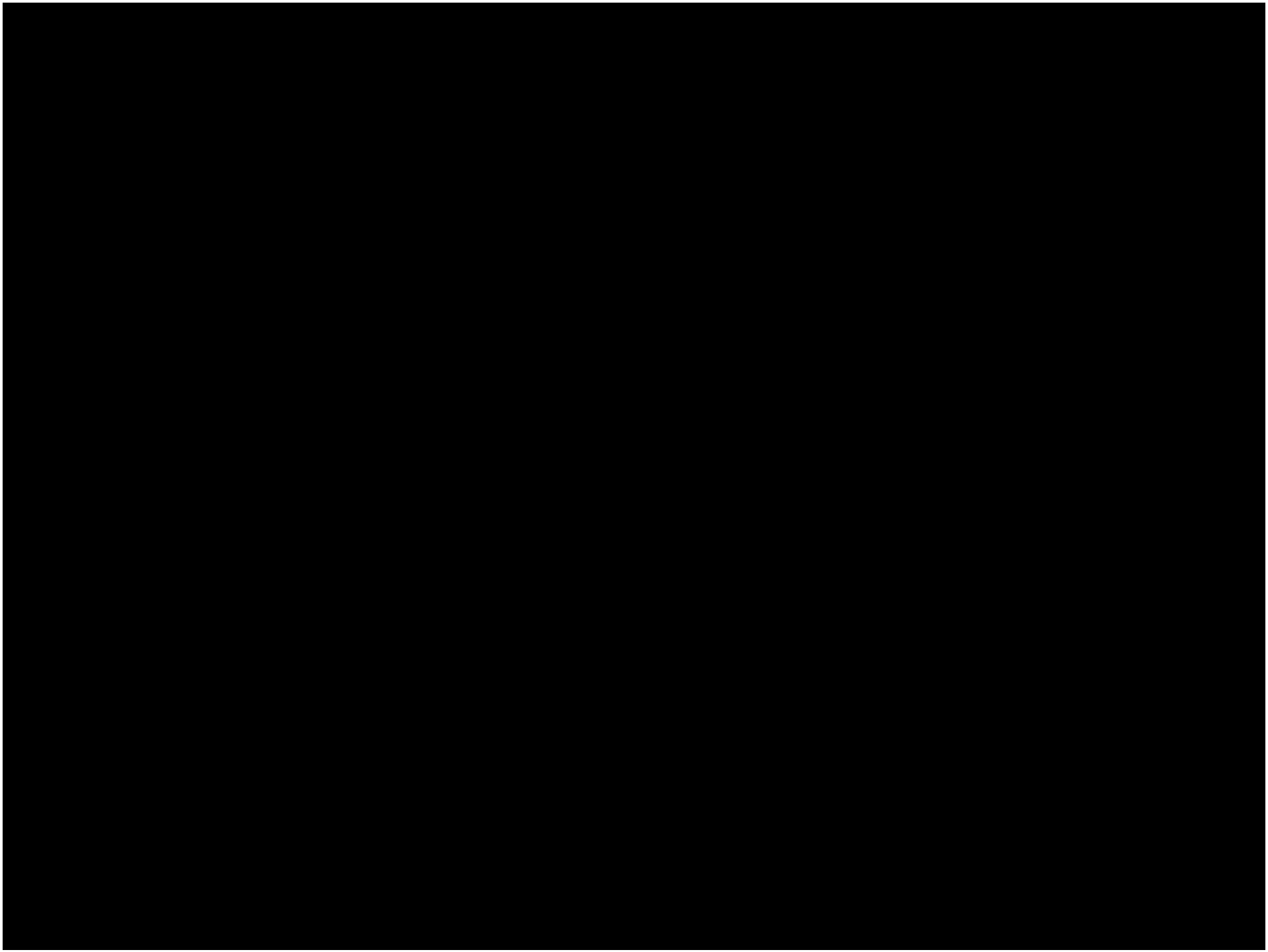


Video of Rescuer Extrication from the Nacelle

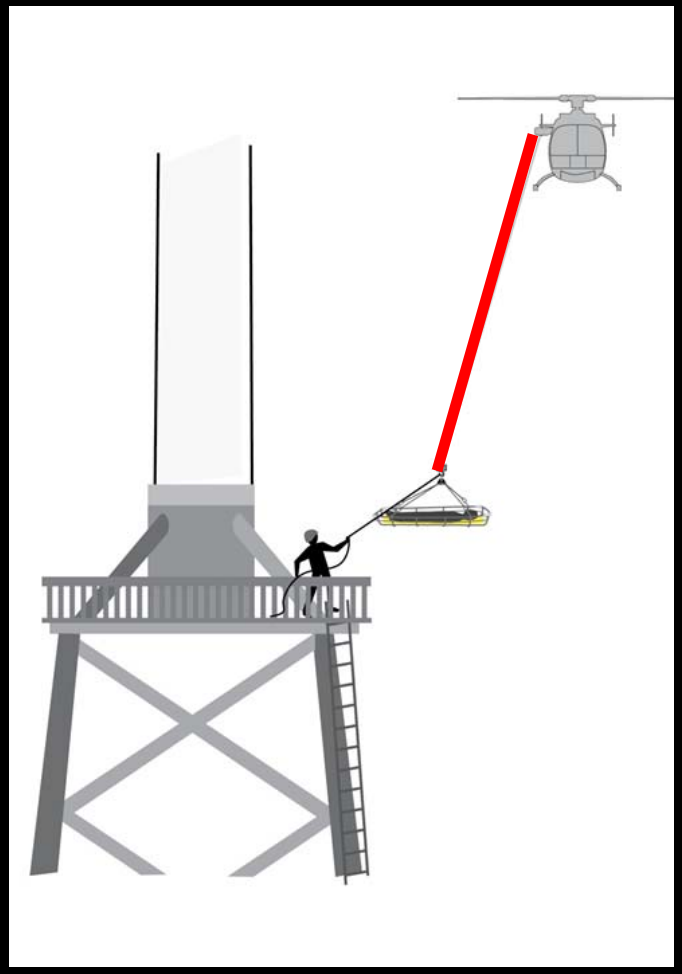
Offshore extrication of a rescuer from the top of the nacelle

