Summary of Invention

Technical Problem

[0011]

The amount of power supplied from a renewable power sourse to a power system varies according to charges, over a short period of time, in the weather conditions. For example, in a photovoltaic power generation apparatus, the amount of power that is supplied varies as a result of small clouds that pass in front of the sun.

[0012]

In practice, it is difficult to design a power supply schedule that can anticipate, over a short period of time, the degree of change in weather conditions.

[0013]

Consequently, in the power system control method described in Patent Literature 1, it is difficult, in practice, to have the operation schedule (control information) of the secondary battery that is created by the power system control device that is an upper device, reflect chandes, in the amount of supplied power, that will occur due to changes, over a short period of time, in weather conditions.

[0014]

Accordingly, the power system control method described in Patent Literature 1 has the problem of being unable to cope with the actual variation state of the power system, in which the control information from the upper device is not reflected.

[0015]

The above problem is not solved either by the system described in Patent Literature 2 that does not control charge and discharge of battery cells, as a matter of course.

[0016]

An object of the present invention is to provide a battery control system, a battery control device, a battery control support device, a battery control method, a battery control support method and a program that can solve the above-described problem.

Solution to Problem

[0017]

A battery control device according to a first aspect of the present invention is a battery control device controlling an operation of a battery connected to a power system, the device includes:

detection means that detects state information that shows the state of said battery~~battery-related information that shows a state of the battery, or a voltage of an interconnection point of the power system and the battery~~;

first communication means that transmits the state information ~~a detection result of the detection means~~ to an external device, and receives operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, for controlling the operation of the battery from the external device; and

control means that controls the operation of the battery~~, based on a state of the power system, and~~ based on the operation control information received by the first communication means.

[0017a]

A battery control device according to a second aspect of the present invention is a battery control device controlling an operation of a battery that is connected to a power system, the device comprising:

detection means that detects a state of an interconnection point of said power system and said battery;

first communication means that transmits the state of the interconnection point to an external device, and receives operation control information, that is generated based on;

the state of the interconnection point, and

an adjustment target voltage that is a voltage of a voltage adjustment target spot in said power system, to control the operation of said battery from the external device; and

control means that controls the operation of said battery based on the operation control information received by said first communication means.

[0018]

A battery control support device according to a third aspect of the present invention is a battery control support device communicating with a battery control device controlling an operation of a battery connected to a power system, the device includes:

second communication means that communicates with the battery control device, and receives state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices;~~battery-related information that shows a state of the battery, or a voltage of an interconnection point of the power system and the battery;~~

recognition means that recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devices;~~situation of the power system;~~ and

processing means that generates operation control information for controlling the

operation of the battery, based on the state information ~~battery-related information~~ and the power amount ~~situation of the power system~~ that is recognized by the recognition means, and transmits the operation control information from the second communication means to the battery control device.

[0018a]

A battery control support device according to a fourth aspect of the present invention is a battery control support device communicating with a battery control device controlling an operation of a battery connected to a power system, the device comprising:

second communication means that receives a state of the interconnection point of said power system and said battery;

recognition means that recognizes an adjustment target voltage that is a voltage of a voltage adjustment target spot in said power systems; and

processing means that generates operation control information to control the operation of said battery, based on the state of the interconnection point and the adjustment target voltage that is recognized by said recognition means, and transmits the operation control information from said second communication means to said battery control device.

[0019]

A battery control system according to a fifth aspect of the present invention is a battery control system including a first control device that controls an operation of a battery connected to a power system, and a second control device that communicates with the first control device,

the first control device includes;

detection means that detects state information that shows the state of said~~battery-related information that shows a state of the battery or a state of an interconnection point of the power system and the battery~~,

first communication means that transmits the state information ~~a detection result of the detection means~~ to the second control device, and receives operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control the operation of the battery from the second control device, and

control means that controls the operation of the battery ~~based on a state of the power system and~~ based on the operation control information received by the first communication means, and

the second control device comprises:

second communication means that communicates with the first control means, and receives state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices; ~~the battery-related information,~~

recognition means that recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devices; ~~situation of the power system,~~ and

processing means that generates the operation control information based on the ~~battery-related~~state information received by the second communication means and based on the power amount~~situation of the power system~~ recognized by the recognition means, and transmits the operation control information from the second communication means to the first control device.

