# **Testing**

**1.1 Measurements**

**1.1.1. Measuring requirements**

1.1.1.1 Measurements have to be performed by a qualified person and the results of measurements have to be verifiably traceable in the meaning of §5 of the Metrology Act.

1.1.1.2 Quality measuring equipment has to comply to class A requirements of the standard EVS-EN 61000-4-30. Measuring frequency of the equipment has to be at least 9,6 kHz.

1.1.1.3 Sampling rate of other measuring devices has to be at least 0,1 kHz; the exact required sampling rate will be agreed with main grid operator separately for each testing.

1.1.1.4 Measurements have to be carried out in the connection point and only measuring circuits of current and voltage transformers can be used. Measurements from protection circuits are not permitted.

1.1.1.5 In case of production devices with synchronous generator, the measurements have to be carried out additionally in the exiting and stator circuits. In these cases the measuring device and principles will be agreed with Main grid operator separately.

1.1.1.6 The use of specific measuring device has to be coordinated with Main grid operator before the testing.

**1.1.2 Measuring characteristics**

1.1.2.1 The measuring device must have relevant calibration certificates during the testing period. The measuring device has to be separate from other control systems. One measuring device has to record the process in the production unit with fast processes in the following major characteristics:

1.1.2.2 Production units with synchronous generators:

• 3 phase stator L-N terminal voltages

• 3 phase stator terminal currents

• 3 phase L-N PCC (Point of Common Coupling) voltages

• 3 phase PCC currents

• Active power, PCC MW

• Reactive power, PCC MVar

• Active power MW

• Reactive power MVar

• Generating unit rotor field voltage

• Generating unit rotor field current

• Main exciter field voltage

• Main exciter field current

• AVR reference voltage

• Voltage applied to AVR summing junction (step etc.)

• Power system stabiliser output

• DC signal input to AVR Steam Turbine

1.1.2.3 Production units connected with inverter (wind and solar energy power stations):

• 3 phase L-N PCC voltages

• 3 phase PCC currents

• Active power MW, PCC

• Reactive power MVar, PCC

**1.2 Reporting principles for test results**

**1.2.1 The following test results have to be reported:**

1.2.1.1 Personal data of the tester;

1.2.1.2 Time and location of the test, used measurement equipment;

1.2.1.3 Location and diagram of measurement equipment connections;

1.2.1.4 The figures of test results have to be clearly understandable;

1.2.1.5 List of manually collected data (e.g. measuring device value);

1.2.1.6 Measurement data in .csv or .txt file format;

1.2.1.7 SCADA out-prints of the power grid condition, alarms and operation commands (can be obtained from the Main grid operator, including the operation system connection log of the production unit);

1.2.1.8 The report of the test results has to be presented in both paper and digital format (one copy);

1.2.1.9 Other relevant data.

**1.3 Additional requirements for testing production devices with synchronous generators**

1.3.1 Tests performed before synchronisation have to be carried out and reported to the Main grid operator prior to the synchronisation.

1.3.2 The content of the primary regulation tests will be agreed in the testing plan depending on the particular nature of the production unit.

**1.4 Additional requirements for production units connected with inverter (wind and solar energy power stations)**

1.4.1 The following actions have to be fixated when testing production units connected through inverter (wind and/or solar power station):

1.4.2 In case of wind power station:

1.4.2.1 switch-off caused by surplus wind;

1.4.2.2 switch-off caused by change of wind direction;

1.4.2.3 switch-off caused by decrease of wind speed;

1.4.2.4 switch-on.

1.4.3 In case of production unit connected through (solar power station):

1.4.3.1 switch-off caused by decrease of solar intensity;

1.4.3.2 switch-on.

1.4.4 **Testing primary regulation**

Primary regulation test is not fully reflected in the testing table as the exact programme for testing primary regulation function depends on the type of production unit and the controller logic (distributed or central control).

1.4.5 **The impact of frequency regulator following simulated frequency**

1.4.5.1 The aim of the testing is to investigate the possibility for generating primary reserve and the reaction of active power to the frequency deviation.

1.4.5.2 Primary regulation test takes place in two parts; first part consists of checking the formation of primary reserve and the second includes checking primary regulation with different droops and deadbands. Control signals and regulation settings will be activated from the control centre. The generation of frequency deviation can be done using the change of setting value or the simulation of external frequency signal. A simulated digital or analogue signal can be used as an external frequency signal.

