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IECRE OPERATIONAL DOCUMENT

IEC System for Certification to Standards relating to Equipment for use in Renewable Energy applications (IECRE System)

Assessment of RETLs for the measurement of electrical characteristics of electricity producing wind turbines

IECRE OD-551-16:2017(EN)

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE ZZ

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1 Introduction

This Operational Document (OD) covers the assessment of an electrical characteristics measurement test for Test Laboratories who want to get this competence area recognised under IECRE.

Specifically, this OD covers the standard assessment as per the W E -OMC Rules of Procedure. The scope of this OD is the IEC 61400-21 standard.

This scope is referenced in this OD as 'the standard'.

The standard assessment is based on four elements:
– A review of three reports issued by the Applicant within the last three years
– Successful participation in an electrical characteristics measurement proficiency test
– Review of key internal procedures

In this document, the Applicant is the organisation asking for an assessment according to this OD. The applicant may be an already recognised RETL or an organisation not yet recognised under IECRE for this competence area. An RETL refers to an IECRE recognised Test Laboratory.

2 Review of reports issued

In order to have three reports reviewed, the Applicant shall submit an overview of reports submitted the last three years with the IECRE logo. In case the assessment is for a candidate RETL or the Applicant has issued fewer than three IECRE test reports for electrical characteristic testing, the Applicant shall submit to the IECRE Secretariat a list of reports issued that state compliance with the standard.

The Lead Assessor, together with the Technical Assessors and/or experts, shall select from this list three reports. These reports have to be submitted to the IECRE Secretariat by the Applicant.

The reports shall be reviewed for compliance with the standard, as per the checklist in Chapter 6 of this OD. A filled-out version of the check list shall be included in the final assessment report.

3 Proficiency testing

3.1 Topics of proficiency testing

Proficiency tests shall be performed according to IEC-RE Draft OD-551xxxxxxx.

Note: it should be included: Flicker, switchings, harmonics, interharmonics, higher frequency components, response to voltage drops (power calculation acc. Annex C symmetrical components), grid protection, measurement hardware, uncertainty.

4 Review of internal procedures

The following procedures should normally be checked:
– Identification of the turbine under test
– Test requirements
– Instrumentation
– Processing of measured data
– Uncertainty analysis
– Minimum test report results as per template Annex A of IEC61400-21

Details on these key procedures can be found in the respective table below.

5 Inspection of field test

As part of the assessment the assessment team should inspect one test in the field to establish if a nearby test site is available. If not, the test lab has to provide the needed information in form of photo - and written documentation.

a) Compliance with the standard

b) Compliance with the key internal procedures as defined under section 4 of this OD

c) Identify further process or technical issues that could affect the result of the test

6 Checklist

Please note that this checklist is used for reviewing reports as well as the applicant's internal procedures and may be used as well for the on-site inspection