[0020]

A battery control method according to a sixth aspect of the present invention is a battery control method that is performed by a battery control device that controls an operation of a battery connected to a power system, wherein the method includes;

detecting state information that shows the state of said battery~~battery-related information that shows any one of a state of the battery and a state of an interconnection point of the power system and the battery~~;

transmitting the ~~battery-related~~state information to an external device, and receiving operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control the operation of the battery from the external device; and

controlling the operation of the battery based on ~~a state of the power system and~~ the operation control information.

[0021]

A battery control support method according to a seventh aspect of the present invention is a battery control support method performed by a battery control support device that communicates with a battery control device that controls an operation of a battery connected to a power system, wherein the method includes;

receiving state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices~~battery-related information that shows a state of the battery, or a voltage of an interconnection point of the power system and the battery, from the battery control device~~;

recognizing a power amount that is allotted to said batteries that are controlled by the N battery control devices~~situation of the power system~~; and

generating operation control information to control the operation of the battery, based on the state ~~battery-related~~ information and the power amount~~situation of the power system~~, and

transmitting the operation control information to the battery control device.

[0022]

A battery control method according to an eight aspect of the present invention is a battery control method that is performed by a battery control system including a first control device that controls an operation of a battery connected to a power system, and a second control device that communicates with the first control device, wherein

the first control device detects state information that shows the state of said batterybattery-related information that shows any one of a state of the battery and a state of an interconnection point of the power system and the battery,

the second control device recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devicessituation of the power system,

the first control device transmits the state ~~battery-related~~ information to the second control device,

the second control device receives the ~~battery-related~~ state information,

the second control device generates operation control information to control the operation of the battery, based on the ~~battery-related~~ state information and the power amount~~situation of the power system~~,

the second control device transmits the operation control information to the first control device,

the first control device receives the operation control information, and

the first control device controls the operation of the battery, based on ~~a state of the power system and the~~ operation control information.

[0023]

A recording medium according to a ninth aspect of the present invention is a computer-readable recording medium recording a program for causing a computer to execute:

a detection procedure of detecting state information that shows the state of said battery~~battery-related information that shows a state of a battery connected to a power system, or a state of an interconnection point of the power system and the battery~~;

a communication procedure of transmitting the ~~battery-related~~state information to an external device, and receiving operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control an operation of the battery from the external device; and

a control procedure of controlling the operation of the battery, based on ~~a state of the power system and~~ the operation control information.

[0024]

A recording medium according to a tenth aspect of the present invention is a computer-readable recording medium recording a program for causing a computer to execute:

a reception procedure of receiving state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices~~battery-related information that shows a state of a battery, or a state of an interconnection point of a power system and the battery~~, from a battery control device that controls an operation of the battery connected to the power system;

a recognition procedure of recognizing a state information that shows the state of said

battery from each of N (N is an integer that is one or larger) battery control devicessituation of the power system; and

a processing procedure of generating operation control information to control the operation of the battery, based on the battery-relatedstate information and the power amountsituation of the power system, and transmitting the operation control information to the battery control device.

Advantageous Effect of Invention

[0025]

What is claimed is:

1. A battery control device controlling an operation of a battery that is connected to a power system, the device comprising:

detection means that detects state information that shows the state of said battery ~~battery-related information that shows a state of said battery, or a voltage of an interconnection point of said power system and said battery~~;

first communication means that transmits the state information ~~a detection result of said detection means~~ to an external device, and receives operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control the operation of said battery from the external device; and

control means that controls the operation of said battery~~, based on a state of said power system, and~~ based on the operation control information received by said first communication means.

2. The battery control device according to claim 1,

wherein said control means controls the operation of said battery, based on a state of said power system, and based on the operation control information received by said first communication means. ~~said detection means detects state information that shows the state of said battery, as the battery-related information, and~~

~~said first communication means receives from the external device the operation control information that is generated based on:~~

~~the detection result of said detection means, and~~

~~a power amount that is allotted to all batteries that are controlled by N (N is a number that is 1 or larger) battery control devices in order to adjust a power amount in said power system,.~~

3. The battery control device according to claim 2,

wherein said control means further controls the operation of said battery based on the state information.

