



CL-Windcon

Closed Loop Wind Farm Control

New wind power plant control in the framework of existing certification schemes

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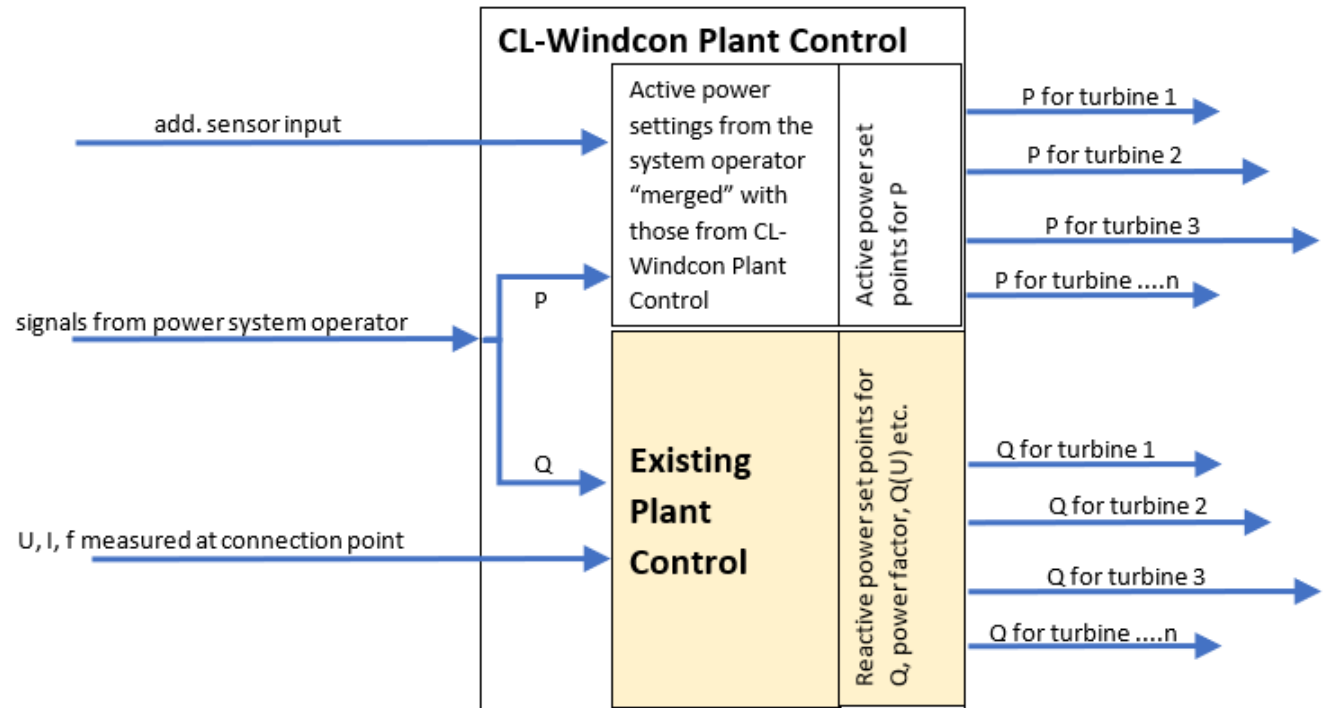
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DO WE HAVE THE STANDARDS TO CERTIFY CL-WINDCON PLANT CONTROL (CLW-PC)?

Review on:

- Control System
- Grid Code Compliance
- Loads



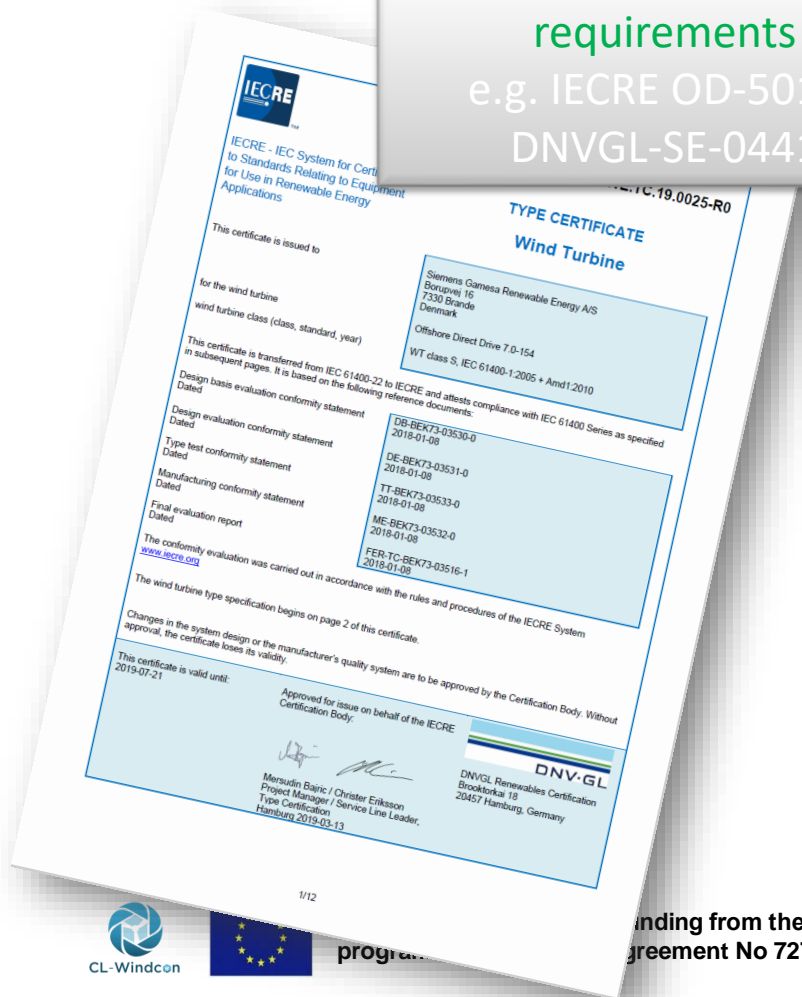


TYPE CERTIFICATE

WIND TURBINE LEVEL

Mechanical, structural and electrical design requirements
 e.g. IECRE OD-501 or DNVGL-SE-0441

Grid Code Compliance (GCC) requirements
 e.g. FGW TG8 or DNVGL-SE-0124



program

financing from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska Curie grant agreement No 727477