Video courtesy Uni-Fly Helicopters

Wikipedia



Rescuer Extrication from the Transition Piece



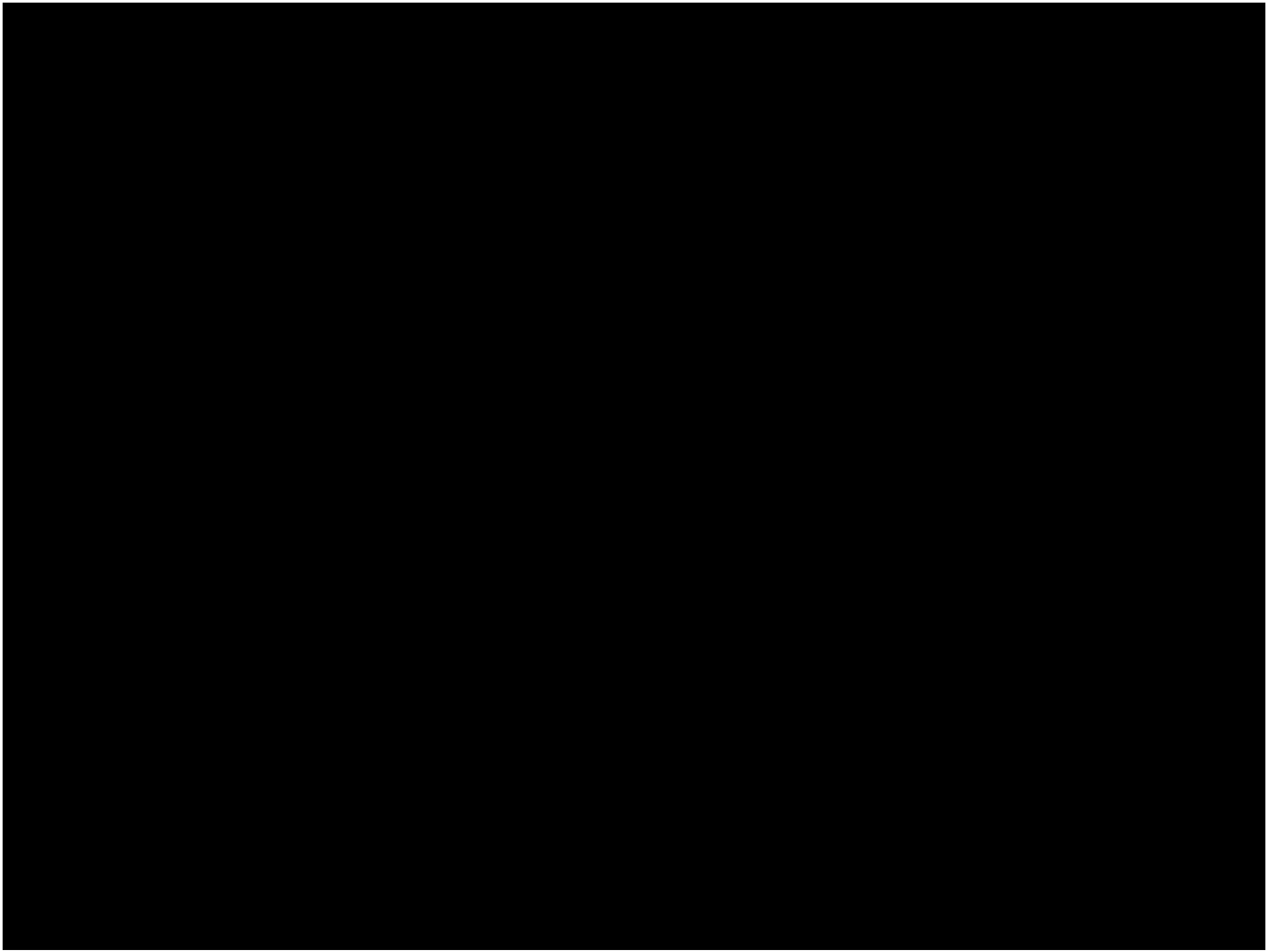
Drawing courtesy Axel Manz

- The main rotor must have enough clearance from the tower.
- The angle of the cable must be within the manufacturer's limits.

Video of Rescuer Extrication from the Transition Piece

Training for an extrication of a rescuer from the Transition Piece using an onshore training facility

Video courtesy Wiking Helicopters



Video Example #2 of Litter Rescue

© Wiking Helicopters

Training for litter extrication from the transition piece.

