PSCAD test template

# Documentation

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|  | **Requirement** | **Acceptance** |
| **Documentation** | PSCAD version compatibility |  |
| Usable time step |  |
| List of dependencies in PSCAD, list of needed files |  |
| Minimum SCR |  |
| Model bandwidth and observable oscillation frequencies |  |
| Description of protection functions and signals |  |
| Description of possible POD or MSU |  |
| Instructions to change the control mode and setpoints of each available control mode |  |
| Instructions to transfer the model to another simulation project  |  |

# Used SCR values

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | **R (Ohm)** | **X (Ohm)** |
| **Used SCR values** | SCR Normal |  |  |
| SCR Minimum |  |  |
| VCSCR |  |  |

# Functionalities

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Number** | **Active power** | **Test** | **Description** | **Background network** | **Acceptance criteria** | **Model complies (Yes/No)** | **Comments** |
| **Functionalities** | **1.1** | 1.0 pu | Setpoint change - voltage droop control | Setpoint change 1.0 pu -> 0.98 pu -> 1.0 pu -> 1.02 -> 1.0 pu | SCR Normal | Reactive power to PCC is expected |  |  |
| **1.2** | 1.0 pu | Setpoint change - Q-control | Setpoint change 0.0 pu -> -0.1 pu -> 0.0 pu -> 0.1 pu | SCR Normal | Reactive power to PCC is expected |  |  |
| **1.3** | P ramp | Setpoint change - pf-control | Setpoint change 1.0 -> 0.98. After setpoint change P change 1.0 pu -> 0.8 pu -> 1.0 pu. | SCR Normal | Reactive power to PCC is expected |  |  |
| **1.4** | P ramp | Setpoint change - Active power max | Setpoint change 1.0 pu -> 0.5 pu -> 1.0 pu | SCR Normal | Active power is expected |  |  |
| **1.5** | P ramp | Setpoint change - Active power min | Setpoint change Pmin -> 0.5 pu -> Pmin | SCR Normal | Active power is expected |  |  |
| **2.1** | 0.5 pu | FMS | Frequency 50 Hz -> 49.5 Hz -> 50 Hz -> 50.5 Hz -> 50 Hz | SCR Normal | Active power follows frequency setpoints. Droop 2-12 %. |  |  |
| **2.2** | 0.5 pu  | LFSM-O | Frequency 50 Hz -> 49 Hz -> 50 Hz -> 51 Hz -> 50 Hz | SCR Normal | Active power regulates as expected. Droop 2-12 %. |  |  |
| **Capabilities** | **3.1** | 1.0 pu | Operating limits - Voltage - Full power | PPC voltage 1.0 pu -> 0.9 pu -> 1.0 pu -> 1.1 pu -> 1.0 pu | Infinite bus - Forced voltage to PCC | Stable operation |  |  |
| **3.2** | 0.5 pu | Operating limits - Voltage - Partial power | PPC voltage 1.0 pu -> 0.9 pu -> 1.0 pu -> 1.1 pu -> 1.0 pu | Infinite bus - Forced voltage to PCC | Stable operation |  |  |
| **3.3** | 1.0 pu | Operating limits - Frequency - Full power | Frequency 50 Hz -> 47.5 Hz -> 50 Hz -> 51.5 Hz -> 50 Hz | SCR Normal | Stable operation. Active power reduction is not more than 10 % per 1 Hz when frequency is below 49.0 Hz |  |  |
| **3.4** | 0.5 pu | Operating limits - Frequency - Partial power | Frequency 50 Hz -> 47.5 Hz -> 50 Hz -> 51.5 Hz -> 50 Hz | SCR Normal | Stable operation. Active power reduction is not more than 10 % per 1 Hz when frequency is below 49.0 Hz |  |  |
| **4.1** | P ramp | Compensation equipment logic disconnect | Active power ramp 0.81 pu -> 0.19 pu | SCR normal | Compensation devices shall be connected at the beginning and shall be disconnected during the active power ramp |  |  |
| **4.2** | P ramp | Compensation equipment logic connect | Active power ramp 0.19 pu -> 0.81 pu  | SCR normal | Compensation devices shall be disconnected at the beginning and shall be connected during the active power ramp |  |  |
