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Proposals for WFC certification approaches and perspectives of OEM's and operators

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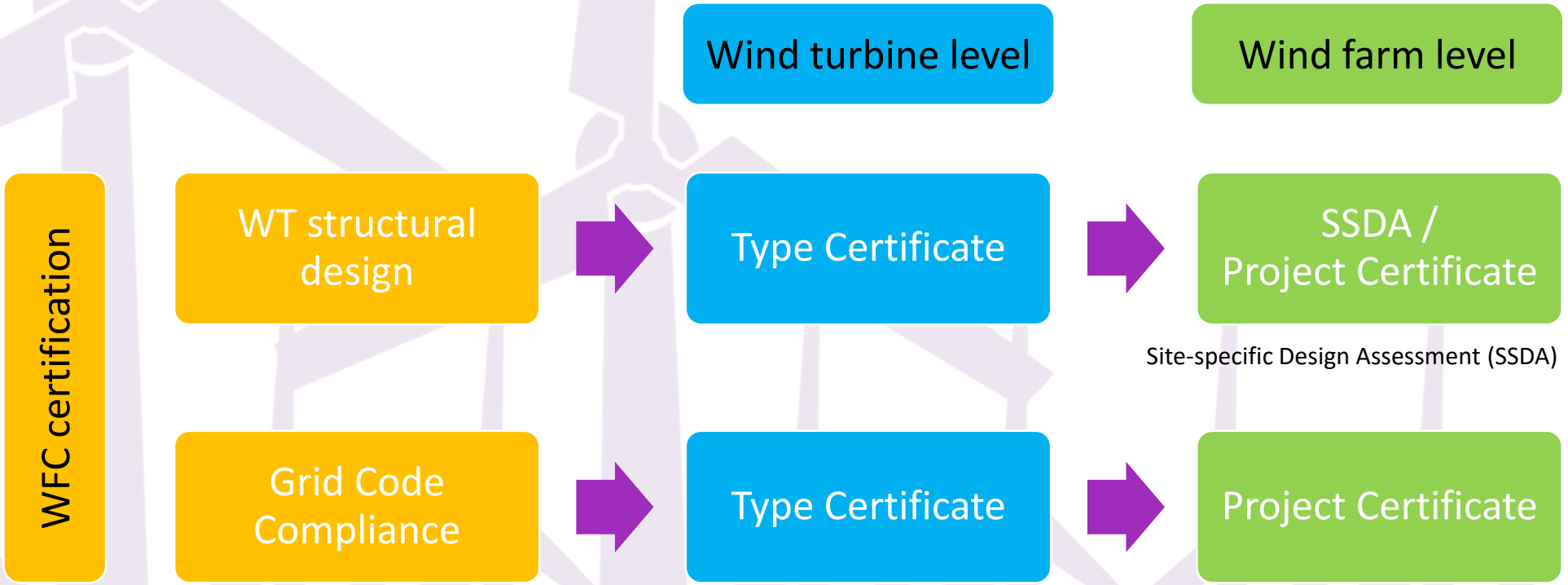
Introduction



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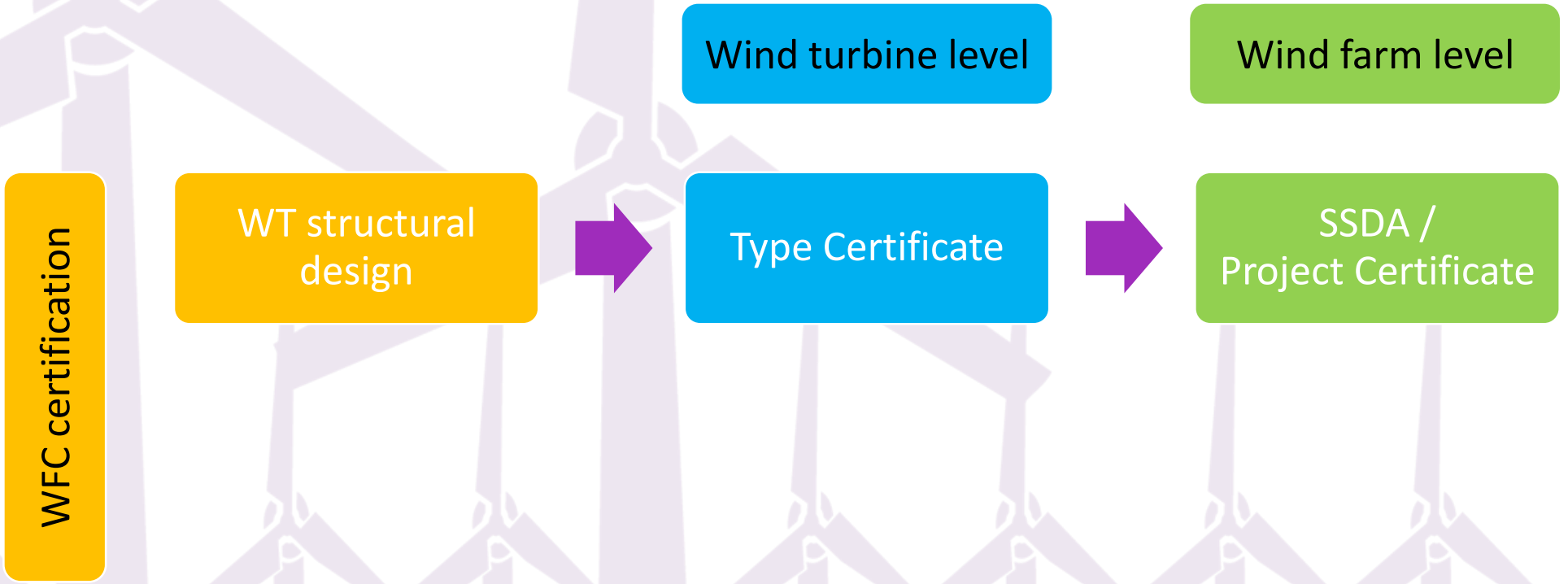