PROJECT CERTIFICATE

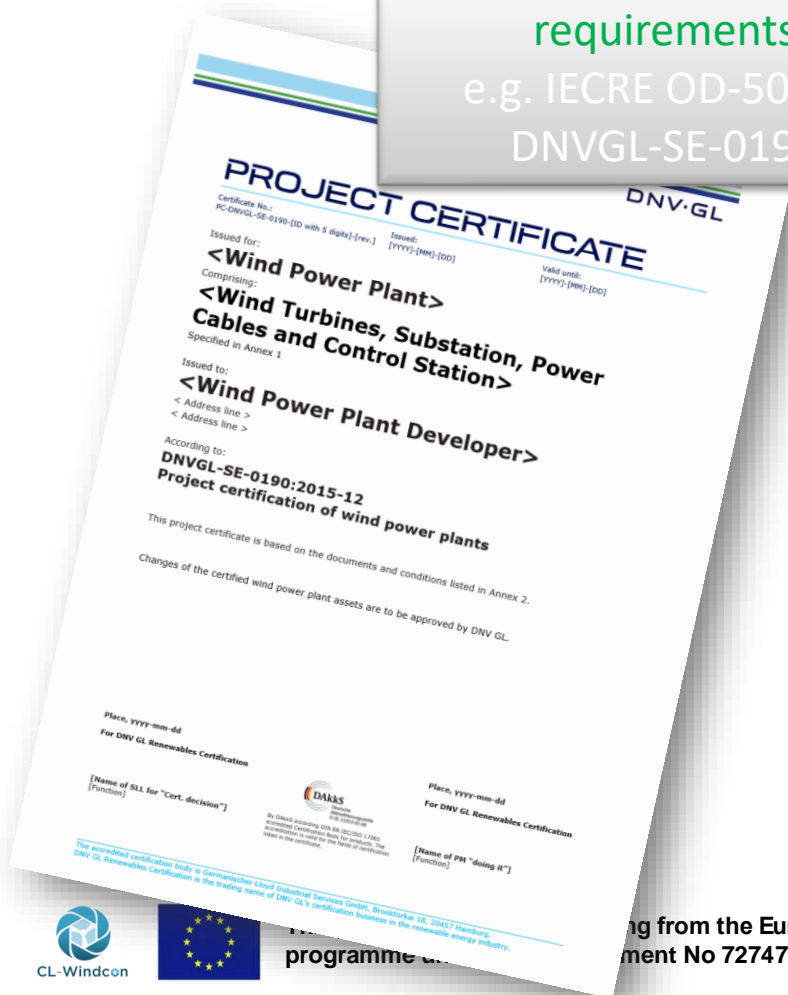
WIND FARM LEVEL

Mechanical, structural and electrical design requirements

e.g. IECRE OD-502 or DNVGL-SE-0190

GCC requirements



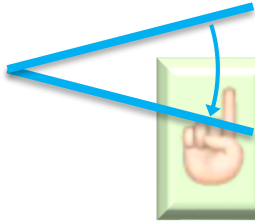
e.g. FGW TG8 or DNVGL-SE-0124

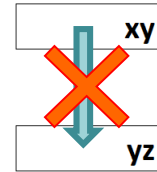




CONTROL SYSTEM

PRACTICAL RECOMMENDATIONS

- Commands from CLW-PC shall never override protection functions or parameters in WT control!
- Tune protection functions carefully! 
- Add possible failures to WT failure analysis! 
- Calibration of wind vane up to 40 ° yaw misalignment! 



Change of standards not suggested



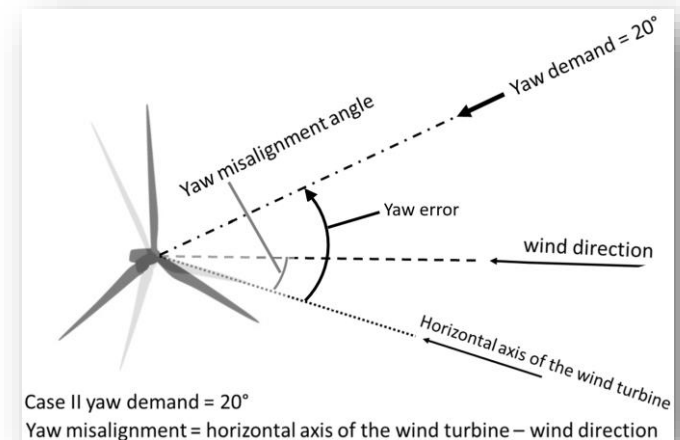
CONTROL SYSTEM

SUGGESTED CHANGES FOR STANDARDS

- Testing for certification:
 - all demand values from CLW-PC to wind turbine
 - all actual values from wind turbine to CLW-PC

- Commissioning:
 - all CLW-PC functions
 - all communication lines

- Inspections:
 - for maintenance of Project Certificate inspection program to be extended acc. to CLW-PC

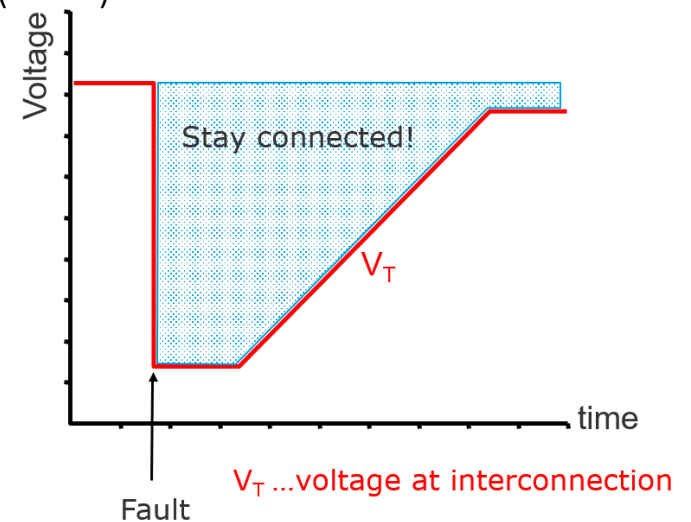


Change of standards is suggested!!!



