

# Complications with implementing Nacelle LIDAR PCV on V164

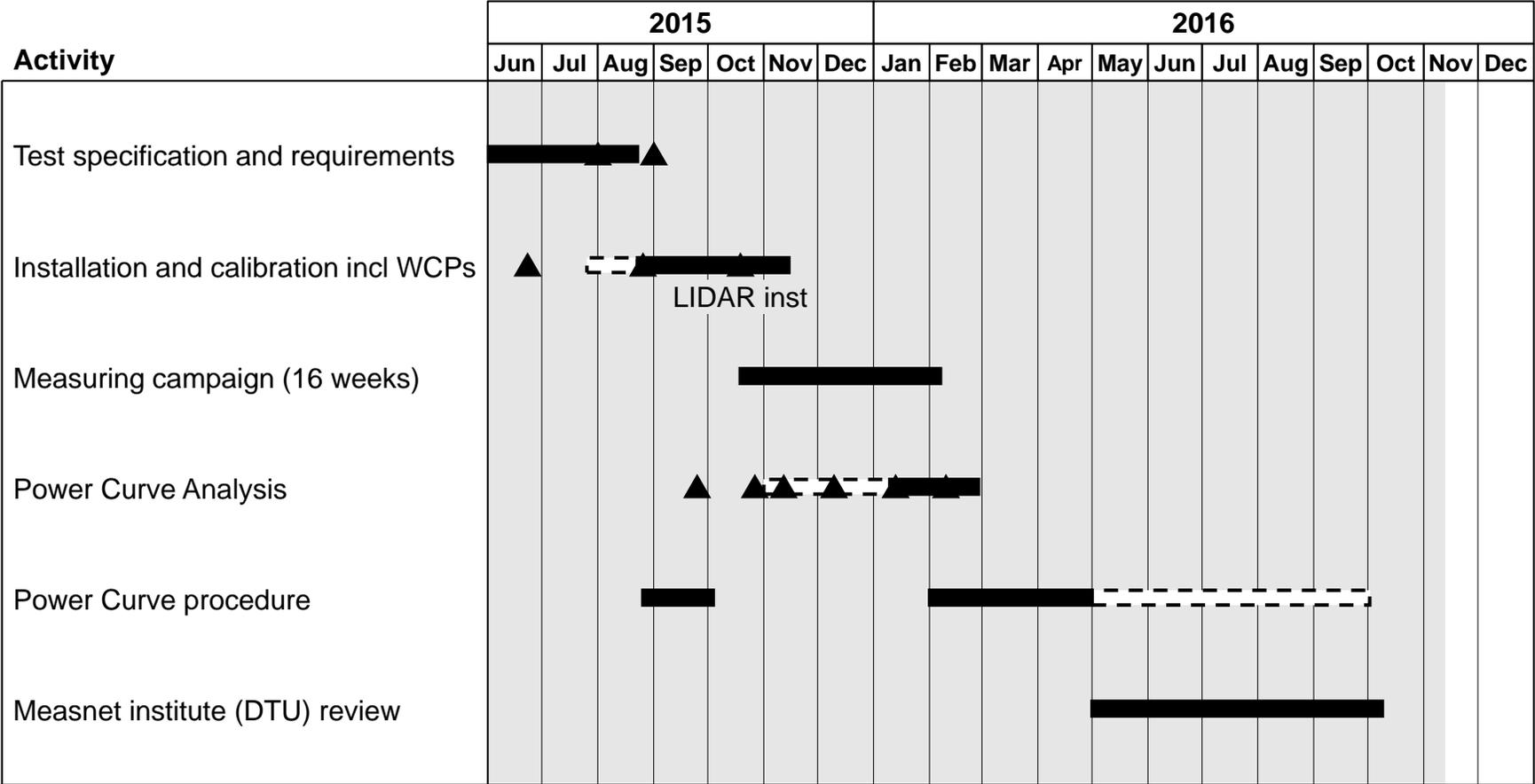
## Presentation to Unitte poject at DTU/Risø 15<sup>th</sup> November