- Using anti rotation rudder
- Using an unattended litter

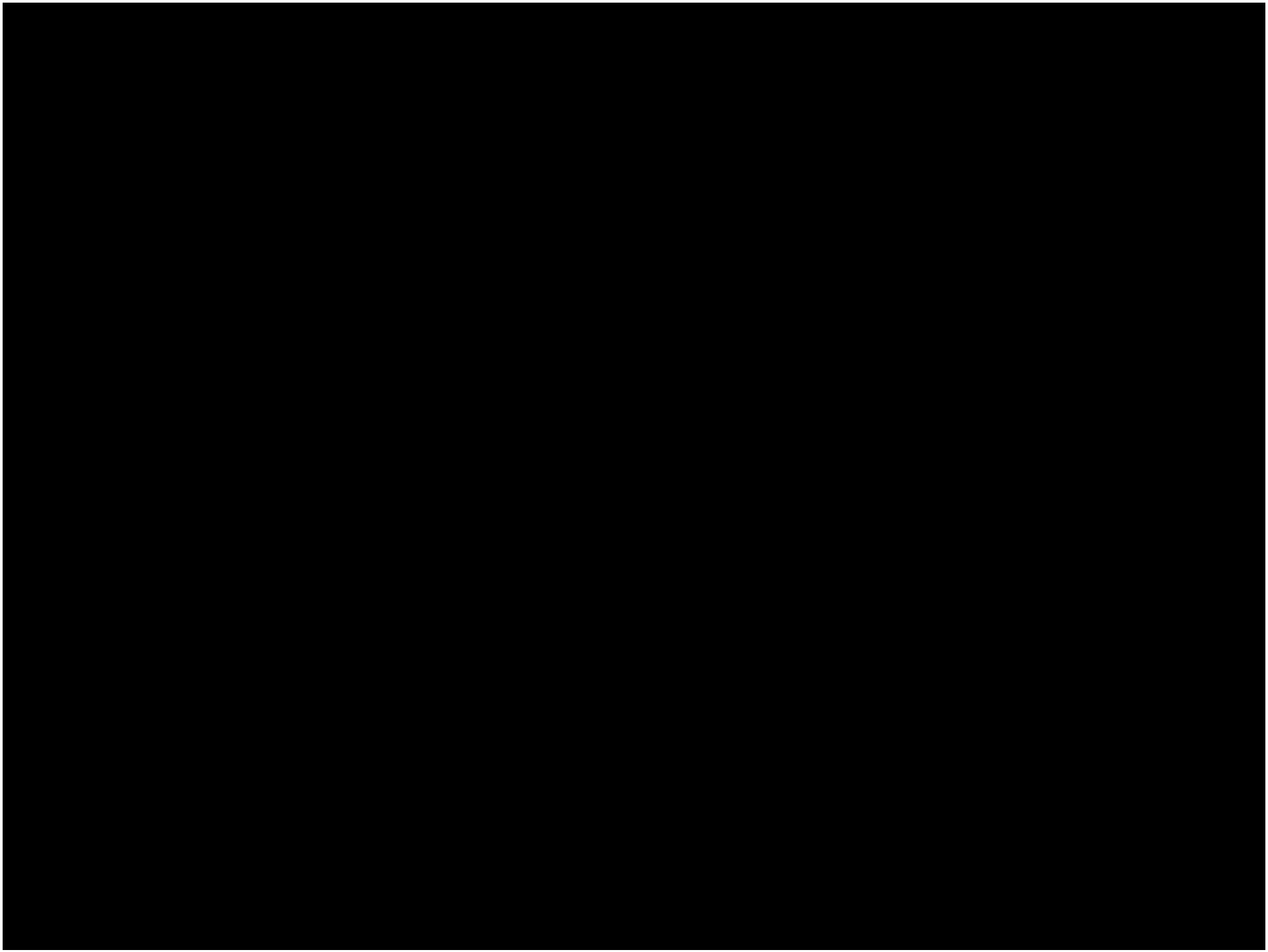
Video courtesy Wiking Helicopters

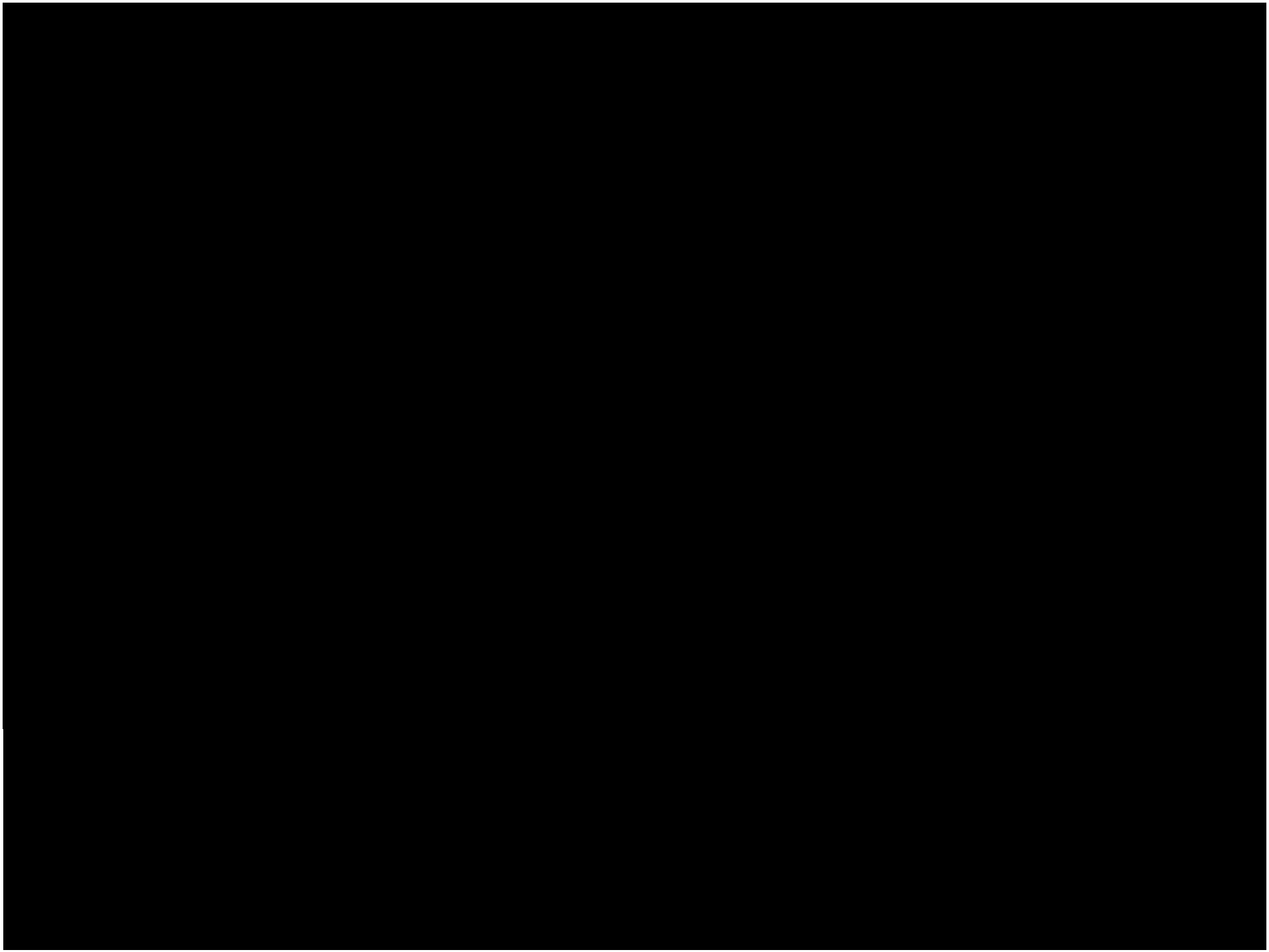
Video Example #3 of Litter Rescue

© Wiking Helicopters

- Airlift of litter from the top winching platform.
  - Using an attendant and anti rotation rudder.

