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Technical note:

XML file format specification for SITE COMPLIANCE 3rd party mode

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Introduction

windPRO 3.1 implements a new 'mode' in SITE COMPLIANCE. The new mode allows users to load pre-calculated results for the IEC main checks to enable users, which have in-house tools to calculate the IEC checks, to do load calculations with LOAD RESPONSE.

This document describes the XML file format and the minimum requirements for the XML file and the optional extras.

The XML file format for IEC check results is also implemented as an export format via result-to-file for SITE COMPLIANCE calculations (close calculation and right click). For existing users of SITE COMPLIANCE it will be a good starting point to make an XML result export for an existing calculation and have a look at the XML file, delete blocks and use it as template.

XML file format

PARK or single WTG

The XML file should contain results of the IEC main checks either as one file per WTG or with multiple WTGs in one XML file. For multiple WTGs in same XML, the file contains a block named <WTG Index="X"> for each WTG where X is an (arbitrary) WTG index numbering.

```
<?xml version="1.0"?>
<WindPROSITECOMPLIANCEexport>
  <WTG Index="0">
</WindPROSITECOMPLIANCEexport>
```

Each WTG block should contain the following sections, where all sections (main checks) are required except for *TerrainComplexity* and *ExtremeWind* which do not directly contribute to fatigue and is not needed by LOAD RESPONSE.

```
<?xml version="1.0"?>
<WindPROSITECOMPLIANCEexport>
  <WTG Index="0">
    <MainData>
    <WindTurbineCharacteristics>
    <TerrainComplexity>
    <ExtremeWind>
    <Turbulence>
    <WindDistribution>
    <FlowInclination>
    <WindShear>
    <AirDensity>
  </WTG>
</WindPROSITECOMPLIANCEexport>
```



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IMPORTANT NOTE: It is the users' responsibility to ensure that possible turbulence structure corrections required for complex terrain has been applied to the turbulence data in the XML file!

The following text describes the contents and minimum requirements of each block in the XML file.

MainData

The *MainData* block must contains the following information:

```
<MainData>
  <SiteID>Wind turbine name</SiteID>
  <PositionGEOWGS84>
    <Longitude>15.411632</Longitude>
    <Latitude>54.124893</Latitude>
  </PositionGEOWGS84>
  <DesignStandard>IEC61400-1 ed. 3 (2010)</DesignStandard>
</MainData>
```

SiteID is simply a string name ID for each WTG.

PositionGEOWGS84 contains the WTG position as decimal lat-long using datum WGS84.

DesignStandard specifies the IEC standard used in calculation of the IEC checks. For IEC ed. 3 the string is "IEC61400-1 ed. 3 (2010)", and for ed. 2 the string is "IEC61400-1 ed. 2 (1999)".

WindTurbineCharacteristics

This block should contain the following data, which either serve as general characterization of the WTG or are required to evaluate the wind speed dependent IEC checks:

```
<WindTurbineCharacteristics>
  <RatedPower>3,000</RatedPower>
  <HubHeight>99.0</HubHeight>
  <RotorDiameter>101.0</RotorDiameter>
  <Urated>12.0</Urated>
  <Ucut_out>25.0</Ucut_out>
</WindTurbineCharacteristics>
```

RatedPower is the rated power in kW.

HubHeight is the hub height in meters.

RotorDiameter is the rotor diameter in meters.

Urated is the wind speed in m/s where the turbine reaches rated power.

Ucut_out is the cut-out wind speed in m/s of the wind turbine.

The two latter wind speeds are both required in the evaluation of the Effective turbulence check where they define the required check range of wind speeds.

TerrainComplexity

This block is not required to perform LOAD RESPONSE. The block should include the terrain complexity index for the WTG position. $I_c=0$ is not complex terrain and $I_c=1$ is complex, any values between 0 and 1 is also possible according to IEC61400-1 ed. 3 (2010).



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```
<TerrainComplexity>
  <Ic>1.0</Ic>
</TerrainComplexity>
```

ExtremeWind

This block is not required to run LOAD RESPONSE. The block should contain the extreme wind speed estimates.