# Agenda

- ❖ **Introduction**
- ❖ **Voice-of-the-customer**
- ❖ **Mounting considerations**
- ❖ **General observation on PCV precision and accuracy**
- ❖ **Summary**

# Introduction

Measuring campaign at Østerild and development of power curve procedure completed



WindIris LIDAR installed on V164

# Voice-of-the-customer

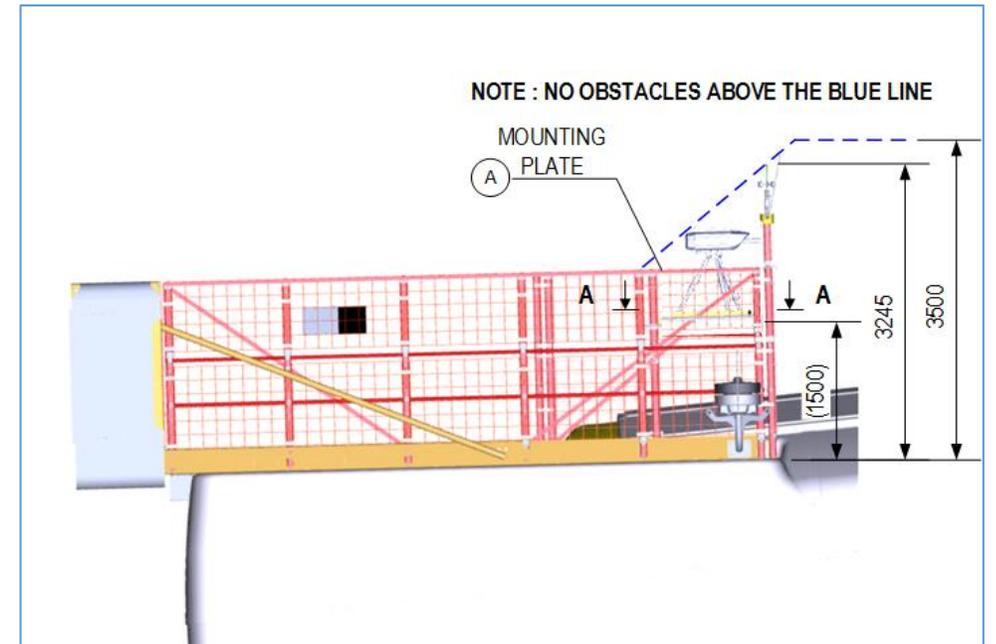
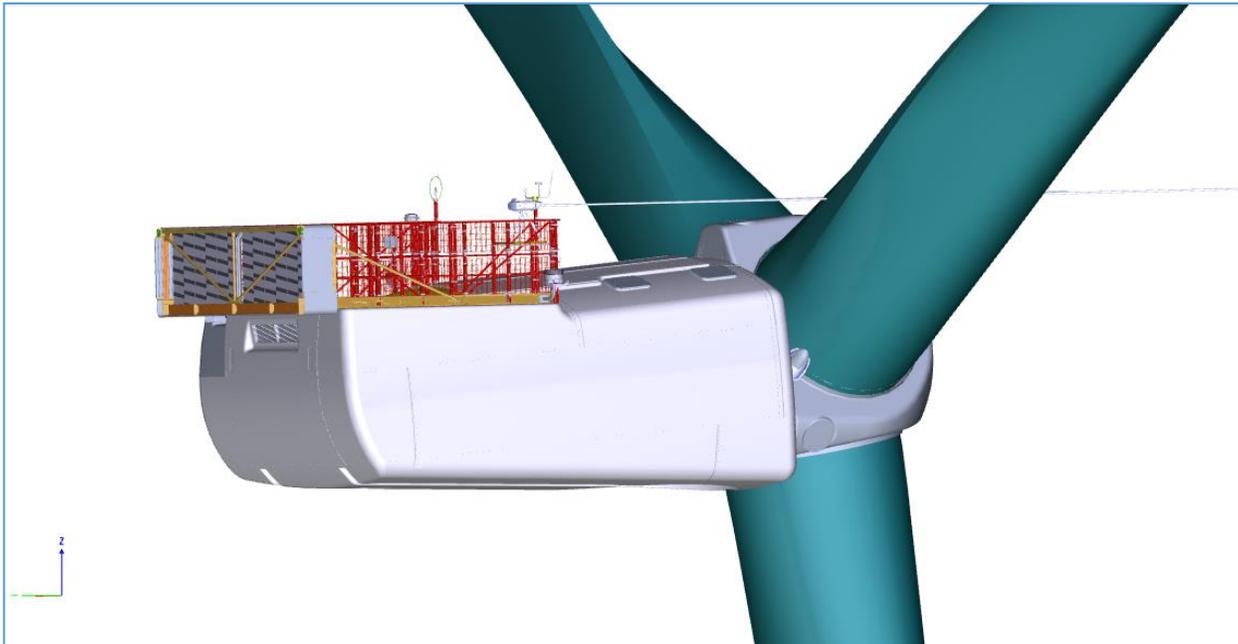
Nacelle mounted LIDARs needs first of all to measure horizontal precise and accurate. However several additional requirements shall be satisfied