6.1 General (section 6.1, 7.1, 7.1.1, 7.1.2, 7.1.3 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.1.1	6.1	Are the all required quantities (wind turbine specifications, voltage quality, voltage drop response, power control, grid protection and reconnection) stated?		
6.1.2	6.1	Is the generator sign convention used, i.e. the positive direction of the power flow is defined to be from the generator to the grid?		
6.1.3	7.1.1	Are the location of the measuring points and the specific configuration of the assessed wind turbine stated?		
6.1.4	7.1.1	Is the wind speed range stated in the report, if measurements are taken above 15 m/s and are not be omitted?		
6.1.4	7.1.2	Is any data measured during periods not complying with the given test conditions excluded?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.1.5	7.1.2	Is the wind turbine connected directly to the MV-network through a standard transformer with appropriate rated apparent power?		
6.1.6	7.1.2	Is the total harmonic distortion of the voltage including all harmonics up to the order of 50 less than 5%?		
6.1.7	7.1.2	Is the grid frequency measured as 0.2s average data within ±1% of nominal frequency during test periods?		
6.1.8	7.1.2	Is the rate of change of the grid frequency measured as 0.2s average data less than 0.2% of the nominal frequency per 0.2s during test periods?		
6.1.9	7.1.2	Is the voltage within ±10% of its nominal value measured as 10 min average data at the wind turbine terminals during test periods?		
6.1.10	7.1.2	Is the rate of change of the grid frequency measured as 0.2s average data less than 0.2% of the nominal frequency per 0.2s during test periods?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.1.11	7.1.2	Are the general test conditions like the average turbulence intensity, the short-circuit apparent power and the impedance phase angle of the grid at the connection point of the WT stated?		
6.1.12	7.1.2	Is the voltage unbalance factor less than 2% measured as 10 min average data at the wind turbine terminals during test periods?		
6.1.13	7.1.3	Is the measurement system according to the requirements of IEC 61400-21?		
6.1.14	7.1.3	Are the uncertainties of the test and measurement results stated? Are they within the specifications, given in the IEC 61400-21?		
6.1.15	7.1.3	Are calculations done according to annex C of the IEC61400-21?		
6.1.16	7.1.3	Are the sample rates of all of the measurements according to the requirements of the IEC 61400-21?		

6.2 Identification of the turbine under test (section 6.2, 7.2 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.2.1	6.2	Are the rated data of the wind turbine (Pn, Sn, Un, In) stated according to the requirements of IEC 61400-21		

6.3 Voltage fluctuations (section 6.3, 6.3.1, 6.3.2, 6.3.3, 7.3, 7.3.1, 7.3.2, 7.3.3, 7.3.4 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.3.1	6.3	Are flicker and voltage changes reported?		
6.3.2	6.3.2	Is the flicker analysis done considering the 99th percentile for the network impedance phase angles (30°, 50°, 70° and 85°) and reported each respectively for the four annual average wind speeds (6 m/s, 7.5 m/s, 8.5 m/s and 10 m/s)?		
6.3.3	6.3.2	Are the characteristics evaluated and reported on an operating reactive power as close as possible to zero / Q=0?		
6.3.4	6.3.3	Are switching operations reported for turbine start-up at cut-in wind speed?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.3.5	6.3.3	Are switching operations reported for turbine start-up at rated or higher wind speed?		
6.3.6	6.3.3	Is the worst case of switching between generators reported? * *Only for turbines with multiple windings or more than one generator		
6.3.7	6.3.3	Is the maximum number of the switching operation within a 10 min period and a 2 h period reported?		
6.3.8	6.3.3	Are the flicker step and voltage change factors for the network impedance phase angles 30°, 50°, 70° and 85°, reported?		
6.3.9	7.3.2	Is the selected short circuit ratio $S_{k,fic}/S_n$ between 20 and 50?		
6.3.10	7.3.2	Is the accuracy of the evaluated P_{st} values better than 5%?		
6.3.11	7.3.3	Are the instantaneous line current and phase to neutral measurements done for each of the three lines at the turbine terminals?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.3.12	7.3.3	Are there collected at least fifteen 10-min time-series (5 for each of the 3 phases) of instantaneous current and voltage measurements for each 1 m/s wind speed bin, between cut-in wind speed and 15m/s?		
6.3.13	7.3.3	Are the switching operations (except switching of capacitors) excluded from the measurement?		
6.3.14	7.3.3	Is the voltage flicker $c(\psi_k, v_a)$ during tests reported?		
6.3.15	7.3.3	Are the flicker coefficient sets of 10 min measurements analyzed/presented as a function of the network impedance phase angles and wind speed distribution values?		
6.3.16	7.3.4	Are the instantaneous line current and phase to neutral measurements done for each of the three lines at the turbine terminals?		
6.3.17	7.3.4	Have the measurements been performed 5 times per case?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.3.18	7.3.4	Is the measured 1 min-averaged wind speed within a ± 2m/s range of the required wind speed?		

