Annex 16

Certification file template of qualification for supplying secondary frequency control in 300s

*[**Scope**: Everything **at each stage of partial commissioning**]*

SECONDARY FREQUENCY CONTROL 600 SEC SLOPE VERSION.

Real tests
Final folder

Objectives

The RPG's power response to a level N modification must be consistent with the generator or Reserve Provider's commitments in terms of quantity, stability and speed.

Description

As the RPG is coupled to the network, the following tests will be performed:

in the case of partial commissioning: For the purposes of this file, the term $P_{max\ RPG}$ corresponds to the maximum power installed at each partial commissioning stage, if applicable.

- **Test 1:** RPG at its maximum power P_{test1} (maximum power depending on external conditions on the day of the test) from which the automatic frequency restoration reserve band $2.pr_{test}$ is subtracted: Artificial injection of a ramp from -1 to +1 of level N (see figure 1) in 600 seconds at the telecontrol level and maintain at +1 for 30 minutes.
- **Test 2:** RPG at its maximum power P_{test2} (maximum power depending on external conditions on the day of the test): Artificial injection of a ramp +1 to -1 at level N (see figure 1) in 600 seconds and maintain at -1 for 30 minutes.
- **Test 3:** RPG at its minimum power $P_{min\ RPG}$: Artificial injection of a ramp from -1 to +1 of level N (see figure 1) in 600 seconds and maintain at +1 for 30 minutes.
- **Test 4:** RPG at its minimum power $P_{min\ RPG}$ from which the automatic frequency restoration reserve band $2{\cdot}pr_{test}$ is subtracted: Artificial injection of a ramp +1 to -1 at level N (see figure 1) in 600 seconds and maintain at -1 for 30 minutes.