GRID CODE COMPLIANCE

- Grid Codes request wind power plant control to ensure stability of electrical grid
- Wind farm receives set points from the network operator regarding
 - active power
 - reactive power, power factor or voltage control
- Functions implemented by Existing Plant Control (E-PC)
- E-PC and CLW-PC functions partly overlap and must be merged





GRID CODE COMPLIANCE

SUGGESTED CHANGES FOR STANDARDS

Design

- Clear hierarchy between E-PC and CLW-PC
- Functionality for override of CLW-PC to be ensured
- Extension of electric simulation models including validation for CLW-PC

Testing

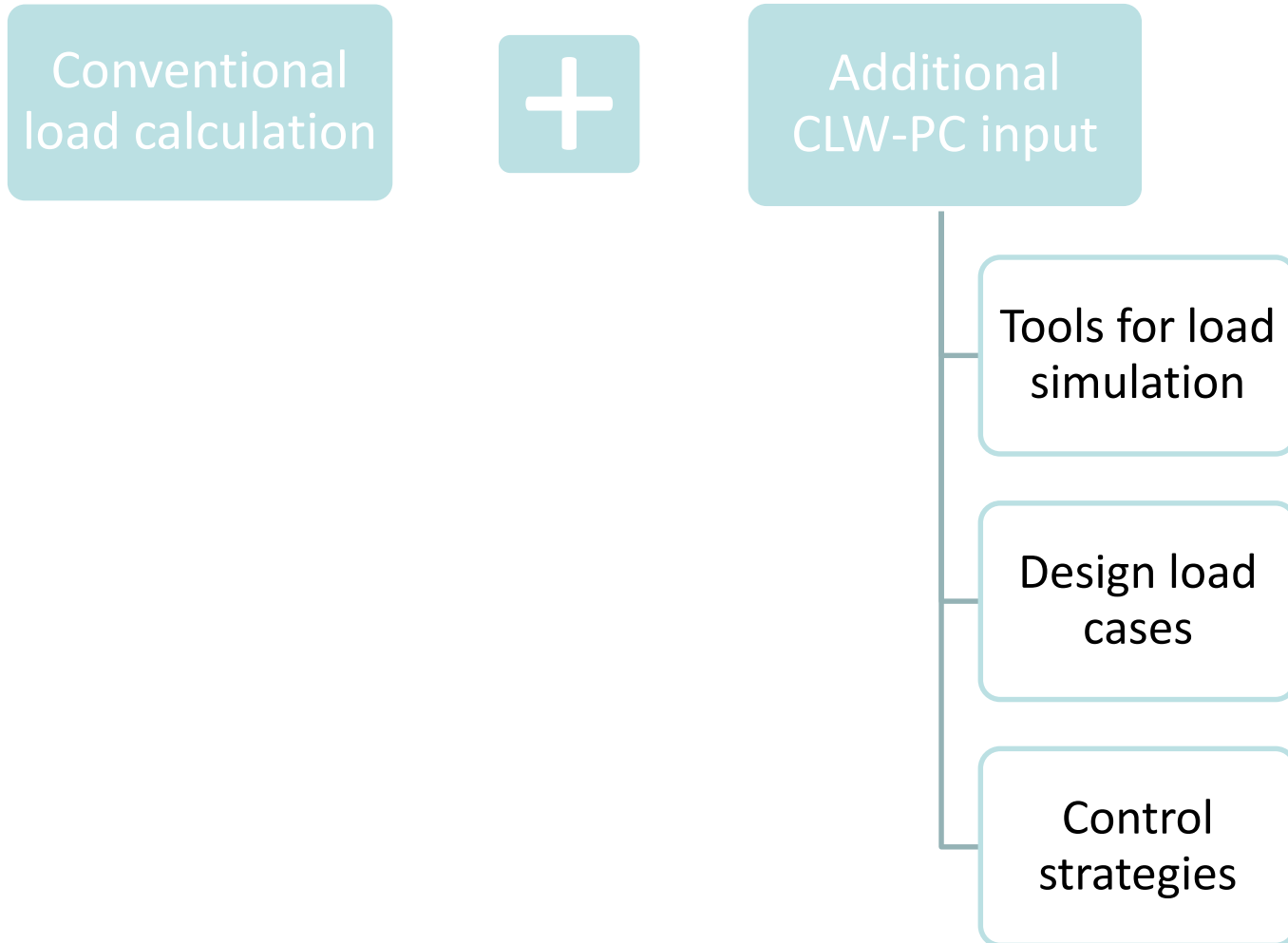
- FRT including tests for high yaw misalignment. Design loads!
- Priorities and co-ordination between CLW-PC and the E-PC
- Controllability of active power
 - IEC61400-21-x should be changed!!!

