

CONTROL CIRCUIT OF BACKUP POWER SUPPLY, AND CONTROL METHOD FOR CONTROL CIRCUIT

Technical Field

5 The present disclosure relates to the technical field of backup power supply, and in particular to a control circuit of a backup power supply and a control method for the control circuit.

Background

10 With the development of society, nowadays more and more large factories and important research bases are in need of uninterrupted power supply for their devices, because once the power is off, all the devices therein will shut down, impacting the work flow; in the worst cases, all previous efforts on products that have been developed for a long time will be wasted, causing heavy losses. Such
15 large factories and important research bases are typically provided with backup power supplies in case of power failure such as failure of urban power network.

 In terms of design, however, existing backup power supplies adopt a relatively small number of buses and a relatively small number of generators connected to each bus. During use, malfunction of some of the devices will occur
20 when buses or generators fail to meet the power demand due to maintenance, failure or the like. In addition, power supply safety hazards may be caused by synchronous supply of power to a plurality of devices with one generator.

Summary

25 An object of the present disclosure is to provide a control circuit of a backup power supply and a control method therefor, so as to solve the problem that during power off, backup power supplies used in large factories and important research bases cannot meet their power demand due to maintenance, failure or the

like of the buses or generators, thus causing malfunction of some of the devices and possible power supply safety hazards.

According to a first aspect, an embodiment of the present disclosure provides a control circuit of a backup power supply which comprises a first backup power supply and a second backup power supply, wherein the first backup power supply is connected with the second backup power supply through a first bus tie switch; the first backup power supply is correspondingly provided with at least one first load bank and at least one second load bank and is connected with the first load bank through a first feeder switch, and the first load bank is connected with the second load bank through a second bus tie switch; the second backup power supply is correspondingly provided with at least one third load bank and at least one fourth load bank and is connected with the second load bank through a second feeder switch, the third load bank is connected with the first backup power supply through a third feeder switch and is connected with the fourth load bank through a third bus tie switch, and the second backup power supply is connected with the fourth load bank through a fourth feeder switch.

Optionally, the first backup power supply comprises a first bus; and a plurality of first generator sets being electrically connected with the first bus and configured to supply power to the first load bank and/or the second load bank and/or the third load bank and/or the fourth load bank through the first bus.

Optionally, the second backup power supply comprises a second bus; and a plurality of second generator sets electrically connected with the second bus configured to supply power to the first load bank and/or the second load bank and/or the third load bank and/or the fourth load bank through the second bus.

Optionally, further comprising at least one third backup power supply; each of the third backup power supplies is connected in sequence through a bus tie switch; and the second backup power supply is connected with a first of the third backup power supplies through a fourth bus tie switch.

Optionally, the third backup power supply is configured to supply power to the first load bank and/or the second load bank and/or the third load bank and/or the fourth load bank when the first backup power supply and the second backup power supply are not capable of meeting preset power supply demands for the first load bank and/or the second load bank and/or the third load bank and/or the fourth load bank.

According to a second aspect, an embodiment of the present disclosure further provides a control method for a control circuit of a backup power supply, wherein the control method is applied to the control circuit of the backup power supply according to the first aspect of the present disclosure, and comprises: determining whether power-supply sources corresponding to the first load bank, the second load bank, the third load bank and the fourth load bank are in an abnormal operation state; when the power-supply sources are in an abnormal state, determining the number of the power-supply sources in the abnormal state; when the number of the power-supply sources in the abnormal state is less than or equal to a first preset threshold, determining whether the first backup power supply is in a maintenance mode; when the first backup power supply is not in the maintenance mode, turning on the first feeder switch, or turning on the first feeder switch and the second bus tie switch, and/or, turning on the third feeder switch, or turning on the third feeder switch and the third bus tie switch, to enable the first backup power supply to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

Optionally, when the first backup power supply is in the maintenance mode, determining whether the second backup power supply is in the maintenance mode; when the second backup power supply is not in the maintenance mode, turning on the second feeder switch and the second bus tie switch, and/or turning on the fourth feeder switch and the third bus tie switch, so as to enable the second backup power supply to supply power to the load banks corresponding to the

power-supply sources in the abnormal state.

