

CLAIMS

What is claimed is:

1. A method for determining an operating state of a photovoltaic array, comprising:
acquiring present operating state data of the photovoltaic array, wherein the photovoltaic
5 array comprises at least two photovoltaic strings in parallel, and the present operating state
data comprises present output current values of the photovoltaic strings and present
irradiances corresponding to the photovoltaic strings;
determining present characteristic parameters of the photovoltaic array based on the
present operating state data, wherein the present characteristic parameters characterize
10 characteristics of a present operating state of the photovoltaic array, and the present
characteristic parameters comprise a present characteristic current value, a present current
discrete rate and the present irradiances; and
determining an operating state of the photovoltaic array by comparing the present
characteristic parameters with standard characteristic parameters of the photovoltaic array,
15 wherein the standard characteristic parameters are determined based on historical operating
state data of the photovoltaic array, and the standard characteristic parameters comprise a
standard characteristic current value, a standard current discrete rate and a standard irradiance
corresponding to the photovoltaic string.
- 20 2. The method according to claim 1, wherein determining the operating state of the
photovoltaic array by comparing the present characteristic parameters with the standard
characteristic parameters of the photovoltaic array comprises:
determining that the operating state of the photovoltaic array is normal in response to the
present characteristic current value being less than or equal to the standard characteristic
25 current value; and
determining that the operating state of the photovoltaic array is normal in response to the
present characteristic current value being greater than the standard characteristic current value
and the present irradiance being less than or equal to the standard irradiance.

3. The method according to claim 2, wherein determining the operating state of the photovoltaic array by comparing the present characteristic parameters with the standard characteristic parameters of the photovoltaic array further comprises:

5 acquiring present current discrete rates corresponding to N continuous sampling moments in response to the present characteristic current value being greater than the standard characteristic current value and the present irradiance being greater than the standard irradiance, wherein N is an integer greater than or equal to 1; and

 determining that the operating state of the photovoltaic array is abnormal in response to
10 present current discrete rates corresponding to at least M continuous sampling moments being greater than the standard current discrete rate, wherein M is an integer greater than or equal to 1, and M is less than or equal to N.

4. The method according to claim 3, wherein after determining that the operating state of
15 the photovoltaic array is abnormal, the method further comprises:

 determining a minimum output current value of the present output current values corresponding to the M continuous sampling moments; and

 determining a photovoltaic string corresponding to the minimum output current value as an abnormal photovoltaic string.
20

5. The method according to any one of claims 1 to 4, wherein determining the present characteristic parameters of the photovoltaic array based on the present operating state data comprises:

 acquiring filtered present output current values by filtering the present output current
25 values based on a current threshold, wherein the current threshold is determined based on the historical operating state data of the photovoltaic array, and the filtered present output current values are less than or equal to the current threshold;

 determining a K percentile in the filtered present output current values as the present characteristic current value, wherein K is an integer greater than or equal to 50; and

30 determining a ratio of a current standard deviation to a current average corresponding to

the filtered present output current values as the present current discrete rate.

6. The method according to any one of claims 1 to 4, wherein before acquiring the present operating state data of the photovoltaic array, the method further comprises:

5 acquiring the historical operating state data of the photovoltaic array within a preset time period, wherein the historical operating state data comprises historical output current values of the photovoltaic strings, historical irradiances corresponding to the photovoltaic strings, and historical ambient temperatures and historical wind speeds of environment where the photovoltaic strings are located;

10 calculating a photovoltaic module temperature corresponding to the photovoltaic array based on a maximum irradiance, a maximum wind speed and a maximum ambient temperature, wherein the maximum irradiance is determined based on the historical irradiances, the maximum ambient temperature is determined based on the historical ambient temperatures, and the maximum wind speed is determined based on the historical wind
15 speeds;

 calculating a first maximum output current value corresponding to the photovoltaic array based on the photovoltaic module temperature and the maximum irradiance, wherein the first maximum output current value is an output current value of the photovoltaic string under the maximum irradiance;

20 calculating a second maximum output current value corresponding to the photovoltaic array based on a rated installed capacity and a maximum system voltage, wherein the rated installed capacity is a rated power of a combiner connected to the photovoltaic array, the maximum system voltage is a system voltage of an inverter connected to the combiner, and the second maximum output current value is a maximum current value that the combiner
25 allows the photovoltaic strings to input;

 determining a minimum value of the first maximum output current value and the second maximum output current value as a current threshold;

 acquiring filtered historical operating state data by filtering the historical operating state data based on the current threshold, wherein the filtered historical output current values are
30 less than or equal to the current threshold; and

determining the standard characteristic parameters based on the filtered historical operating state data.

7. The method according to claim 6, wherein determining the standard characteristic
5 parameter based on the filtered historical operating state data comprises:

constructing a first characteristic curve based on the filtered historical output current values and acquisition moments corresponding to the filtered historical output current values, wherein the first characteristic curve characterizes a power generation performance of the photovoltaic array, and the first characteristic curve is a normal distribution curve; and
10 determining the standard characteristic current value based on the first characteristic curve and a preset empirical coefficient;

constructing a second characteristic curve based on the filtered historical output current values and filtered historical irradiances, wherein the second characteristic curve is a linear curve; and determining the standard irradiance based on the standard characteristic current
15 value and the second characteristic curve; and

calculating a historical current discrete rate of the photovoltaic array based on the filtered historical output current values; and calculating the standard current discrete rate based on the historical current discrete rate and a failure current discrete rate.

20 8. An apparatus for determining an operating state of a photovoltaic array, comprising:

a first acquiring module, configured to acquire present operating state data of the photovoltaic array, wherein the photovoltaic array comprises at least two photovoltaic strings in parallel, and the present operating state data comprises present output current values of the photovoltaic strings and present irradiances corresponding to the photovoltaic strings;

25 a first determining module, configured to determine present characteristic parameters of the photovoltaic array based on the present operating state data, wherein the present characteristic parameters characterize characteristics of a present operating state of the photovoltaic array, and the present characteristic parameters comprise a present characteristic current value, a present current discrete rate and the present irradiances; and

30 a second determining module, configured to determine an operating state of the

photovoltaic array by comparing the present characteristic parameters with standard characteristic parameters of the photovoltaic array, wherein the standard characteristic parameters are determined based on historical operating state data of the photovoltaic array, and the standard characteristic parameters comprise a standard characteristic current value, a
5 standard current discrete rate and a standard irradiance corresponding to the photovoltaic string.

9. A computer device, comprising a processor and a memory storing at least one instruction, at least one program, a code set or an instruction set therein, wherein the at least
10 one instruction, the at least one program, the code set or the instruction set, when loaded and executed by the processor, causes the processor to perform the method for determining the operating state of the photovoltaic array according to any one of claims 1 to 7.

10. A computer-readable storage medium, storing at least one instruction, at least one
15 program, a code set or an instruction set therein, wherein the at least one instruction, the at least one program, the code set or the instruction set, when loaded and executed by a processor, causes the processor to perform the method for determining the operating state of the photovoltaic array according to any one of claims 1 to 7.