Video courtesy Wiking Helicopters





Offshore Wind Farms

Offshore represents <10% of the global market, but *that will increase substantially* in the coming five years.

© Vertical Magazine

HeliOffshore

HeliOffshore has a new *Wind Farm Group* with 3 sub-groups

- Safety strategy
- Helidecks
- Search and rescue (SAR)
  - Accident reports on HeliOffshore website

HeliOffshore

The companies involved in the group so far are:

- Leonardo Helicopters
- Bell
- Airbus Helicopters
- Wiking Helikopter Service
- CHC Helicopter Bristow Group
- Heli Service International
- HTM Helicopters
- KN Helicopters
- NHV
- Era
- Equinor
- and wind turbine manufacturers

HeliOffshore

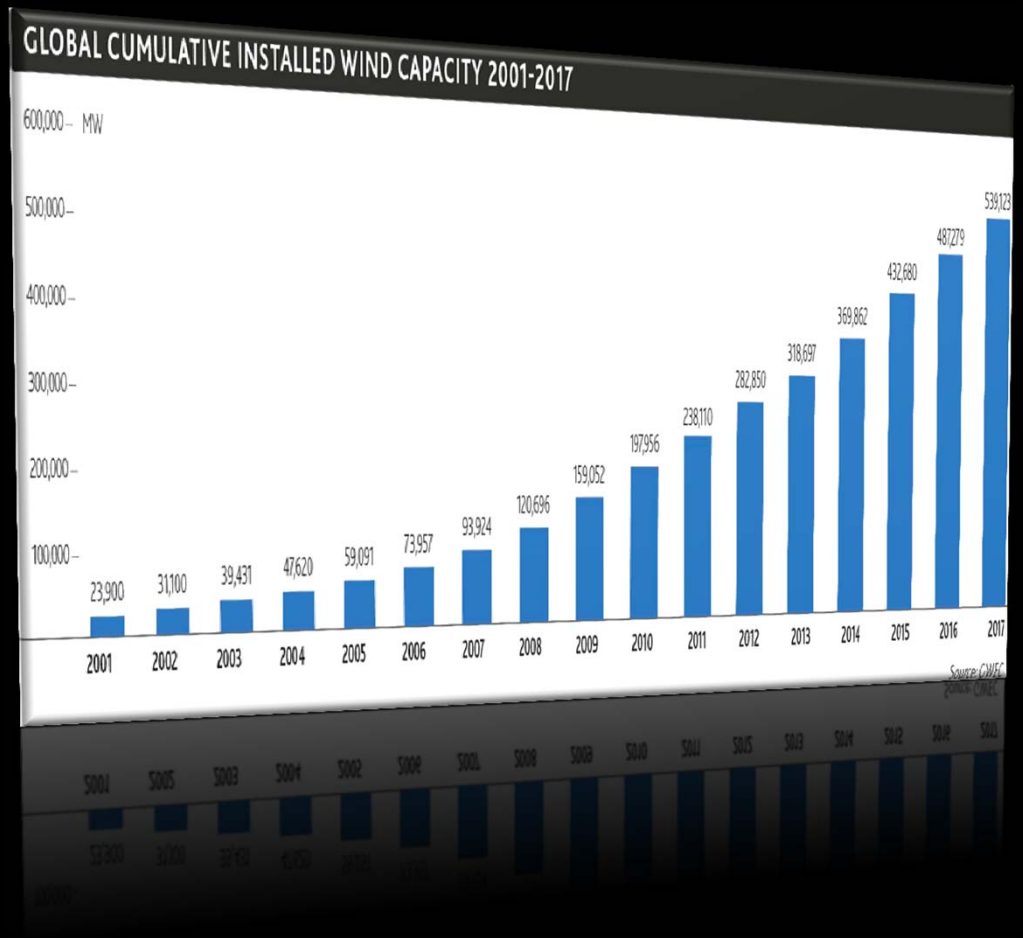
Offshore Wind Event, 2018.

The new group's first meeting is THIS WEEK at the 9th annual Offshore Wind Event.

It will publish new guidelines in 2019.

Wind Turbine Hazards and Rescue Operations

Let's prepare!



Industry growth will impact the rescue community worldwide.

Wind Turbine Hazards and Rescue Operations

Merci,
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danke,
grazie.

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