| Requirement to PCV   | Importance (1-10) | Comments   |
|--|-------------------|--|
| Measuring range minimum 2.5 D (410+ m)   | 8                 | Most LIDARs only specified and documented up maximum 400 m   |
| Reliability and track record   | 4                 | Still new technology; some but limited experience available, but no statistical data available in Vestas/MVOW        |
| Data availability (high)   | 2                 | Limited data availability will prolong measurement period  |
| Measuring height at hub height +/- 2.5% (proposal for +/- 1.0%)                | 9                 | As minimum tilt and roll measurement to locate LOS height, but possibly adjustment by internal LIDAR software        |
| Measurement of horizontal wind speed (precision and accuracy)                  | 10                | Documented accuracy be calibration (by accredited measuring institute or come with LIDAR)                            |
| Measurement of other wind parameters (direction, shear, veer, turbulence, etc) | 5                 | Possible in 2nd generation LIDARs  |
| Safety (Eye-safe)  | 6                 | Not real concern as most LIDAR have eye-safety zones defined   |
| Positioning (on nacelle roof)  | 7                 | Need careful considerations to not obstructing LOS and HSE requirements  |
| Compliance to IEC 61400-12-1   | 9                 | Traceability to cup anemometer on metmast procedure to secure transparency and fit the definition of the power curve |
| Site service and back office support   | 1                 | Several available measuring institutes   |

# Suitable location for mounting appeared to be first obstacle

Few available positions and need to accept close vicinity to anemometer for wind turbine

- ❖ HSE prohibits walking on nacelle roof outside heli hoist area
- ❖ Nacelle tilt and height of spinner requires LIDAR to be elevated to not obstruct LOS
- ❖ Helicopter access prohibits obstacles certain areas
- ❖ Only (or most suitable area) in the escape area in both sides of the heli hoist area. Not ideal as the location is close to the anemometer for the wind turbine possibly influencing the measured wind speed by the turbine



# Summary

Positive results achieved in one test, but limited statistical results publicly available. Nacelle LIDAR for PCV is still new technology.

- ❖ Horizontal wind speed from WindIris documented high correlation to metmast at large distance. Other makes expected to be able to perform similarly:
  - Need show documented performance at 420-450+ m
  - **General calibration procedure required** covering various makes and types
  - Attention to mounting shall be considered
  
- ❖ Good results achieved at Østerild, but **limited statistical results** available to MVOW:
  - How to handle atmospheric stability? Filtering by measure other wind speed parameters such as shear and veer
  - How precise are LIDARs? Should calibration constants be applied
  - How accurate are LIDARs? Good guidance on uncertainty calculation available in literature, but subject to discussion in lieu of missing standards

Let's move the horizon.