4. The battery control device according to claim 2,

wherein said detection means detects battery information for determining a chargeable and dischargeable capacity of said battery, as the state information,

the operation control information is a ratio of a total amount of chargeable and dischargeable capacities of the batteries controlled by the N battery control devices, and the power amount allotted to all the batteries, and

said control means determines an adjustment power amount that is obtained by adjusting the power amount, which is determined in accordance with the state of said power system, based

the correction.

12. The battery control device according to any one of claims 2, 3, and 6 to 11,

wherein said detection means detects battery information for determining a chargeable and dischargeable capacity of said battery as the state information.

13. The battery control device according to claims 2 to 12,

wherein said control means controls the operation of said battery based on a difference of the state of said power system with respect to a reference state of said power system.

14. A battery control device controlling an operation of a battery that is connected to a power system, the device comprising: ~~The battery control device according to claim 1,~~

detection means that detects a state of an interconnection point of said power system and said battery;

first communication means that transmits the state of the interconnection point to an external device, and receives operation control information, that is generated based on;

the state of the interconnection point, and

~~wherein said detection means detects a state of the interconnection point as the battery-related information,~~

~~said first communication means receives the operation control information that is generated based on;~~

~~the detection result of said detection means, and~~

an adjustment target voltage that is a voltage of a voltage adjustment target spot in said power system, to control the operation of said battery from the external device; and

control means that controls the operation of said battery based on the operation control information received by said first communication means. ~~the state of said power system is the state of the interconnection point.~~

15. The battery control device according to claim 14,

wherein said first communication means receives the operation control information that is correlation information that shows correlation between the state of the interconnection point and the adjustment target voltage,

said control means calculates the adjustment target voltage from the state of the interconnection point by using the correlation information, and when a result of the calculation is

outside a predetermined voltage range, the control means controls the operation of said battery by using the correlation information so that the adjustment target voltage is within the predetermined voltage range.

16. The battery control device according to claim 15,

wherein said power system is provided with a voltage adjustment device that changes the adjustment target voltage to a voltage within a specific voltage range in the predetermined voltage range when the adjustment target voltage is continuously outside the specific voltage

range for a specific time period, and

when the result of the calculation is larger than an upper limit value of the predetermined voltage range, said control means controls the operation of said battery by using the correlation information so that the adjustment target voltage is included in a range between the upper limit value and an upper limit value of the specific voltage range, and when the result of the calculation is smaller than a lower limit value of the predetermined voltage range, said control means controls the operation of said battery by using the correlation information so that the adjustment target voltage is included in a range between the lower limit value and a lower limit value of the specific voltage range.

17. A battery control support device communicating with a battery control device controlling an operation of a battery connected to a power system, the device comprising:

second communication means that communicates with said battery control device, and receives state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices; ~~battery-related information that shows a state of said battery, or a voltage of an interconnection point of said power system and said battery;~~

recognition means that recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devices; ~~situation of said power system;~~ and

processing means that generates operation control information to control the operation of said battery, based on the state information ~~battery-related information~~ and the power amount ~~situation of said power system~~ that is recognized by said recognition means, and transmits the operation control information from said second communication means to said battery control device.

~~18. The battery control support device according to claim 17,~~

~~wherein said second communication means receives the battery-related information that is state information showing the state of said battery from each of N (N is an integer that is one or larger) battery control devices, and~~

~~said recognition means recognizes a power amount that is allotted to all batteries that are controlled by the N battery control devices in order to adjust a power amount in said power system, as the situation of said power system.~~

~~19~~18. The battery control support device according to claim ~~18~~17,

wherein the state information is battery information for determining a chargeable and

dischargeable capacity of said battery, and

said processing means generates a ratio of a total amount of chargeable and dischargeable capacities of the batteries controlled by the N battery control devices, and the power amount

allotted to all of said batteries, as the operation control information.

~~20~~19. The battery control support device according to claim ~~18~~17or ~~19~~18,

wherein said processing means generates correction information that shows a charge amount or a discharge amount that brings the state of said battery close to a reference state, based on the state information, and transmits the correction information from said second communication means to said battery control device.

~~21~~20. The battery control support device according to claim ~~20~~19,

wherein the number N of said battery control devices is M (M is an integer that is two or larger), and

said processing means generates each piece of correction information in which a total sum of a charge amount and a discharge amount becomes zero when the charge amount is a positive value and the discharge amount is a negative value with respect to the charge amount or the discharge amount shown in each piece of the correction information.