Optionally, when the number of the power-supply sources in the abnormal state is greater than the first preset threshold, enabling the first backup power supply and the second backup power supply to supply power to the load banks
5 corresponding to the power-supply sources in the abnormal state.

Optionally, enabling the first backup power supply and the second backup power supply to supply power to the load banks corresponding to the power-supply sources in the abnormal state comprises: selecting to turn on the first feeder switch, the second feeder switch and the second bus tie switch, and/or
10 to turn on the third feeder switch, the fourth feeder switch and the third bus tie switch according to the number of the power-supply sources in the abnormal state, to enable the first backup power supply and the second backup power supply to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

Optionally, when the control circuit of the backup power supply further comprises at least one third backup power supply, the control method further comprises: when the number of the power-supply sources in the abnormal state is greater than a second preset threshold which is greater than the first preset threshold, the first backup power supply, the second backup power supply and the
20 at least one third backup power supply are enabled according to the number of the power-supply sources in the abnormal state, so as to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

The technical solutions of the present disclosure have the following beneficial effects:

25 the embodiment of the present disclosure provides a control circuit of a backup power supply, comprising a first backup power supply and a second backup power supply, wherein the first backup power supply is connected with the second backup power supply through a first bus tie switch; the first backup

power supply is correspondingly provided with at least one first load bank and at least one second load bank and is connected with the first load bank through a first feeder switch, and the first load bank is connected with the second load bank through a second bus tie switch; the second backup power supply is correspondingly provided with at least one third load bank and at least one fourth load bank and is connected with the second load bank through a second feeder switch, the third load bank is connected with the first backup power supply through a third feeder switch and is connected with the fourth load bank through a third bus tie switch, and the second backup power supply is connected with the fourth load bank through a fourth feeder switch. Therefore, the first backup power supply and the second backup power supply may be cross-feeding; when a power-supply source is in an abnormal state, different backup power supplies may be flexibly selected to continuously supply power to the load bank corresponding to the power-supply source in the abnormal state, thus avoiding the occurrence of the abnormal operation of the device due to power failure and further effectively avoiding the occurrence of the power supply safety hazards.

The embodiment of the present disclosure provides a control method for a control circuit of a backup power supply, comprising: determining whether power-supply sources corresponding to the first load bank, the second load bank, the third load bank and the fourth load bank are in an abnormal operation state; when the power-supply sources are in an abnormal state, determining the number of the power-supply sources in the abnormal state; when the number of the power-supply sources in the abnormal state is less than or equal to a first preset threshold, determining whether the first backup power supply is in a maintenance mode; when the first backup power supply is not in the maintenance mode, turning on the first feeder switch, or turning on the first feeder switch and the second bus tie switch, and/or, turning on the third feeder switch, or turning on the third feeder switch and the third bus tie switch, to enable the first backup power

supply to supply power to the load banks corresponding to the power-supply sources in the abnormal state. An electrical device may be continuously supplied by determining the number of the power-supply sources in the abnormal state and flexibly selecting the backup power supply according to the state of the backup power supply, which avoids the occurrence of the abnormal operation of device due to the power failure and further effectively avoids the occurrence of the power supply safety hazards.

Brief Description of the Drawings

FIG. 1 shows a schematic structural diagram of a control circuit of a backup power supply according to an embodiment of the present disclosure;

FIG. 2 shows another schematic structural diagram of a control circuit of a backup power supply according to an embodiment of the present disclosure;

FIG. 3 shows a flowchart of a control method for a control circuit of a backup power supply according to an embodiment of the present disclosure; and

FIG. 4 shows another schematic structural diagram of a control circuit of a backup power supply according to an embodiment of the present disclosure.