6.4 Current harmonics, interharmonics and higher frequency components (section 6.4, 7.4 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.4.1	6.4	Are the measurement values presented in tables over 10% power bins from 0 to 100% of the rated active power?		
6.4.2	6.4	Is the value of an active power bin a “midpoint”? (e.g.: 50% power bins means that average active power in this bin is >= 45% and < 55%)		
6.4.3	6.4	Are the harmonic current components calculated as “subgrouped values” up to 50th harmonic ? (see IEC 61000-4-7:2002, chapter 5.6)		
6.4.4	6.4	Are the interharmonic current components calculated as “subgrouped values up to 2 kHz” ? (see Annex A, IEC 61000-4-7:2002)		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.4.5	6.4	Are the higher frequency current components specified as “subgrouped values for frequencies between 2 and 9 kHz” ? (see Annex B, IEC 61000-4-7:2002)		
6.4.6	7.4	Have at least 9 time series (3 x 3 phase measurements) been recorded for each 10 % bin ?		
6.4.7	7.4.	Is the used window size stated in the report?		
6.4.8	7.4.	Is the THC of the voltage stated in the report?		
6.4.9	7.4.	Has a Class I device (acc 61000-4-7) been used for harmonic calculation?		

6.5 Response to voltage drops (section 6.5, 7.5 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.5.1	6.5	Are the tests regarding response to voltage drops performed on the complete wind turbine?		
6.5.2	6.5 &7.5	Is the response of the wind turbine to temporary voltage drops stated for the wind turbine operating at a) between 0,1 P_n and 0,3 P_n and b) above 0,9 P_n ?		
6.5.3	6.5	Does the stated response include results from 2 consecutive tests of each case (VD1-VD6 in Table 1)?		
6.5.4	6.5 & 7.5	Does the stated response include time-series of active power, reactive power, active current, reactive current and voltage at wind turbine terminals?		
6.5.5	6.5 & 7.5	Do the time-series of active power, reactive power, active current, reactive current and voltage at wind turbine terminals correspond to the time shortly prior to the voltage drop and until the effect of the voltage drop has abated?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.5.6	7.5 & Annex C	Are the active power, reactive power, active current, reactive current and voltage at wind turbine terminals presented as positive sequence fundamentals and given for each line period (50 or 60 Hz)?		
6.5.7	Annex C	Is the sampling frequency of the voltages and currents at least 2 kHz per channel?		
6.5.8	6.5 & 7.5	Is the wind turbine operational mode specified for each test?		
6.5.9	7.5	Is the 10 min average wind speed stated for each test?		
6.5.10	7.5	Are the short-circuit emulator parameters (i.e. impedances Z_1 and Z_2 in Figure 5) stated in the description of the test equipment?		
6.5.11				

6.6 Active Power (section 6.6, 6.6.1, 6.6.2, 6.6.3, 7.6, 7.6.1, 7.6.2, 7.6.3 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.6.1	6.6.1	Is the maximum measured power of the wind turbine specified as a 600 s average value P600, a 60 s average value, P60 and as a 0,2 s average value, P0,2?		
6.6.2	7.6.1	Is the test and measurement procedure according to the requirements of IEC61400-21?		
6.6.3	6.6.2	Is the ability of the wind turbine to operate in ramp rate limitation control mode characterized by test results according to the requirements of IEC 61400-21?		
6.6.4	6.6.2	Are the test results reported as 0,2 s average data of available and measured power over 10 minutes presented in a graph?		
6.6.5	7.6.2	Is the test and measurement procedure according to the requirements of IEC61400-21?		
6.6.6	6.6.3	Is the ability of the wind turbine to operate in active power set-point control mode characterized by test results according to the requirements of IEC 61400-21?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.6.7	6.6.3	Are the test results reported as 0,2 s average data of available and measured power over the test period presented in a graph?		
6.6.8	6.6.3 and 7.6.3	Is the test and measurement procedure according to the requirement of the IEC 61400-21?		