```
<ExtremeWind>
  <U1year10min>29.2</U1year10min>
  <U50year10min>42.1</U50year10min>
</ExtremeWind>
<Turbulence>
```

U1year10min is the 10min average extreme wind speed with 1 year recurrence period.

U50year10min is the 10min average extreme wind speed with 50 years recurrence period.

Turbulence

This block should contain the results of the effective turbulence check. Minimum is the Omnidirectional effective turbulence. If the sector-wise effective turbulence is included, LOAD response will allow sector-wise calculations. If the Total turbulence is included all calculation options will be available in LOAD RESPONSE (depending also on the data for the other IEC checks). For definitions of effective and total turbulence, see appendix 2 in the LOADS manual: http://help.emd.dk/knowledgebase/content/WindPRO3.0/05-UK_windPRO3.0-LOADS.pdf

```
<Turbulence>
  <Unit>StDev</Unit>
  <Quantile>90</Quantile>
  <WohlerExponent>10</WohlerExponent>
  <EffectiveTurbulenceOmnidirectional>
  <EffectiveTurbulenceSectorWise>
  <TotalTurbulence>
</Turbulence>
```

Unit defines if the turbulence is given as standard deviations (in m/s) 'StDev', or as turbulence intensity in % 'TIPct' or turbulence intensity as fraction 'TI'.

Quantile specifies the quantile, which is '90' for IEC ed. 3 and '84' for IEC ed. 2.

WohlerExponent is the Wöhler exponent used in the calculation of effective turbulence.

EffectiveTurbulenceOmnidirectional should include the effective turbulence calculated as the integral over all directions for each wind speed for the relevant wind speed range, typically from 4m/s to 25m/s, but this requirements will depend on which LOAD RESPONSE turbine models will be used subsequently and that models cut-in and cut-out wind speed. Values from 3m/s to 30m/s will be a safe interval.

EffectiveTurbulenceSectorwise as above, but integrated over each of the 12 sectors sector for each wind speed bin in the relevant wind speed range.

TotalTurbulence should include the total turbulence calculated at a resolution of 1° at directions 0.5°, 1.5°, 2.5° and so forth (half degrees center values are used to prevent values at sector boundaries). For each wind speed for the relevant wind speed range.



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WindDistribution

This block should contain the wind speed Weibull distribution parameters and sector frequencies. Sector-wise values are always required, omnidirectional values are optional.

```
<WindDistribution>
  <WindDistributionOmniDirectional>
  <WindDistributionSectorWise>
</WindDistribution>
```

WindDistributionOmniDirectional is optional and should contain the omnidirectional Weibull A and k parameters as shown below.

```
<WindDistributionOmniDirectional>
  <WeibullA>7.730000</WeibullA>
  <Weibullk>2.400000</Weibullk>
</WindDistributionOmniDirectional>
```

WindDistributionSectorWise should contain the sector-wise Weibull A and k parameters and frequency for each of 12 sectors as shown below.

```
<WindDistributionSectorWise>
  <Sectors>
    <Sector Sector="0" Angle="0">
      <WeibullA>7.578204</WeibullA>
      <Weibullk>1.787109</Weibullk>
      <Frequency>4.760849</Frequency>
    </Sector>
    <Sector Sector="1" Angle="30">
      <WeibullA>7.729126</WeibullA>
      <Weibullk>2.208984</Weibullk>
      <Frequency>8.463835</Frequency>
    </Sector>
    <Sector Sector="2" Angle="60">
```

FlowInclination

This block should contain the maximum flow inclination angle in degrees as a minimum (referred to as omnidirectional value) and sector-wise flow inclinations are optional.

```
<FlowInclination>
  <FlowInclinationOmniDirectional>
  <FlowInclinationSectorWise>
</FlowInclination>
```

FlowInclinationOmniDirectional should contain the maximum flow inclination angle in degrees as shown below.