… for wind farms to be retrofitted with WFC functionalities
… for wind farms designed to apply WFC

DNV GL proposals for WFC certification approaches

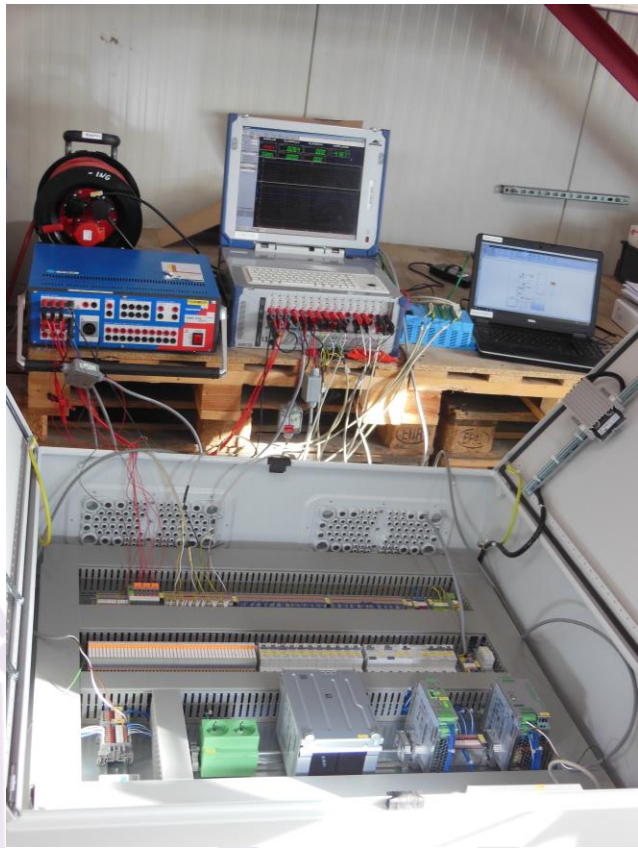
WFC certification Approach 1 – Straightforward integration

- First projects expected to comprise less complex WFC features
  - integration might be easily realised for existing turbine types.
  - straightforward certification

- Example:
  - Look-up table based “induction control” for selected turbines of wind farm
  - Simple argumentation that loads cannot exceed existing envelope
    - Certification by inclusion into existing Type Certificate /SSDA

WFC certification Approach 2 – Risk-based certification

- Limited guidance for WFC certification in existing standards
  - Clear guidance missing for more complex new WFC designs
- For more complex new designs – Technology Qualification according to DNVGL-RP-A203
  - Assess new technology using risk-based approach
  - Possibility to mitigate risks: measurement project on performance of WFC
  - Provide clear path to desired certification, e.g. SSDA
  - Reach comparable safety level as Type and Project Certification



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WFC certification Approach 3 – Certification facilitated by measurements

New approach in **DNVGL-SE-0190 section 8.13 "Wind farm control"** ed. 2020!

- Case: Simulation model / tool validation appears difficult
  - Within SSDA load simulations are assessed by plausibility checks only
    - ➢ issue of "conditioned" SSDA covering WFC
  - Measure the performance of the WFC during first years of operation
  - After confirmation of initial assumptions by measurements
    - ➢ DNV GL issues "unconditioned" SSDA with intended wind plant configuration

Perspectives of

- WT OEMs
- operators
- DNV GL as certification body

Perspectives of wind turbine OEMs

- Too large computational effort for wind farm simulation tools
- Not practical for design load calculations and thus not for certification
- Prefers risk-based approach for certification
- “Certification facilitated by measurements” approach is seen as an option for wind farms to be retrofitted with WFC features.
- Prefers verification of WFC features already in the type certification phase or as type certificate amendment option.
- Power curve verification is a standard package of type certification. OEM asked for new certification service to confirm increase of Annual Energy Production (AEP) by WFC

Perspectives of operators
Current situation

- WT OEMs only slowly ready to sell WFC functionalities for GCC adapted to the individual requirements of the operator
- Focus is mainly on grid connection and requirements from direct marketer rather than addressing new WFC functionalities (optimisation of loads / AEP / operation)

Perspectives of operators

- Will only implement WFC if risk is low or manageable!
- Requires WT OEM to provide interface which allows routing of set points
- Operator does not investigate and take responsibility for the influence of WFC on fatigue loads.
- Expects from certification of WFC that WT OEMs take care about site specific conditions and compliance with the load design envelope of WT
- Retrofit installation to be aligned with WT OEM to avoid warranty conflicts
- Requires WFC functionalities to include ability for “ancillary services” (although not yet marketed)

Perspectives of certification body / conclusions

- No relevance of AEP and optimization tasks for certification!
- Ensure clear interfaces between WT OEM and operator regarding impact of operation on fatigue load
- Limit load certification efforts / ensure proper validation of models for wake and load simulation of wind farm
- Atmospheric conditions expected to become relevant parameter for site assessment
- Site-specific controller design
- Valuable output from FarmConners expected – certification possible today!

Questions?