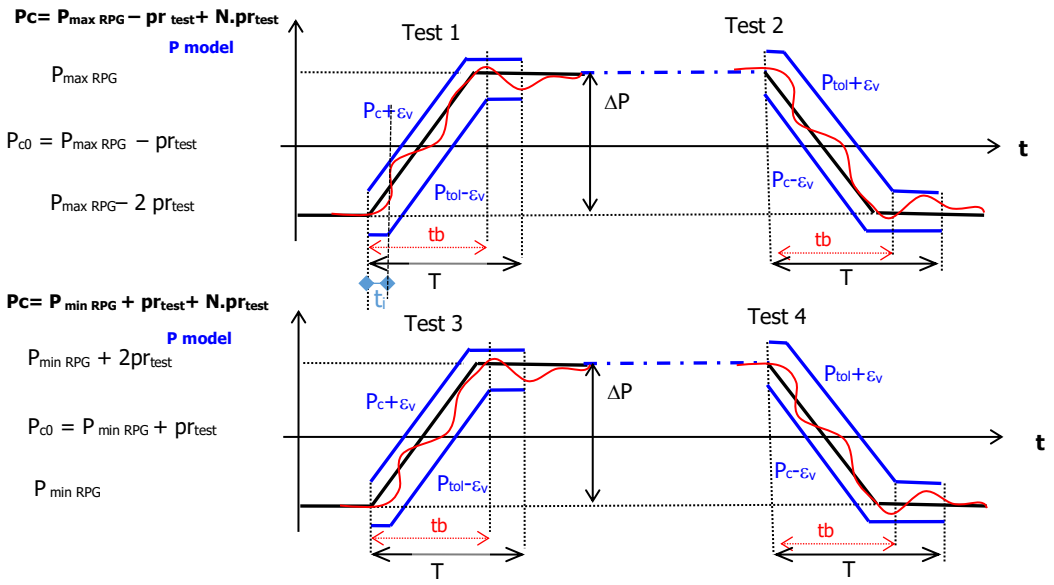

Figure 1a

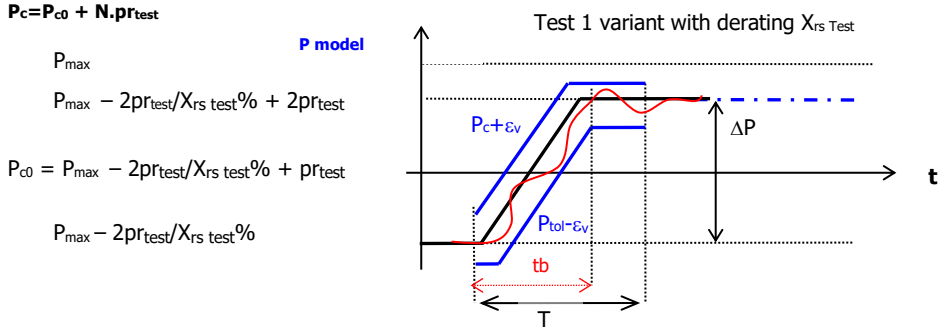

Figure 1b

tb: the response time after which the automatic frequency restoration reserve band is released
E_V: uncertainty about the active power measurement
t_i: the time after which the power variation is greater than the measurement uncertainty of the power variation.
P_{tol}: P_c /(1+ T_{max} .p) (first order transfer function with filtering of the setpoint by a time constant Tmax and p representing the Laplace variable)
T: ramp time increased by 100s

If the RPG wishes to schedule asymmetric secondary frequency control, additional tests 5 to 8 will also be carried out. Depending on the scheduling chosen in operation (upward or downward asymmetric) the level variation will be chosen in accordance (between +1 and 0 or between -1 and 0). In addition, if asymmetrical scheduling is planned with both an upward and downward reserve, the tests will be carried out with a level variation between -1 and +1 taking into account the most restrictive case of reserve scheduling planned in operation (e.g.: RPG at its Pmax, to which scheduled upward aFRR and downward aFRR is subtracted, and level between +1 and -1 and RPG at its Pmin, to which scheduled upward aFRR and downward aFRR is added and level between +1 and -1):

Test 5: The RPG at its maximum power P_{test5} (maximum power depending on external conditions on the day of the test) from which the automatic frequency restoration reserve band pr_{test} is subtracted: Artificial injection of a ramp from 0 to +1 (or -1 to 0) from the N level in 300 seconds at the telecontrol level and maintain at +1 (or 0) for 30 minutes.

- **Test 6:** The RPG at its maximum power P_{test5} (maximum power depending on external conditions on the day of the test): Artificial injection of a ramp from +1 to 0 (or 0 to -1) of level N in 300 seconds and maintain at 0 (or -1) for 30 minutes.
- **Test 7:** RPG at its minimum power $P_{min\ RPG}$: Artificial injection of a ramp from 0 to +1 (or -1 to 0) from the N level in 300 seconds and maintain at +1 (or 0) for 30 minutes.
- **Test 8:** RPG at its minimum power $P_{min\ RPG}$ from which the automatic frequency restoration reserve band $2 \cdot pr_{test}$ is added: Artificial injection of a ramp from +1 to 0 (or 0 to -1) of level N in 300 seconds and maintain at 0 (or -1) for 30 minutes.

Special conditions

- If the RPG production unit consists of two thermal generators, which are dependant on each other and whose response dynamics to the frequency control of the second is significantly slower than that of the first, such as combined-cycle gas power, the generator may choose to perform the various tests taking into account an X_{rs} % derating. For example, the initial power will be P_{test} , from which a maximum of $2.PR_{test}/X_{rs\ test}$% is subtracted for tests 1 or 5, as described in Figure 1b. Regardless of the version of the tests chosen by the generator to establish the compliance of the installation, the supply dynamic of the automatic frequency restoration reserve described above must be guaranteed in operation under operating conditions consistent with the results of the tests, regardless of the final dispatch schedule chosen by the generator. In operation, RTE will monitor compliance with this obligation according to the terms defined in the connection agreement, any deviations being treated as non-compliance.
- Tests must be scheduled and performed in conjunction with RTE.
- The RPG does not participate in primary and secondary frequency control at the time of testing (primary control in service but transparent for small movements).
- If tests [1-2] and [3-4] (respectively [5-6] and [7-8]) are identical (e.g. reserve between $P_{min\ RPG}$ and $P_{max\ RPG}$), only tests 1 and 2 will be carried out (respectively 5 and 6).
- If maintenance of the final power for 30 min for the tests has been demonstrated in other tests in the file, these may be shortened in order to only demonstrate that the dynamics and stability of the final power were respected.
- Excluding RPG subject to derating in relation to $P_{min\ RPG}$ and $P_{max\ RPG}$: With regard to tests [3-4] or [7-8]: In the absence of tests, a certificate guaranteeing that the behaviour of the RPG is similar to those of tests [1-2] or [5-6] is appropriate.
- Tests [5-6] and [7-8] carried out with a pr_{test} reserve allow tests [1-2] and [3-4] to be validated with a $pr_{test}/2$ reserve with the provision of a certificate guaranteeing that the behaviour of the RPG is similar in this case.