| **5.1** | 1.0 pu | Reactive power capability - Full Power | PCC voltage 1.0 pu -> 0.9 pu -> 1.0 pu -> 1.1 pu -> 1.0 pu | Infinite bus - Forced voltage to PCC | Reactive power matches reactive power capacity calculations |  |  |
| **5.2** | 1.0 pu | Plant operating in momentary operating point 0.85 pu – Full power | PCC voltage 1.0 pu -> 0.85 pu -> 1.0 pu | Infinite bus - Forced voltage to PCC | Reactive power shall be produced for a minimum of 10 seconds |  |  |
| **6.1** | 1.0 pu | Step response test - Full power | Background network voltage 1.0 pu -> 0.98 pu -> 1.0 pu -> 1.02 pu -> 1.0 pu | VCSCR | Rise time for all steps 1.0±0.1 s. Reactive power to PCC matches droop setting. |  |  |
| **6.2** | 1.0 pu | Step response test 10 s - Full power | Background network voltage 1.0 pu -> 0.98 pu -> 1.0 pu -> 1.02 pu -> 1.0 pu | VCSCR | Rise time for all steps 10 ± 1 s. Reactive power to PCC matches droop setting. |  |  |
| **7.1.1** | 1.0 pu | Fault ride through test 1 - VJV | VJV table 10.1 or 10.2 test | SCR Normal, after fault SCR minimum | No tripping, expected recovery |  |  |
| **7.1.2** | 1.0 pu | Fault ride through test 2 - VJV | VJV table 10.1 or 10.2 test | SCR Normal | No tripping, expected recovery |  |  |
| **7.2** | 1.0 pu | Multiple FRT | 10 consecutive 100 ms bolted three phase faults during same simulation | SCR Normal | Expected performance |  |  |
| **7.3** | 1.0 pu | Fault current injection | Fault sequence or separate simulations of three phase faults with following PPC residual voltages: 0.9 pu, 0.8 pu, 0.7 pu, 0.6 pu, 0.5 pu, 0.4 pu, 0.3 pu, 0.2 pu, 0.1 pu, 0.0 pu. | SCR Normal | Active and reactive current provisions calculated. Reactive power k-factor shall be as defined in VJV. Reactive current shall be prioritized. |  |  |
| **7.4** | 1.0 pu | LVRT | Fault sequence or separate simulations of PPC voltage drops | Infinite bus - Forced voltage to PCC / SCR Normal | LVRT activates and deactivates at expected thresholds  |  |  |
| **Protections** | **8.1** | 1.0 pu | High voltage protection | Voltage raised until power plant trips | Infinite bus - Forced voltage to PCC | Power plant trips and user will be notified about the protective function. |  |  |
| **8.2** | 1.0 pu | Low voltage protection | Voltage lowered until power plant trips | Infinite bus - Forced voltage to PCC | Power plant trips and user will be notified about the protective function. |  |  |
| **8.3** | 1.0 pu | High frequency protection | Frequency raised until power plant trips | SCR Normal | Power plant trips and user will be notified about the protective function. |  |  |
| **8.4** | 1.0 pu | Low frequency protection | Frequency lowered until power plant trips | SCR Normal | Power plant trips and user will be notified about the protective function. |  |  |
| **PSCAD** | **A1** | - | Version compatibility v5.0.1 / Fortran Compiler | Model run with PSCAD 5.0.1 versionModel supports Intel oneAPI compiler | N/A | No errors with different versions or compilers |  |  |
| **A2** | - | Compability with other models and multiple instances | Model is compatible with other models, multiple instances, and separate parametrization | N/A | Model runs with other turbine models with no issues. No errors with multiple instances or separate parametrization of different instances |  |  |
| **A3** | - | Model aggregation, equipment, signals, and control modes | Model is aggregated according to instructions and includes required equipment, signals, and control modes | N/A | No errors with aggregation or included equipment. Model includes required signals and control modes |  |  |
| **A4** | - | Multiple run and snapshot features | Model supports multiple run and snapshot features | N/A | No errors with multiple run or snapshot features |  |  |