Claims

1. A method of determining, in a measurement system, a frequency response characteristic within a synchronous area of an electric power grid, electricity flowing in the grid in accordance with a grid frequency, wherein the electric power grid is connected to a first group of one or more power units each arranged to consume electric power from and/or provide electric power to the electric power grid such that a change in power provision and/or consumption by said first group of one or more power units results in a change in power flow in the electric power grid, wherein power flow to and/or from each of the power units is modulated on the basis of a sequence of control signals, thereby modulating the grid frequency to provide a frequency modulated signal according to the sequence of control signals, the method comprising:

measuring, in the measurement system, a frequency characteristic relating to a frequency of electricity flowing in the electric power grid;

accessing a database storing data relating to power characteristics of said one or more power units and determining, on the basis thereof, a characteristic relating to said power flow modulation; and

determining a frequency response characteristic associated with at least one area of said electric power grid on the basis of the measured frequency characteristic and the said determined power flow modulation characteristic.

2. A method according to claim 1, in which determining the frequency response characteristic comprises correlating the measured frequency characteristic with said power flow modulation characteristic.

3. A method according to claim 1, in which determining the frequency response characteristic comprises determining a ratio of said power flow modulation characteristic and the measured frequency characteristic.

4. A method according to any preceding claim in which said power flow modulation characteristic comprises a magnitude characteristic relating to said power flow modulation.

5. A method according to claim 4, in which said magnitude characteristic comprises an amplitude of the power flow.

6. A method according to any preceding claim, in which said measured frequency characteristic is measured on the basis of one or more of: a frequency of alternating voltage, a frequency of alternating current, a measured frequency of power flowing in the electric power grid; a rate of change of frequency; a period of alternating current or voltage.

7. A method according to any preceding claim, in which said measured frequency characteristic comprises a time variation in frequency associated with said modulated signal.

8. A method according to any preceding claim, in which said frequency response characteristic comprises an inertia characteristic.

9. A method according to claim 8, in which said inertia characteristic comprises at least one of a rise time and a fall time associated with said frequency modulated signal.

10. A method according to any of claims 1 to 7, in which said frequency response characteristic comprises a characteristic relating to a magnitude of variation in grid frequency per unit change in power balance.

11. A method according to any preceding claim, in which of the first group of power units is a distributed group of power units, the method comprising:

modulating power flow to and/or from each of the first group of power units in accordance with a control pattern, such that the consumption and/or provision of

power by the plurality of power units is coordinated to provide a collective frequency modulated signal, having a collective frequency characteristic, that is detectable by the measurement system.

12. A method according to claim 11, comprising sending a signal specifying said control pattern to each power unit of the first group of power units.

13. A method according to claim 11 or claim 12, in which the control pattern comprises a repeating pattern, and the method comprises controlling power to and/or from the first group of one or more power units continuously according to the repeating pattern.

14. A method according to any of claim 11 to claim 13, comprising controlling power to and/or from the first group of one or more power units intermittently according to the control pattern.

15. A method according to any of claim 11 to claim 14, in which said collective modulated signal includes an identifier identifying said group of power units, the method comprising:

accessing a database storing one or more identifiers each associated with said first group of one or more power units; and

determining a correspondence between the identifier included in the collective modulated signal and one or more of the identifiers stored in the database, thereby identifying said first group of one or more power units.

16. A method according to claim 15, in which each identifier stored in the database is associated with at least one area of the electric power grid and the method comprises determining an area with which the determined frequency response characteristic is associated on the basis of the determined identifier correspondence.

17. A method according to any preceding claim, in which the electric power grid is connected to a second group of one or more power units arranged to consume power from and/or provide power to the electric power grid, the method comprising:

determining, on the basis of the determined frequency response characteristic, one or more parameters for use in triggering a change in consumption and/or provision of power by the second group of one or more power units; and

transmitting said one or more parameters for receipt at said second group of power units.

18. A method according to claim 17, comprising:

receiving, at the second group of power units, said one or more parameters;

deriving, on the basis of the received parameters, a trigger condition;

determining, based on a measured frequency characteristic of electric power flowing in the grid locally to a second group of power units, whether the trigger condition is satisfied; and

in response to a determination that the trigger condition is satisfied, changing a power flow to and/or from the second group of power units.

19. A method according to claim 18, comprising, at the measurement system:

analysing a measured frequency characteristic of electric power flowing in the grid locally to said second group of power units;

extrapolating, based on the analysis, future values of said measured frequency characteristic;

determining, based on the extrapolation, whether the trigger condition is satisfied.

20. A method according to any one of claim 17 to 19, comprising:

defining, at the measurement system, a first series of values associated with the frequency characteristic during a first time period and a second series of values associated with the frequency characteristic during a second, later, time period;

determining, at the measurement system, a first polynomial function having a first set of coefficients on the basis of said first series of values and a second

polynomial function having a second set of coefficients on the basis of said second series of values; and

determining, at the measurement system, whether the trigger condition is satisfied on the basis of a difference between the first set of coefficients and the second set of coefficients.

21. A method according to any of claim 1 to claim 16, in which the electric power grid is connected to a second group of one or more power units arranged to consume power from and/or provide power to the electric power grid, the method comprising:

determining, based on the determined frequency response characteristic associated with an area associated with the second group of power units, one or more parameters for use in triggering a change in consumption and/or provision of power by the second group of one or more power units;

deriving a trigger condition on the basis of the measured frequency response characteristic;

measuring, in an area associated with the second group of power units, a frequency characteristic relating to a frequency of electricity flowing in the electric power grid;

communicating the measured frequency characteristic measured in the area associated with the second group of power units to the measurement system;

determining, based on the communicated measured frequency characteristic, whether the trigger condition is satisfied; and

in response to a determination that the trigger condition is satisfied, sending a request to the second group of power units to change a power flow to and/or from the second group of power units.

22. A method according to any of claim 17 to 21, in which the second group of power units is the same as the first group of power units.

23. A method according to any preceding claim, in which the power modulation comprises modulation of at least one of real power and reactive power.

24. A measurement system for determining a frequency response characteristic within a synchronous area of an electric power grid, wherein electricity flows in the grid in accordance with a grid frequency and the electric power grid is connected to a group of one or more power units each arranged to consume electric power from and/or provide electric power to the electric power grid such that a change in power provision and/or consumption by said power unit results in a change in power flow in the grid, wherein power flow to and/or from each of the power units is modulated on the basis of a sequence of control signals, thereby modulating the grid frequency to provide a frequency modulated signal, the measurement system being arranged to:

measure a frequency characteristic relating to a frequency of electricity flowing in the electric power grid;

access a database storing data relating to power characteristics of said one or more power units and determine, on the basis thereof, a characteristic relating to said power flow modulation; and

determine a frequency response characteristic associated with at least one area of said electric power grid on the basis of the measured frequency characteristic and the said determined power flow modulation characteristic.