Input data (RTE → Generator)

Reminder: automatic frequency restoration reserve half-band $pr_{test} \geq$ …MW (see 3.2.2 secondary load-frequency control SFC) will be transmitted by the generator at the time of the test.

- For tests 1, 2, 5 and 6: the test is considered admissible if P_{test} is greater than or equal to 70% P_{max_RPG}. In the case of derating, the initial power of tests 1 and 5 is greater than or equal to 70% $P_{max\ RPG}$.
- In the case of automatic frequency restoration reserve dependent on external conditions, pr_{test} will be the maximum possible at the time of the tests and must be greater than 70 % of pr_{max}, pr_{max} being the automatic frequency restoration reserve half band that can be scheduled under the best possible external conditions.
- When performing tests 1 and 5 with a derating $X_{rs\ test\%}$, this must be greater than 60%.

The time constant T_{max} is equal to 20s (for generation units not subject to the 2003-2008-2020 orders and subsequent, the time constant must be close to this 20s criterion and in any case remain below the 60 sec continuous controlled dynamic from the Frequency Ancillary Services terms and conditions).
The value of ε_V is taken equal to ε_V =max (1MW, 5% pr_{test}).
Time T is equal to the ramp time increased by 100s.

Results (Generator → RTE)

- pr (MW)
- X_{rs}
- P_{test}
- Any interactions between the different units of the installation will be described.

For each of the tests, records of the time signals in figure 1:

- Level signal artificially injected into the speed control
- Active power at the connection point provided by the RPG

Records include the following values:

- T_b
- ti
- ΔP
- T
- $Pc \pm \varepsilon_v$, $Ptol \pm \varepsilon_v$

And the following items

- Justification of parameters chosen during tests related to external conditions: $P_{max\ RPG}$; pr_{test}; $X_{rs\ test}$; $P_{min\ RPG}$.
- Conditions for reaching the $pr_{maximum}$ (associated with the X_{rs}) depending on the external conditions and justification (if applicable in asymmetric).
- Theoretical table of the different parameters in operation depending on the external conditions: $P_{max\ RPG}$; pr; X_{rs}; $P_{min\ RPG}$ (if applicable in asymmetric).
- Where appropriate, the most restrictive tests selected for tests 5 to 8.

These records must include the pre- and post-event steady-state phases (at least 10 seconds before and 60 seconds after). There is a need to zoom in on the transient phenomena with a minimum sampling of 10 Hz.

These records should be in the following format:

- PDF and digital format of records (e.g. Excel file).
- Graphs with legend (measured quantities and units).
- Curve scales adapted to the measured amplitudes.

Criteria for compliance

For all tests, the records must visually prove that the following points are observed:

- Non-oscillating waveform comparable to figure 1.
- Variation $\Delta P = 2.pr_{test}$ for tests 1 to 4 and, if applicable, variation $\Delta P = pr_{test}$ for tests 5 to 8.
- Time t_i less than 2 s;
  If t_i is difficult to measure, provide a dated record showing the movement of the actuators in response to the frequency stimulus.
  An activation period greater than 2s must be justified by technical elements
- Released reserve maintained throughout the duration of the test.

For tests 1, 3 and if applicable for tests 5 and 7 (positive ramps):

- The measured power must be situated for 95% of the time T within the model formed by the $P_c + \varepsilon_V$ and $P_{tol} - \varepsilon_V$ curves with $P_c = P_{c0} + N.pr_{test}$ and $P_{tol} = P_c/(1+T_{max}.p)$

For tests 2, 4, and if applicable for tests 6 and 8 (negative ramps):

- The measured power must be situated for 95% of the time T within the model formed by the $P_c + \varepsilon_V$ and $P_{tol} - \varepsilon_V$ curves with $P_c = P_{c0} + N.pr_{test}$ and $P_{tol} = P_c/(1+T_{max}.p)$