**Annex X (Informative)**

**Data exchange format for site assessment parameters**

1. General

This annex specifies the digital format for site suitability data exchange. The format is based on json file format [1] and has to follow the specification in this document. UTF-8 encoding [2] should be used. The example of the file which follows this specification is attached as annex Y (Informative).

2. Top level keys

Following 10 top level keys shall be used. The value of each key is an object or an array of objects, the description of which are summarized in table X.1.

Table X.1 The contents of the top level keys

|  |  |  |
| --- | --- | --- |
| Top Level Keys | value type | description |
| Meta Data | object | Summary of the meta data such as wind climate discretization information, number and IDs of wind turbine and measurement devices, coordinate system |
| Project Information | object | General project information. The keys of this object are the IDs of the wind turbines defined in the Meta Data object. |
| Turbine layout Summary | object | Summary of the turbine layout and estimated wind climate at the position of turbine. The keys of this object are the IDs of the wind turbines defined in the Meta Data object. |
| Measurement Device Summary | object | Summary of the measurement devices. The keys of this object are the IDs of the measurement devices defined in the Meta Data object. |
| WS Frequency | object | Wind rose and sector wise frequency distribution of wind speed at each turbine positions and measurement device positions. The keys of this object are the IDs of the wind turbines and measurement devices defined in the Meta Data object. |
| WS Weibull | object | Wind rose and sector wise weibull parameters. (The weibull parameters are fitted base on the discretized wind climate) |
| Ambient Mean TI | object | sector wise and omnidirectional ambient mean turbulence intensity as functions of wind speed |
| SD TI | object | sector wise and omnidirectional standard deviation of turbulence intensity as functions of wind speed |
| Extreme Ambient TI | object |  |
| Temperature | object |  |
| Shear | object |  |
| Inflow Angle | object |  |
| CcT | object |  |

3. Wind Climate Discretization

The value for the key “Wind Climate Discretization” is an object, the contents of which are summarized in table X.2.

Table X.2 The contents of the object

|  |  |  |
| --- | --- | --- |
| Keys | value type | description |
| Number of wind direction sectors | int | Number of wind direction sectors. This shall be 12 or 16 according to the local requirement. |
| Wind speed bin width | int | Wind speed bin width. This shall be 1 or 2. The definition of the bin setting for each case is shown in figure X.1. |
| Number of measurement devices | int | The number of measurement devices (met masts) in the project. |
| Measurement device IDs | array of string | The IDs of the measurement devices. The number of the elements of the array is “Number of measurement devices” defined in this section and the elements are the IDs of the measurement devices. |
| Number of wind turbines | int | The number of wind turbines in the project. |
| Wind turbine IDs | array of string | The IDs of the wind turbines. The number of the elements of the array is “Number of wind turbines” defined in this section and the elements are the IDs of the wind turbines. |
| coordinate system | string | The coordinate system used to define the location of measurement devices and wind turbines. e.g., “lon-lat WGS84”, “UTM 54S” etc. |

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Figure X.1 The definition of the wind speed bins

4. Project Information

Table X.3

|  |  |  |
| --- | --- | --- |
| Keys | value type | description |
| Project name | string | The project name |
| Project owner | string | The owner of the project |
| Project number | optional | The project number (optional) |
| Name | string | Name of person & organization completing form |
| Date | string (YYYY-MM-DD) | Date when form was completed |
| Revision number | int | the revision number in an integer number |
| Reason for revision | string | The reason for the revision |
| Country & state | string | The country and state where the project is to be built. It is recommended to use ISO 3166[3]. |
| Turbine Coordinates Datum | string |  |
| Turbine Coordinates Projection | string |  |
| Accompanying report file name | string |  |
| Accompanying report revision number | string |  |
| Number of wind turbine | int |  |
| Number of metmast | int |  |

5. Turbine summary

The value for the key “Turbine summary” is an array of object. The number of the elements of the array is equal to “The number of wind turbine” in Table X.3. Each element of the array is an object which contain the information summarized in table X.4.

Table X.4 The contents of the object which is an element of the array, as the value correspond to the top level key “Turbine summary”.

|  |  |  |
| --- | --- | --- |
| Keys | value type | description |
| Project name | string | The project name |
| WTG ID | string | The ID of each wind turbine generator. This ID is used throught this format. |
| x | double | easting in [m] or longitude in [deg] of the |
| y | double | northing in [m] or latitude in [deg] of the position of the wind turbine. |
| elevation | float | elevation in [m] of the ground at the position of the wind turbine above sea level |
| manufacturer | string | The name of the manufacturer of the wind turbine. |
| model | string | The wind turbine model name |
| rated power | float | rated power in [MW] |
| rotor diameter | float | The diameter of the rotor in [m] |
| hub height | float | The hub height in [m] above ground level. |
| data source | string | The ID of the metmast (see Table X.5) from which the wind climate is derived. |
| Ve50 | float | in [m/s] |
| V50 | float | in [m/s] |
| Cv | float | only relevant if the site extreme wind speed Cv may exceed 10%. |
| Air density | float | Air density for extreme wind speed case, in [kg/m3] |
| Annual Average Wind speed | float | in [m/s] |
| Weibull scale parameter | float | The omnidirectional Weibull scale parameter in [m/s]. |
| Weibull shape parameter | float | The omnidirectional Weibull shape parameter, non-dimensional. |
| CCT | float |  |
| Annual mean wind shear | float | The omnidirectional annual mean wind shear, non-dimensoinal. |
| TI15 | float | Annual average turbulence intensity at 15m/s wind speed, in [%] |
| sigma I | float | The standard deviation of the turbulence intensity at 15m/s wind speed, in [%] |
| Flow inclination angle | float | The inclination of the wind velocity vector from in [deg] |
|  |  |  |

6. Metmast summary

Table X.5 Metmast summary

|  |  |  |
| --- | --- | --- |
| Keys | value type | description |
| Metmast ID | string | The ID of the metmast. This ID is used throught this format. |
| x | double | easting in [m] or longitude in [deg] of the |
| y | double | northing in [m] or latitude in [deg] of the position of the wind turbine. |
| elevation | float | elevation in [m] of the ground at the position of the wind turbine above sea level |
| manufacturer | string |  |
| model | string |  |
| metmast height | float | The hub height in [m] |

7. WS frequency

The value for this key is an array of object. Each element of the array corresponds to either one of the metmasts or one of the turbines, and the number of the elements is the sum of “Number of metmasts” and “Number of Turbines” (see table X.).

|  |  |  |
| --- | --- | --- |
| Keys | value type | description |
| Site type | string | This value should be either “metmast” or “turbine”. If site type = “metmast”, the number of recorded data should be specified in addition to the frequency. If type = “turbine”, only frequency is needed. |
| all wind speed freq | array of float | frequency distribution of wind direction for all the wind speed range. The number of the element of the array should be equal to “number of wind direction sector” (see Table X.2). Note this should be identical |
| all wind speed num | array of int | number of 10 minutes data for each wind direction for all the wind speed range. The number of the element of the array should be equal to “number of wind direction sector” (see Table X.2). This key is only relevant if site type is equal to “metmast”. |
| wind speed freq | 2D array of float (array of array of float) | frequency distribution of wind speed for each wind speed bin and wind direction sector. Presented by using an array the number of element of which is “number of wind direction sector” (see table X.2) and the element of which is an array containing the sector wise wind speed frequency distribution. |
| wind speed num | 2D array of int (array of array of int) |  |

Reference documents

[1] ECMA-404, The JSON data interchange syntax, 2nd edition, 2017.

[2] UTF-8

[3] ISO 3166