Change of standards is suggested!!!



LOADS

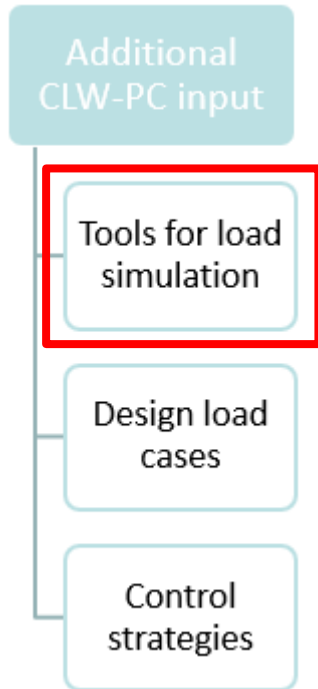
SITE-SPECIFIC LOAD CALCULATION FOR CLW-PC





LOADS

TOOL VALIDATION



Novel tools require validation

- Need of adapted and validated design tools and models for industry and certification
 - blade element method probably invalid for large yaw errors
 - wake location, DWM model
 - wind farm simulation

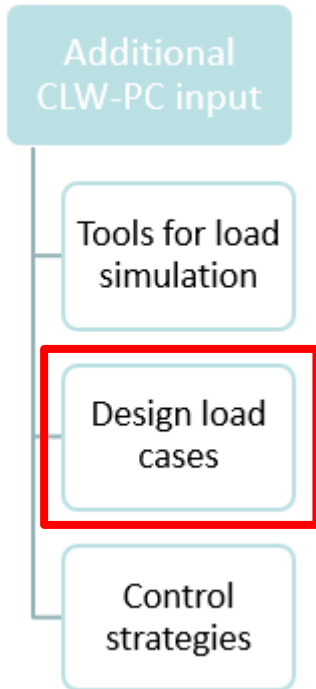
Change of standards not suggested



LOADS

DESIGN LOAD CASES

Change of standards is suggested!!!



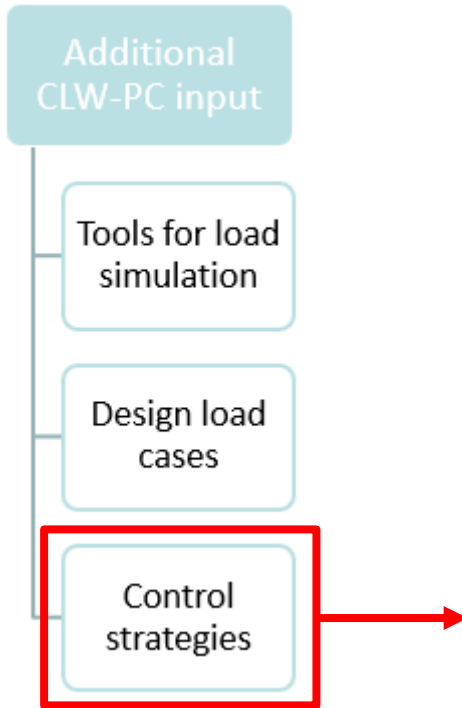
Additional load cases

- Consider all cases dependent on detailed control strategy acc. IEC61400-1 Ed.4
 - all possible actions and faults initiated by CLW-PC
 - wake operation
 - Distinction between acting turbines and affected turbines
 - Acting and affected turbines might change dependent on external conditions, e.g. wind direction



LOADS

CONTROL STRATEGIES



Change of standards not suggested

Increased complexity

- Consider all load reduction strategies
- Identification of turbines with highest fatigue and extreme loads is laborious
- Need to define a subset of operational conditions to minimize the effort.



CONCLUSION

- It is possible NOW to certify CLW-PC by proper interpretation of existing standards!
 - to be agreed with certification body in advance (e.g. tools, design load cases...)!
- Changes of standards suggested for:
 - testing, commissioning, inspection
 - GCC
 - design load cases
- Step-wise introduction to gain more experience
- Good balance for level of requirements in comparison to “conventional” design

THANK YOU!

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www.clwindcon.eu



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