VERSION NOTES

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Certified versions: windPRO 3.3 and windPRO 3.0

The windPRO modules SITE COMPLIANCE and LOAD RESPONSE have previously been certified by TÜV SÜD.
The original certification was based on the model-framework implemented in windPRO version 3.0.
In windPRO 3.3 SITE COMPLIANCE was certified according to IEC61400-1 ed. 4. IEC ed. 4 did not require
changes to LOAD RESPONSE which is still aligned with the original version that was certified.
Since these certifications the following features have been added in the successive later windPRO versions.

Current version: windPRO 4.0

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 4.0 remain identical to
those implemented and certified in windPRO versions 3.0 and 3.3. However, windPRO 4.0 includes minor
additions, which have not been evaluated or certified:

- **Directional tower loads in LOAD RESPONSE**
  New option added to include the effect of wind direction on the fatigue accumulation in wind
  turbine towers.
- **Downscaling in SITE COMPLIANCE**
  New option added to use the windPRO SCALER within SITE COMPLIANCE.
- **Spectral Correction in SITE COMPLIANCE**
  New option added to apply a spectral correction in extreme wind calculations based on model data.
- **Offshore mode in SITE COMPLIANCE**
  New settings option added for offshore sites.
- **Tropical Cyclone Analysis in SITE COMPLIANCE**
  New calculation added to quantify tropical cyclone extreme wind speeds.

Previous version: windPRO 3.6

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.6 remain identical to
those implemented and certified in windPRO versions 3.0 and 3.3. However, windPRO 3.6 includes minor
additions, which have not been evaluated or certified:

- **New option for more flexible Class S definition on individual turbines**
  Flexible class S definitions can now be defined on each individual WTG object.
- **Support for Class S extreme turbulence input**
  Users can now define flexible wind speed dependent Class S extreme turbulence.

Previous version: windPRO 3.5

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.5 remain identical to those implemented and certified in windPRO versions 3.0 and 3.3. However, important additions have been included in 3.5 (and in earlier versions), which have not been evaluated or certified:

- **New option to make DNVGL-ST-0262 compliant lifetime calculations**
  New calculation of uncertainty level of lifetime for generic models and general documentation of alignment with the standard.
- **Further increased flexibility in definition of Class S turbine models**
  The design Weibull k-factor may now be flexibly defined as well as design wind shear and design air density.
- **Ambient site result mode – using '.siteres' files from e.g. resource calculation or GASP**
  Precalculated 'resource' files with ambient climate parameters for all the relevant siting parameters may now be used as a calculation basis as alternative to directly using measurements and/or flow models.

Previous version: windPRO 3.4

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.4 remain identical to those implemented and certified in windPRO versions 3.0 and 3.3. However, important additions have been included in 3.4 (and in earlier versions), which have not been evaluated or certified by TÜV SÜD:

- **New option to include 'DLC Other' (mainly DLC 3.1, 4.1, 6.4) in LOAD RESPONSE**

In LOAD RESPONSE the minor contribution from other fatigue related design load cases (DLCs) may be included for both generic and specific turbine models. The manual appendix on fatigue theory describes further details

Previous version: windPRO 3.3

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.3 remain unchanged and identical to those implemented in windPRO version 3.0. However important additions have been included in 3.3 (and earlier in 3.2 + 3.1), which have not been evaluated or certified by TÜV SÜD:

- **New default option for wind shear: "Ignore all displacement heights in shear estimates"**
  This option is introduced to ensure that wind shear used in load simulations is not underestimated due to displacement heights, if the displacement is not passed to and used in the load simulations.

- **Info on related design load cases (DLC) if a check fails critically**
  A simple info in the commentary field of each check that indicates the relation between the check and the design load case it directly relates to, and which has to be evaluated when the check fails.

Previous version: windPRO 3.2

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.2 remain unchanged and identical to those implemented in windPRO version 3.0. However a number of important additions have been included in 3.2 (and earlier in 3.1), which have not been evaluated or certified by TÜV SÜD:

- **Flexible "Class S" assessments in SITE COMPLIANCE and LOAD RESPONSE**

A flexible definition of class S implemented with explicit TI at each wind speed bin and not via Iref.

- **Improved wind shear calculation option**
  Previously the wind shear was always based on the sector tabulated data for each height in meteo object. In cases with erroneous direction data at some heights or with very strong turning across heights this could lead to unreliable shear estimates. The new options allow the use of concurrent samples across heights only binned according to the direction data for the main height, which is more robust.

- **Extreme wind method "EN1991-1-4" for other flow models than WEng**
  The Euro Code (EN) method has been extended to work also for WAsP and WAsP-CFD. In both cases the raw flow perturbations are always used directly to represent 'neutral' atmospheric conditions, suitable for extreme wind speeds.

- **Added "COV" option for Turbulence based on WEng or WAsP-CFD (based on paper)**
  A new option for using modelled turbulence has been added. This methods simply assumes that the st. dev. is a fraction of the mean TI (i.e. coefficient of variation, COV) predicted by the flow model, default is 0.3 based on a thorough study of the accuracy of predicted loads in Germany.

- **New option for "variable wake width" in the Frandsen model**
  A new option is added to supplement the default assumption in the Frandsen model of fixed wake widths of 22°. The new option was also presented in Frandsen's original dissertation.

- **Visualize "partial fatigue damage" distribution for each WTG sensor including shutdown rules**
  A new option showing the partial contribution in a direction and wind speed bin to the total cumulative fatigue damage. It accounts for both the frequency of the bin and the effect of Wöhler exponent on the contribution.

Previous version: windPRO 3.1

The core features of the SITE COMPLIANCE & LOAD RESPONSE modules in windPRO 3.1 remain unchanged and identical to those implemented in windPRO version 3.0. However a number of important additions have been included, which have not been evaluated or certified by TÜV SÜD:

- **"IEC61400-1 ed. 2" (SITE COMPLIANCE & LOAD RESPONSE)**
  The implementation of the older IEC61400-1 second edition (ed. 2) is based as much as possible on the certified implementation of the third edition (ed. 3) as it handles several issues in ed. 2. This is done without violating the requirements and original intention of ed. 2.

- **"Curtailment" – direction and wind speed shutdown   (SITE COMPLIANCE & LOAD RESPONSE)**
  The curtailment calculation influences (a) the Effective turbulence calculation in SITE COMPLIANCE and (b) the fatigue load calculation in LOAD RESPONSE. In (a) the wake contributions on neighbour turbines are removed for wind speed and direction intervals where a turbine is shut down. In (b) the fatigue calculation for a turbine is affected more directly, as the wind speed and direction intervals where a turbine is stopped will contribute much less to the fatigue accumulation.

- **"Full resolution" fatigue load integration   (LOAD RESPONSE)**
  When no wakes are present, results for this new option will be identical to results using the calculation option "Sectorwise". If wakes are present small differences will be seen as the "full resolution" option will integrate the fatigue in steps of 1 degree and, hence, directly and more accurately account for the wake / non-wake parts within a sector, where the "Sectorwise"

calculation integrates in 30 degree sector steps and, hence, relies on the Frandsen Effective turbulence integration within each sector.

- **"3rd party mode"   (SITE COMPLIANCE)**
  This option allows users to load a set of pre-calculated IEC Main checks from 3rd party software to allow use of LOAD RESPONSE with in-house IEC results. The input format is xml[1] and the same format is used as a result-to-file export format for SITE COMPLIANCE calculations.

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[1] See the format description here: http://www.emd.dk/files/windpro/windPRO_third_party_Load_Response.pdf