1.4.6 **Examination of the primary reserve**

1.4.6.1. The compliance of the production unit’s primary regulation to the Grid Code will be examined in its normal state and in case of emergency.

1.4.7 **Evaluation of primary regulation with different** **deadbands and droops**

1.4.7.1 In case of production units connected through inverter (wind and/or solar power station), the test described in article 3 can be carried out with limited active power, but the output power of the station has to be at least one third of the nominal active power. The simulation of frequency signal to be transmitted to the control system will be done by the customer.

1.4.7.2 The report of the test results has to present the technically maximum output power and the speed of active power change in reaction to the frequency deviation in normal state (min +/- 0,4 Hz) and in case of emergency (min +/- 0,5 Hz). Frequency signal has to be present in parallel with the test results. The frequency signal has to include quick frequency changes (min steps 0,1 Hz).

1.4.7.3 Primary regulation in case of different deadband and droop values will be activated from the control centre of the power system. The purpose of the test is to examine the ability of control systems and production unit to participate in primary regulation.

1.4.7.4 Every test involves measurements during at least 15 minutes and has to record the impact of primary regulation in case of over- and underfrequency (respectively the output decrease and increase connected to the frequency deviation exit over deadband interval.

1.4.7.5 The following values will be measured at interval of minimum 0,2 seconds:

1.4.7.5.1 simulated frequency

1.4.7.5.2 active power output of the production unit

1.4.7.5.3 maximum possible active power of the production unit, in case of production units connected through inverter (wind power station) as a function from measured wind speed.

1.4.7.5.4 change of production unit’s active power per frequency deviation (ΔP/Δf) for examination of the droop.

1.4.7.6 When testing production units with simulated frequency, the required power change speed established in the Grid Code § 261 section 6 has to be considered and must be also presented in the report. The total primary reserve has to be realised in at least 30 seconds, whereas half of the reserve in 10 seconds.

1.4.7.7 Simulated frequency signals for non-emergency situations have been given on Figures 1.5.3.8 and 1.5.3.9 and for emergency situations on Figure 1.5.3.10.

Sagedus = Frequency



Aeg = time

Figure 8.5.3.11 Different stages of simulated frequency signals of the primary regulation test in normal state.



Figure 8.5.3.12 Maximum speed of frequency signal deviation in normal state. If the frequency change exceeds 0,5 Hz/s, the production unit will be switched to emergency state.



Figure 8.5.3.13 Different stages of simulated frequency signal of the primary regulation test in emergency state.

**1.5 Declaration form for readiness for the testing**

Date:

Name of the production unit:

Name of the production device to be tested:

W-code of the production unit:

Location of the connection point:

Output of the production unit or the section to be tested: …….. MW

Start date of the testing period and the planned end date: …………. (dd.mm.yyyy) - ………….. dd.mm.yyyy

Owner/representative of the production unit:

Phone:

e-mail:

Letter of Confirmation.

Herewith I confirm that as of **……** (dd.mm.yyyy) all construction, installation and other electrical operations in the production unit have been completed and the production unit is ready for performing the tests foreseen in the testing plan. The report on operation and monitoring signal tests is attached to the form.

Confirmed by:

Signature:

Date:

*The report on signal testing has to be provided as an Attachment to the Declaration.*

**1.6 Confirmation of the owner/representative of the production unit**

On the basis of quality measurements I confirm that quality indicators ……….. (correspond / do not correspond) the permitted limiting values given in the table and the production unit …….(will not cause / may cause) disturbances to other customers connected to the grid of the main grid operator and their electrical equipment.

Date

Production unit:

Tested part of the production unit:

W-code of the tested production unit:

Nominal power of the tested production unit: ……. MW; …….MVA

Measurements performed by:

Time of measurements:

Representative of the production unit:

Signature Date:

CONFIRMATION OF THE MAIN GRID OPERATOR:

The quality indicators presented in the report …. (are/are not) within the permitted limits and ….. (it is/it is not) allowed to continue the performance of testing plan 1-10.