6.7 Reactive Power (section 6.7, 6.7.1, 6.7.2, 7.7, 7.7.1, 7.7.2 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.7.1	6.7.1	Is the capability of the WT concerning the maximum inductive reactive power and the maximum capacitive reactive power of the WT tested and specified according to the requirements of the IEC 61400-21?		
6.7.2	7.7.1	Is the test and measurement procedure according to the requirement of the IEC 61400-21?		
6.7.3	7.7.1	Is the measurement set-up according to the requirements of the IEC 61400-21		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.7.4	6.7.2	Is the reactive power set-point control mode tested and specified according to the requirements of the IEC 61400-21?		
6.7.5	6.7.2	Are the test results described by a table according to the requirements of IEC 61400-21?		
6.7.6	6.7.2	Are the test results described by a graph according to the requirements of IEC 61400-21?		
6.7.7	7.7.2	Is the test and measurement procedure according to the requirement of the IEC 61400-21?		
6.7.8	7.7.2	Is the measurement set-up according to the requirements of the IEC 61400-21		

6.8 Grid protection (section 6.8, 7.8 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.8.1	6.1	Is he functionality of the grid protection device tested concerning disconnection levels and disconnection times?		
6.8.2	7.1	Is the measurement and test procedure for grid protection testing according to the requirements of IEC 61400-21?		
6.8.3	7.8	Is the undervoltage protection tested according to the requirements?		
6.8.4	7.8	Are the settings and test results of the undervoltage protection test reported?		
6.8.5	7.8	Is the overvoltage protection tested according to the requirements?		
6.8.6	7.8	Are the settings and test results of the overvoltage protection test reported?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.8.7	7.8	Is the underfrequency protection tested according to the requirements?		
6.8.8	7.8	Are the settings and test results of the underfrequency protection test reported?		
6.8.9	7.8	Is the overfrequency protection tested according to the requirements?		
6.8.10	7.8	Are the settings and test results of the overfrequency protection test reported?		
6.8.11	7.8	Is the disconnection time determined from a data sheet or by measurements?		
6.8.12	7.8	Is the disconnection time specified as the time duration from the beginning of the voltage step until the wind turbine is disconnected?		

6.9 Reconnection time (section 6.9, 7.9 of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.9.1	6.9	Is the reconnection time measured and tested according to the requirements of IEC61400-21?		
6.9.2	6.9	Are the test results of the reconnection time reported for the grid failure times of 10 s, 1 min and 10 min?		
6.9.3	6.9	Was the reconnection time chosen as the time duration when the grid is available on the wind turbine terminals until to the instant, when the wind turbine starts to produce power?		
6.9.4	7.9	Was the average wind speed greater than 10 m/s during the test of the reconnection time?		
6.9.5	7.9	Was the wind turbine in operation when the breaker was opened?		
6.9.6	7.9	Was the grid made available again by closing the breaker?		

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.9.7	7.9	Is the failure time specified as the time duration from opening to closing the breaker.		
6.9.8	7.9	Is the tolerance of the failure time within ±1s?		
6.9.9	7.9	Are voltage and active power measured according to the requirements of IEC61400-21?		
6.9.10	7.9	Are the test results reported based on 0,2 s average values of voltage and power?		
6.9.11	7.9	Is the reconnection time determined as the time duration when the voltage returns to its normal level (between 0,9 and 1,1 pu) to the time where the wind turbine starts producing power again (P > 0).		
6.9.12	7.9	Was the measurement set-up according to the requirements of IEC61400-21?		

6.10 Annex A/General (section Annex A of IEC61400-21 Rev. 2)

#	Reference to section in standard	Requirement from standard	Reported / Inspected	Finding
6.10.1	Annex A	Are all of the required descriptions for the measurements, tests, the test site, the grid connection point, the test and measurement system and for the tested wind turbine given?		
6.10.2	Annex A	Are general information for the test report, like number and status of test report, name and address of test organization and of the client stated?		
6.10.3	Annex A	Are all of the required test results stated according to the requirements of the IEC61400-21?		

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