```
<FlowInclinationOmniDirectional>
  <InflowAngle>0.6451</InflowAngle>
</FlowInclinationOmniDirectional>
```

FlowInclinationSectorwise is optional and should contain the flow inclination angles for each sector as shown below. Resolution may be better than 30° but the sector number must be an integer multiple of 12.



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```
<FlowInclinationSectorWise>
  <Sectors>
    <Sector Sector="0" Angle="0">
      <Item Value="-0.0290"/>
    </Sector>
    <Sector Sector="1" Angle="10">
      <Item Value="-0.0384"/>
    </Sector>
    <Sector Sector="2" Angle="20">
      <Item Value="-0.0446"/>
    </Sector>
    <Sector Sector="3" Angle="30">
      <Item Value="-0.0459"/>
    </Sector>
  </Sectors>
</FlowInclinationSectorWise>
```

WindShear

This block should contain estimates of the vertical wind shear exponent. Minimum requirement is the omnidirectional values.

```
<WindShear>
  <WindShearOmnidirectional>
  <WindShearSectorWise>
</WindShear>
```

WindShearOmnidirectional should contain the omnidirectional wind shear estimate as shown below.

```
<WindShearOmnidirectional>
  <AverageShear>0.219</AverageShear>
</WindShearOmnidirectional>
```

WindShearSectorWise should contain the sector-wise wind shear estimates as shown below.

```
<WindShearSectorWise>
  <Sectors>
    <Sector Sector="0" Angle="0">
      <Item Value="0.194"/>
    </Sector>
    <Sector Sector="1" Angle="30">
      <Item Value="0.204"/>
    </Sector>
    <Sector Sector="2" Angle="60">
      <Item Value="0.233"/>
    </Sector>
  </Sectors>
</WindShearSectorWise>
```

AirDensity

This block should contain the mean air density in kg/m^3 as shown below. Sector-wise results are not supported.



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```
<AirDensity>
  <AirDensity>1.165</AirDensity>
</AirDensity>
```

Example - complete XML example with minimum requirements for one WTG

```
<?xml version="1.0"?>
<WindPROSITECOMPLIANCEexport>
  <WTG Index="0">
    <MainData>
      <SiteID>WTG bla bla</SiteID>
      <PositionGEOWGS84>
        <Longitude>15.409276</Longitude>
        <Latitude>54.101014</Latitude>
      </PositionGEOWGS84>
      <IEC_Standard>IEC61400-1 ed. 3 (2010)</IEC_Standard>
    </MainData>
    <WindTurbineCharacteristics>
      <RatedPower>2,300</RatedPower>
      <HubHeight>100.0</HubHeight>
      <RotorDiameter>113.0</RotorDiameter>
      <Urated>11.0</Urated>
      <Ucut_out>25.0</Ucut_out>
    </WindTurbineCharacteristics>
    <TerrainComplexity>
      <Ic>0.0</Ic>
    </TerrainComplexity>
    <ExtremeWind>
      <U1year10min>27.8</U1year10min>
      <U50year10min>39.2</U50year10min>
    </ExtremeWind>
    <Turbulence>
      <Unit>StDev</Unit>
      <Quantile>90</Quantile>
      <WohlerExponent>10</WohlerExponent>
      <EffectiveTurbulenceOmniDirectional>
        <Items>
          <Item WindSpeed="3.0" Value="0.72380"/>
          <Item WindSpeed="4.0" Value="0.88019"/>
          <Item WindSpeed="5.0" Value="1.05852"/>
          <Item WindSpeed="6.0" Value="1.26513"/>
          <Item WindSpeed="7.0" Value="1.47643"/>
          <Item WindSpeed="8.0" Value="1.69383"/>
          <Item WindSpeed="9.0" Value="1.86172"/>
          <Item WindSpeed="10.0" Value="1.95705"/>
          <Item WindSpeed="11.0" Value="2.05100"/>
          <Item WindSpeed="12.0" Value="2.15101"/>
          <Item WindSpeed="13.0" Value="2.24839"/>
          <Item WindSpeed="14.0" Value="2.33886"/>
          <Item WindSpeed="15.0" Value="2.45307"/>
          <Item WindSpeed="16.0" Value="2.55388"/>
          <Item WindSpeed="17.0" Value="2.70429"/>
          <Item WindSpeed="18.0" Value="2.78974"/>
        </Items>
      </EffectiveTurbulenceOmniDirectional>
    </Turbulence>
  </WTG Index="0">
</WindPROSITECOMPLIANCEexport>
```



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```
<Item WindSpeed="19.0" Value="2.96238"/>
<Item WindSpeed="20.0" Value="3.06021"/>
<Item WindSpeed="21.0" Value="3.17807"/>
<Item WindSpeed="22.0" Value="3.30588"/>
<Item WindSpeed="23.0" Value="3.43885"/>
<Item WindSpeed="24.0" Value="3.57355"/>
<Item WindSpeed="25.0" Value="3.71294"/>
<Item WindSpeed="26.0" Value="3.79674"/>
<Item WindSpeed="27.0" Value="3.94882"/>
<Item WindSpeed="28.0" Value="4.10411"/>
<Item WindSpeed="29.0" Value="4.26206"/>
<Item WindSpeed="30.0" Value="4.42172"/>
<Item WindSpeed="31.0" Value="4.58177"/>
<Item WindSpeed="32.0" Value="4.74075"/>
<Item WindSpeed="33.0" Value="4.89726"/>
<Item WindSpeed="34.0" Value="5.05030"/>
<Item WindSpeed="35.0" Value="5.19936"/>
</Items>
</EffectiveTurbulenceOmniDirectional>
</Turbulence>
<WindDistribution>
  <WindDistributionSectorWise>
    <Sectors>
      <Sector Sector="0" Angle="0">
        <WeibullA>7.020338</WeibullA>
        <Weibullk>1.818359</Weibullk>
        <Frequency>4.764451</Frequency>
      </Sector>
      <Sector Sector="1" Angle="30">
        <WeibullA>7.819994</WeibullA>
        <Weibullk>2.376953</Weibullk>
        <Frequency>8.609448</Frequency>
      </Sector>
      <Sector Sector="2" Angle="60">
        <WeibullA>7.076937</WeibullA>
        <Weibullk>2.794922</Weibullk>
        <Frequency>7.656914</Frequency>
      </Sector>
      <Sector Sector="3" Angle="90">
        <WeibullA>6.740503</WeibullA>
        <Weibullk>3.501953</Weibullk>
        <Frequency>6.342061</Frequency>
      </Sector>
      <Sector Sector="4" Angle="120">
        <WeibullA>6.821539</WeibullA>
        <Weibullk>4.033203</Weibullk>
        <Frequency>6.644651</Frequency>
      </Sector>
      <Sector Sector="5" Angle="150">
        <WeibullA>6.858356</WeibullA>
        <Weibullk>3.173828</Weibullk>
        <Frequency>6.013331</Frequency>
      </Sector>
    </Sectors>
  </WindDistributionSectorWise>
</WindDistribution>
</WindDistribution>
```