Name:

Signature: Date:

**1.7 Power quality summary report**

Flicker (95 % of measured values during one week)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Measured | Permitted (110 kV) | Permitted (330 kV) |
| Pst |  |  |  |
| Plt |  |  |  |

Harmonics (99% of measured values during one week)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Measured | Permitted (110 kV) | Permitted (330 kV) |
| THD U () |  |  |  |
| TDD |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Harmonic category | Measured  *Relative voltage uh, %* | Permitted (110 kV)  *Relative voltage uh, %* | Permitted (330 kV)  *Relative voltage uh*, % |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  |  |
| 10 |  |  |  |
| 11 |  |  |  |
| 12 |  |  |  |
| 13 |  |  |  |
| 14 |  |  |  |
| 15 |  |  |  |
| 16 |  |  |  |
| 17 |  |  |  |
| 18 |  |  |  |
| 19 |  |  |  |
| 20 |  |  |  |
| 21 |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

|  |  |
| --- | --- |
|  |  |

Asymmetry (95 % of measured values during one week)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Measured, % | Permitted (110 kV), % | Permitted (330 kV), % |
| ka |  |  |  |

Table of registered overvoltages (measured during one week)

|  |  |  |  |
| --- | --- | --- | --- |
| Registered overvoltages | Time | Figure no. | Remarks |
| ……… | ……… (hh.mm.ss – hh.mm.ss, dd.mm.yyyy) | ……… | ……… |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**1.8 Model test report**

**TEST 1: SECONDARY LOAD CONTROL**

* 1. **Elering test no. correspondence**
  2. This test corresponds to or replaces Elering test ……….

**1.2 Test Conditions**

**1.3 Test Execution**

**1.4 Success Criteria**

**1.5 Comments**

**1.6 Recorded signals**

For example:

VCP, PCP, QCP, P330, Q330, V330, Pref, Qref, OLTC, Vexf, Iexf,

Sampling rate 200 ms (1 s at connection point).

**1.9 Schedule of reception tests for production units with synchronous generators**

**Test 1 Measurements for determination of generator parameters (can be replaced with factory acceptance tests)**

**1.10 Schedule of tests for production units connected through inverter**

START, date: ……….. 201..

END, date: ……….. 201..

Date:

Production unit:

Tested part of the production unit:

W-code of the tested production unit:

Nominal power of the tested production unit: ……. MW; …….MVA

Location of connection point:

Tests performed by:

Contact information:

phone………………………………..

e-mail:

Main grid operator representative(s) for tests:

Name:

Phone:

e-mail:

Main grid operator EJK representative:

Name:

Phone:

e-mail:

Test schedule agreed with the main grid operator:

Name:

Date:

Signature:

Table 1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [DD.MM.YYYY] | Time [HH.MM] |
| 0.1 | **Quality measurement** | All restrictions are off, normal operation of the power plant.  NOTICE  about the start of quality measurements that last for 7 consecutive days. | Other tests are not allowed in the production unit.  After NOTICE of the start of quality measurement, a written record will be created.  START OF TEST | During the tests no installation, regulation or manual breaks can be carried out. Also, no other switches can not be done in the power unit.  Based on the test the accuracy of maintaining reactive power Q=0 Mvar operation in compliance with Grid Code 18 section 10 p.1 |  |  |  |
| 0.2 | After step 0.1 at least 7 days later a NOTICE about the end of quality measurements to EJK. | After NOTICE of the end of quality measurements a record will be created.  END OF TEST |  |  |  |
| **Test schedule steps 1-10** can be performedonly in case the quality measurements have been completed and a short report on the quality measurement results of the generating unit has been approved by main grid operator. Also, a written record has been presented to the power system control centre and the person responsible for the tests. An example of the quality measurement report is provided in section 1.7. A full quality measurement report will be attached to the final report on the test results. Prior condition for required active power at minimum value for tests 1-10 is the average value of output power during 1 minute in the connection point. | | | | | | | |
| 1 | **Operation of the generating unit is not permitted**  **/ permitted** | All generating units are operating, normal operation, P≥50 % Pn | All restrictions off / START OF TEST | Decreasing and restoring output power has to be smoothly regulated at maximum possible speed. |  |  |  |
| **1.1.** |  | Generation unit output is at least P≥50 % Pn during 5 minutes | TRANSMITTED SIGNAL “unit operation NOT PERMITTED” |  |  |  |  |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [dd.mm.yyyy] | Time [hh.mm] |
| **1.2.** |  | 11 minutes has passed since step 1.1. | TRANSMIT SIGNAL “unit operation PERMITTED” |  |  |  |  |
| **1.3.** |  | After step 1.2. generating unit has achieved limitless steady-state operation and output power corresponding to wind conditions has been provided for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  | interval between 2 tests at least 5 minutes | |  |  |  |
| **2** | **Emergency decrease of output power** | All generating units are operating, normal operation, P≥80 % Pn | All restrictions off / START OF TEST | Emergency decrease of output power can be done by switching off the generating unit circuit breakers.  Number and size of limits **XX** depends on the generating unit’s output power and configuration.  *In case the curtailment is done by switching circuit breakers, the output power limit can be reduced. In case the curtailment speed depends on the output power, 80% of rated power has to be used and in case of rated power between 80%... 60%, the test results should include an imitation on calculation model to prove the compliance with the Grid Code.* |  |  |  |
| **2.1.** |  | Generation unit output is at least P≥80 % Pn during 5 minutes | Emergency limit of GENERATING UNIT P 0 % -IN |  |  |  |
| **2.2.** |  | 11 minutes has passed since step 2.1. | Emergency limit of GENERATING UNIT P 0 % - OUT |  |  |  |
| **2.x.** |  | Generation unit output is at least P≥80 % Pn during 5 minutes | Emergency limit of GENERATING UNIT P **XX** % - IN |  |  |  |
| 2.y. |  | 11 minutes has passed since step 2.x. | Emergency limit of GENERATING UNIT XX % - OUT |  |  |  |
| 2.z. |  | After step 2.y. generating unit has achieved limitless steady-state operation and output power corresponding to weather conditions has been provided for 5 minutes. | END OF TEST |  |  |  |
|  |  |  | interval between 2 tests at least 5 minutes | |  |  |  |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [DD.MM.YYYY] | Time [HH.MM] |
| **3** | **Smooth regulation of active power, secondary regulation** | All generating units are operating, normal operation, P≥80 % Pn | Maximum permitted P=100 %, START OF TEST |  |  |  |  |
| **3.1.** |  | Generation unit output is at least P≥80 % Pn during 5 minutes | ENTER P regulating speed …… [MW/min]  ENTER maximum permitted P = 80 % Pn | Decreasing and restoring output power has to be smoothly regulated at given speed. Generating unit can not be switched in/out during the test.  The value at the connection point should be close to the setting value transmitted by SCADA. Permitted deviation ±5% of rated power. |  |  |  |
| **3.2.** |  | 11 minutes has passed since step 3.1. | ENTER maximum permitted = 60 % Pn |  |  |  |  |
| **3.3.** |  | 11 minutes has passed since step 3.2. | ENTER maximum permitted = 40 % Pn |  |  |  |  |
| **3.4.** |  | 11 minutes has passed since step 3.3. | ENTER maximum permitted P = MIN % Pn |  |  |  |  |
| **3.5.** |  | 11 minutes has passed since step 3.4. | ENTER maximum permitted P = 100 % Pn |  |  |  |  |