~~22~~21. The battery control support device according to claim ~~20~~19,

wherein the number N of said battery control devices is M (M is an integer that is two or larger), and

said processing means generates each piece of correction information so that a speed of a change of a total sum of a charge amount and a discharge amount as time elapses becomes an upper limit of a response speed of a power stabilizing operation performed by an external power stabilizing device connected to said power system, or becomes lower, when the charge amount is a positive value and the discharge amount is a negative value, with respect to the charge amount or the discharge amount shown in each piece of the correction information.

~~23~~22. The battery control support device according to claim ~~18~~17,

wherein the number N of said battery control devices is M (M is an integer that is two or larger),

the state of said power system is expressed in a numeric value,

said processing means:

determines a charge amount or a discharge amount that brings the state of said battery close to a target state based on the state information of said battery, for each of said batteries,

corrects the charge amounts or the discharge amounts so that a total sum of the charge amounts or the discharge amounts of the respective batteries is in a linear relation with respect to the numeric value in a situation in which the numeric value showing the state of said power system is within a predetermined range,

generates operation information that shows a relation between the state of said power system and operation contents of said batteries by using the charge amounts or the discharge amounts after correction, and

transmits the operation information from said second communication means to said battery control devices.

~~24~~23. The battery control support device according to claim ~~18~~17,

wherein said processing means transmits a reference state of said battery from said second communication means to said battery control device.

~~25~~24. The battery control support device according to claim ~~24~~23,

wherein said processing means transmits speed-related information for determining a correction speed, at which the state of said battery is corrected, from said second communication means to said battery control device.

~~26~~25. The battery control support device according to any one of claims ~~18~~17 to ~~25~~24,

wherein said recognition means accepts power amount information for determining power amounts, which are allotted to all of said batteries controlled by the N battery control devices, from an external control device that controls said power system.

~~27~~26. The battery control support device according to claim ~~26~~25,

wherein the state information is battery information for determining a chargeable and dischargeable capacity of said battery, and

said recognition means transmits notification information that shows a total amount of chargeable and dischargeable capacities of batteries that are controlled by the N battery control devices, said total amount being determined by the state information from the N battery control devices, to the external control device, and receives the power amount information, which reflects the total amount of the chargeable and dischargeable amounts, from the external control device.

~~28~~27. A battery control support device communicating with a battery control device controlling an operation of a battery connected to a power system, the device comprising:

second communication means that receives a state of the interconnection point of said power system and said battery;

recognition means that recognizes an adjustment target voltage that is a voltage of a voltage adjustment target spot in said power systems; and

processing means that generates operation control information to control the operation of said battery, based on the state of the interconnection point and the adjustment target voltage that is recognized by said recognition means, and transmits the operation control information from said second communication means to said battery control device. ~~The battery control support device according to claim 17,~~

~~wherein the battery-related information is a state of the interconnection point, and~~

~~said recognition means recognizes an adjustment target voltage that is a voltage of a voltage adjustment target spot in said power system, as the situation of said power system.~~

~~29~~28. The battery control support device according to claim ~~28~~27,

wherein said processing means generates correlation information that shows a correlation between the state of the interconnection point and the adjustment target voltage recognized by said recognition means, as the operation control information.

~~30~~29. A battery control system comprising a first control device that controls an operation of a battery connected to a power system, and a second control device that communicates with the first control device,

wherein said first control device comprises:

detection means that detects state information that shows the state of said battery~~battery-related information that shows a state of the battery or a state of an interconnection point of the power system and the battery~~,

first communication means that transmits the state information ~~a detection result of said detection means~~ to said second control device, and receives operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control the operation of the battery from said second control device, and

control means that controls the operation of the battery ~~based on a state of the power system and~~ based on the operation control information received by said first communication means, and

said second control device comprises:

second communication means that communicates with said first control means, and receives state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices; ~~the battery-related information,~~

recognition means that recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devices; ~~situation of the power system,~~ and

processing means that generates the operation control information based on the state information ~~battery-related information~~ received by said second communication means and based on the power amount ~~situation of the power system~~ recognized by said recognition means, and transmits the operation control information from said second communication means to said first control device.