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```
<Sector Sector="6" Angle="180">
  <WeibullA>7.942331</WeibullA>
  <Weibullk>2.724609</Weibullk>
  <Frequency>8.614133</Frequency>
</Sector>
<Sector Sector="7" Angle="210">
  <WeibullA>8.834404</WeibullA>
  <Weibullk>2.611328</Weibullk>
  <Frequency>13.221698</Frequency>
</Sector>
<Sector Sector="8" Angle="240">
  <WeibullA>9.856535</WeibullA>
  <Weibullk>2.673828</Weibullk>
  <Frequency>15.083731</Frequency>
</Sector>
<Sector Sector="9" Angle="270">
  <WeibullA>10.536002</WeibullA>
  <Weibullk>2.396484</Weibullk>
  <Frequency>11.093674</Frequency>
</Sector>
<Sector Sector="10" Angle="300">
  <WeibullA>8.219036</WeibullA>
  <Weibullk>1.857422</Weibullk>
  <Frequency>6.636792</Frequency>
</Sector>
<Sector Sector="11" Angle="330">
  <WeibullA>7.185082</WeibullA>
  <Weibullk>1.830078</Weibullk>
  <Frequency>5.319118</Frequency>
</Sector>
</Sectors>
</WindDistributionSectorWise>
</WindDistribution>
<FlowInclination>
  <FlowInclinationOmniDirectional>
    <InflowAngle>0.4768</InflowAngle>
  </FlowInclinationOmniDirectional>
</FlowInclination>
<WindShear>
  <WindShearOmniDirectional>
    <AverageShear>0.233</AverageShear>
  </WindShearOmniDirectional>
</WindShear>
<AirDensity>
  <AirDensity>1.237</AirDensity>
</AirDensity>
</WTG>
</WindPROSITECOMPLIANCEexport>
```

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