| **3.6.** |  | After step 3.5. generating unit has achieved limitless steady-state operation and output power corresponding to weather conditions has been provided for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  | interval between 2 tests at least 5 minutes | |  |  |  |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [DD.MM.YYYY] | Time [HH.MM] |
| **4** | **Regulation of reactive power at U=const mode** | All generating units are operating, normal operation, P≥50 % Pn | All restrictions off / START OF TEST | Output power cannot be restricted. Operation of all windmills has to be guaranteed at least 50 % of the time at each voltage setting value P≥50 % Pn. Voltage setting values XXX, YYY and ZZZ are determined by EJK.  Actual testing schedule will be adapted according to agreed control signals.  The voltage in the power grid will be changed by EJK at all three stages by EJK (KP or switching reactor or change of transformer rate). Report of the test results has to present these changes and the behaviour of the generating unit in these situations. |  |  |  |
| **4.1.** | Generation unit output is at least P≥50 % Pn during 5 minutes | GENERATING UNIT control U=const- IN, setting U=**XXX** kV |  |  |  |
| **4.2.** | Generation unit output is at least P≥50 % Pn during 5 minutes | GENERATING UNIT control U=const, setting U=**YYY** kV |  |  |  |
| **4.3.** | Generation unit output is at least P≥50 % Pn during 5 minutes  At least 8 hours has passed since step 4.2 | GENERATING UNIT control U=const, setting U=**ZZZ** kV |  |  |  |
| **4.4.** | At least 8 hours has passed since step 4.3 | GENERATING UNIT control U=const- OUT |  |  |  |
| **4.5.** | After step 4.4. generating unit has achieved reactive power in steady-state operation (Q=0 Mvar) and has operated for 5 minutes. | END OF TEST |  |  |  |
|  |  |  | interval between 2 tests at least 5 minutes | |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [DD.MM.YYYY] | Time [HH.MM] |
| **5** | **Measurement of generating unit P/Q capability curve in the connection point**  **Continue on the next page …** | All generating units are operating, normal operation, P≥80 % Pn | All restrictions off / START OF TEST | Decreasing and restoring output power has to be smoothly regulated at given speed. Generating unit can not be switched in/out during the test.  Actual testing schedule will be adapted according to agreed control signals. |  |  |  |
| **5.1.** |  | Generation unit output is at least P≥80 % Pn during 5 minutes | GENERATING UNIT control Q=const - IN  GENERATING UNIT setting value Q ENTER + Q MAX |  |  |  |
| **5.2.** |  | 11 minutes has passed since step 5.1. | GENERATING UNIT setting value Q ENTER - Q MAX |  |  |  |
| **5.3.** |  | 11 minutes has passed since step 5.2. | ENTER maximum permitted P = 80 % Pn  GENERATING UNIT setting value Q = - Q MAX |  |  |  |
| **5.4.** |  | 11 minutes has passed since step 5.3. | GENERATING UNIT setting value Q ENTER + Q MAX |  |  |  |
| **5.5.** |  | 11 minutes has passed since step 5.4. | ENTER maximum permitted P = 70 % Pn  GENERATING UNIT setting value Q = +Q MAX | Decreasing and restoring output power has to be smoothly regulated at given speed. Generating unit cannot be switched in/out during the test. |  |  |  |
| **5.6.** |  | 11 minutes has passed since step 5.5. | GENERATING UNIT setting value Q ENTER - Q MAX |  |  |  |  |
| **5.7.** |  | 11 minutes has passed since step 5.6. | ENTER maximum permitted P = 60 % Pn  GENERATING UNIT setting value Q = -Q MAX |  |  |  |  |
| **5.8.** |  | 11 minutes has passed since step 5.7. | GENERATING UNIT setting value Q ENTER +Q MAX |  |  |  |  |
| **5.9.** |  | 11 minutes has passed since step 5.8. | ENTER maximum permitted P = 50 % Pn  GENERATING UNIT setting value Q = +Q MAX |  |  |  |  |
| **5.10.** |  | 11 minutes has passed since step 5.9. | GENERATING UNIT setting value Q ENTER - Q MAX |  |  |  |  |
| **5.11.** |  | 11 minutes has passed since step 5.10. | ENTER maximum permitted P = 40 % Pn  GENERATING UNIT setting value Q = -Q MAX |  |  |  |  |
| **5.12.** |  | 11 minutes has passed since step 5.11. | GENERATING UNIT setting value Q ENTER +Q MAX |  |  |  |  |
| **5.13.** |  | 11 minutes has passed since step 5.12. | ENTER maximum permitted P = 30 % Pn  GENERATING UNIT setting value Q = +Q MAX |  |  |  |  |
| **5.14.** |  | 11 minutes has passed since step 5.13. | GENERATING UNIT setting value Q ENTER -Q MAX |  |  |  |  |
| **5.15.** |  | 11 minutes has passed since step 5.14. | ENTER maximum permitted P = 20 % Pn  GENERATING UNIT setting value Q = -Q MAX |  |  |  |  |
| **5.16.** |  | 11 minutes has passed since step 5.15. | GENERATING UNIT setting value Q ENTER +Q MAX |  |  |  |  |
| **5.17.** |  | 11 minutes has passed since step 5.16. | ENTER maximum permitted P = 10 % Pn  GENERATING UNIT setting value Q = +Q MAX |  |  |  |  |
| **Part no** | **DESCRIPTION** | **Initial conditions** | **Power system control centre activity** | Comments | Check [OK/-] | Date [DD.MM.YYYY] | Time [HH.MM] |
| **5.18.** |  | 11 minutes has passed since step 5.17. | GENERATING UNIT setting value Q ENTER -Q MAX |  |  |  |  |