~~31~~30. A battery control method that is performed by a battery control device that controls an operation of a battery connected to a power system, the method comprising:

detecting state information that shows the state of said battery ~~battery-related information that shows any one of a state of the battery and a~~

~~state of an interconnection point of the power system and the battery~~;

transmitting the ~~battery-related~~state information to an external device, and receiving operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control the operation of the battery from the external device; and

controlling the operation of the battery based on ~~a state of the power system and~~ the operation control information.

~~32~~31. A battery control support method that is performed by a battery control support device that communicates with a battery control device that controls an operation of a battery connected to a power system, the method comprising:

receiving state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices~~battery-related information that shows a state of the battery, or a voltage of an interconnection point of the power system and the battery, from the battery control device~~;

recognizing a power amount that is allotted to said batteries that are controlled by the N battery control devices~~situation of the power system~~; and

generating operation control information to control the operation of the battery, based on the ~~battery-related~~state information and the ~~situation of the power system~~power amount, and transmitting the operation control information to the battery control device.

~~33~~32. A battery control method that is performed by a battery control system including a first control device that controls an operation of a battery connected to a power system, and a second control device that communicates with the first control device, wherein:

the first control device detects state information that shows the state of said battery~~battery-related information that shows any one of a state of the battery and a state of an interconnection point of the power system and the battery~~,

the second control device recognizes a power amount that is allotted to said batteries that are controlled by the N battery control devices~~situation of the power system~~,

the first control device transmits the ~~battery-related~~state information to the second control device,

the second control device receives the ~~battery-related~~state information,

the second control device generates operation control information to control the operation of the battery, based on the ~~battery-related~~state information and the power amount~~situation of the power system~~,

the second control device transmits the operation control information to the first control device,

the first control device receives the operation control information, and

the first control device controls the operation of the battery, based on ~~a state of the power system and~~ the operation control information.

~~34~~33. A computer-readable recording medium recording a program for causing a computer

to execute:

a detection procedure of detecting state information that shows the state of said batterybattery-related information that shows a state of a battery connected to a power system, or a state of an interconnection point of the power system and the battery;

a communication procedure of transmitting the battery-relatedstate information to an external device, and receiving operation control information, that is generated based on:

the state information, and

a power amount that is allotted to said batteries that are controlled by N (N is a number that is 1 or larger) battery control devices, to control an operation of the battery from the external device; and

a control procedure of controlling the operation of the battery, based on a state of the power system and the operation control information.

3534. A computer-readable recording medium recording a program for causing a computer to execute

a reception procedure of receiving state information that shows the state of said battery from each of N (N is an integer that is one or larger) battery control devices battery-related information that shows a state of a battery, or a state of an interconnection point of a power system and the battery, from a battery control device that controls an operation of the battery connected to the power system;

a recognition procedure of recognizing a power amount that is allotted to said batteries that are controlled by the N battery control devicessituation of the power system; and

a processing procedure of generating operation control information to control the operation of the battery, based on the battery-relatedstate information and the power amountsituation of the power system, and transmitting the operation control information to the battery control device.

35. The battery control device according to claim 1, wherein said first communication means receives the operation control information from the external device at irregular intervals.

36. The battery control support device according to claim 17, wherein said processing means transmits the operation control information to said battery control device at irregular intervals.

37. The battery control system according to claim 29, wherein said first communication

means receives the operation control information from the external device at irregular intervals; and said processing means transmits the operation control information to said battery control device at irregular intervals.

38. The battery control method according to claim 30, wherein the operation control information is received from the external device at irregular intervals.

39. The battery control support method according to claim 31, wherein the operation control information is transmitted to said battery control device at irregular intervals.

40. The battery control device according to claim 1, wherein time intervals, according to which said control means controls the operation of said battery based on a state of said power system and based on the operation control information, are irregular intervals.

41. The battery control system according to claim 29, wherein time intervals, according to which said control means controls the operation of said battery based on a state of power system and based on the operation control information, are irregular intervals.

42. The battery control method according to claim 30, wherein time intervals for controlling the operation of said battery based on a state of said power system and based on the operation control information, are irregular intervals.

43. The battery control device according to claim 14, wherein said control means controls the operation of said battery, based on a state of said power system, and based on the operation control information received by said first communication means.