| **5.19.** |  | 11 minutes has passed since step 5.18. | ENTER maximum permitted P = 100 % Pn (P restriction out)  GENERATING UNIT control Q=const - OUT |  |  |  |  |
| **5.20.** |  | After step 5.19 generating unit has achieved reactive power in steady-state operation (Q=0 Mvar) and has operated for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  |  | interval between 2 tests at least 5 minutes |  |  |  |
| **6** | **Reactive power regulation**  **Q=const** | All generating units are operating, normal operation, P≥20 % Pn | All restrictions off / START OF TEST | Generating unit cannot be switched in/out. |  |  |  |
| **6.1.** | Generation unit output is at least P≥20 % Pn during 5 minutes | GENERATING UNIT control Q=const - IN  GENERATING UNIT setting value Q ENTER Q = +½ Q MAX | Accuracy of holding setting value in the connection +/- 10 % from Pn.  Actual testing schedule will be adapted according to agreed control signals.  The voltage in the network will be changed by EJK at all three stages (KP or switching reactor or change of transformer rate). Report of the test results has to present these changes and the behaviour of the generating unit in these situations. Report of the test results has to present these changes and the behaviour of the generating unit in these situations. |  |  |  |
| **6.2.** | 60 minutes has passed since step 6.1. | GENERATING UNIT setting value Q ENTER Q = -½ Q MAX |  |  |  |  |
| **6.3.** | 60 minutes has passed since step 6.2. | GENERATING UNIT control Q=const - OUT |  |  |  |  |
| **6.4.** | After step 6.3. generating unit has achieved reactive power in steady-state operation (Q=0 Mvar) and has operated for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  | interval between 2 tests at least 5 minutes |  |  |  |
| **7** | **Short-term network interruption** | All generating units are operating, normal operation, P≥50 % Pn | All restrictions off / START OF TEST | Before switching off VL all inverters have to be in operation and after VL is switched in, the inverters have to switch back to the network. |  |  |  |
| **7.1.** |  | Generation unit output is at least P≥50 % Pn during 5 minutes | Generating unit VL …… OUT |  |  |  |  |
| **7.2.** |  | 10 seconds has passed since step 7.1. | Generating unit VL …… IN |  |  |  |  |
| **7.3.** |  | After step 7.2. generating unit has achieved limitless steady-state operation and output power corresponding to weather conditions has been provided for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  |  | interval between 2 tests at least 5 minutes |  |  |  |
| **8** | **Short term network interruption without the central control system** | All generating units are in operation, P≥50 % Pn  The control computer of the generating unit has been taken out of the operation. | All restrictions off / START OF TEST | Before switching off VL all inverters have to be in operation and after VL is switched in, the inverters have to switch back to the network. |  |  |  |
| **8.1.** | Generation unit output is at least P≥50 % Pn during 5 minutes | Generating unit VL …… OUT |  |  |  |  |
| **8.2.** | 10 seconds has passed from the step 8.1. | Generating unit VL …… IN |  |  |  |  |
| **8.3.** | After step 8.2. generating unit has achieved limitless steady-state operation and output power corresponding to weather conditions has been provided for 5 minutes. | END OF TEST |  |  |  |  |
|  |  |  |  | interval between 2 tests at least 5 minutes |  |  |  |
| **9.1** | **Operation without the central control system 24 h** | NOTICE from the production unit that the control computer of the station has been taken out of operation. | START OF TEST  [no orders can be given during the test / EJK does not interfere] | No other tests can be performed in the production unit simultaneously. |  |  |  |
| **9.2** |  | 24 hours after the notice of step 9.1 a new NOTICE will be sent by the production unit that the control computer of the station is back in operation. | [no orders can be given during the test / EJK does not interfere]  END OF TEST |  |  |  |  |
|  |  |  |  | interval between 2 tests at least 5 minutes |  |  |  |
| **10** | **Primary regulation** | All generating units are operating, normal operation, P≥40 % Pn  Primary regulation test has to be performed in cooperation with EJK.  All control signals and transmission times have to be presented in the report | The signals of activating and setting the primary regulation are transmitted by the control centre of the power system. | A more precise test schedule has to be agreed with the network operator. |  |  |  |
| **11** | **Additional tests if needed** |  |  | Additional tests to prove the compliance of the production unit to the technical requirements (e. g. FACTS equipment tests, etc.) |  |  |  |
|  |  |  |  |  |  |  |  |
| **12** | **FAULT-RIDE-TROUGH test** | The owner of the production unit will be notified about the test in advance. |  | The test is performed by the network operator. Short circuit length up to 250 ms;  Short circuit required for the test (1f-m; 2f-m or 3f) will be generated in the connection point or in its close proximity |  |  |  |
|  |  |  |  |  |  |  |  |