Detailed Description of the Embodiments

The technical solutions of the disclosure will be described below clearly and comprehensively in conjunction with accompanying drawings. Apparently, the embodiments described are some of the embodiments rather than all embodiments of the disclosure. Based on the embodiments of the disclosure, all other embodiments obtained by those of ordinary skill in the art without creative efforts shall fall within the protection scope of the disclosure.

In the description of the present disclosure, it should be noted that the terms "install", "connect", "couple" and the like should be understood in a broad sense unless otherwise clearly specified and limited. For example, a connection may be

a fixed connection, a detachable connection or an integrated connection; it may be a mechanical connection or an electrical connection; a connection may be a direct connection, or an indirect connection through an intermediate medium, or may be an internal communication of the two components, which may be a wireless connection or a wired connection. For those ordinarily skilled in the art, the specific meanings of the above terms in the present disclosure can be understood in specific situations.

In addition, the technical features involved in different embodiments described below can be combined with each other as long as they do not conflict with each other.

As shown in FIG. 1, an embodiment of the present disclosure provides a control circuit of a backup power supply, comprising a first backup power supply 100 and a second backup power supply 200, wherein the first backup power supply 100 is connected with the second backup power supply 200 through a first bus tie switch 1; the first backup power supply 100 is correspondingly provided with a first load bank 2 and a second load bank 3, and is connected with the first load bank 2 through a first feeder switch 4, and the first load bank 2 is connected with the second load bank 3 through a second bus tie switch 5; the second backup power supply 200 is correspondingly provided with a third load bank 6 and a fourth load bank 7, and is connected with the second load bank 3 through a second feeder switch 8, and the third load bank 6 is connected with the first backup power supply 100 through a third feeder switch 17, and is connected with the fourth load bank 7 through a third bus tie switch 9; and the second backup power supply is connected with the fourth load bank 7 through a fourth feeder switch 10. It should be noted that in the embodiment of the present disclosure, Take the first load bank 2, the second load bank 3, the third load bank 6 and the fourth load bank 7 all set to 1 as an example. In practical applications, a plurality of first load banks 2, second load banks 3, third load banks 6 and fourth load

banks 7 may be set according to actual needs, which is not limited in the present disclosure. With the design of the above circuit, the first backup power supply 100 and the second backup power supply 200 may be cross-feeding; when a power-supply source is in an abnormal state, a backup power supply may be flexibly selected to continuously supply power to the load bank corresponding to the power-supply source in the abnormal state, thus avoiding the occurrence of the abnormal operation of the device due to power failure and further effectively avoiding the occurrence of the power supply safety hazards.

When the first backup power supply 100 is in maintenance or failure, the second feeder switch 8 and the second bus tie switch 5 may be turned on to make the second backup power supply 200 supply power to the first load bank 2 connected to the first backup power supply 100, and the fourth feeder switch 10 and the third bus tie switch 9 may also be turned on to make the second backup power supply 200 supply power to the third load bank 6 connected to the first backup power supply 100. When the second backup power supply 200 is in maintenance or failure, the first feeder switch 4 and the second bus tie switch 5 may be turned on to make the first backup power supply 100 supply power to the second load bank 3 connected to the second backup power supply 200, and the third feeder switch 17 and the third bus tie switch 9 may also be turned on to make the first backup power supply 100 supply power to the fourth load bank 7 connected to the second backup power supply 200.

In an embodiment, as shown in FIG. 2, the first backup power supply 100 comprises: a first bus 11; and a plurality of first generator sets 12 being electrically connected with the first bus 11 for supplying power to the first load bank 2 and/or the second load bank 3 and/or the third load bank 6 and/or the fourth load bank 7 through the first bus 11. The second backup power supply 200 comprises: a second bus 13; and a plurality of second generator sets 14 being electrically connected with the second bus 13 for supplying power to the first load

bank 2 and/or the second load bank 3 and/or the third load bank 6 and/or the fourth load bank 7 through the second bus 13.

In an embodiment, as shown in FIG. 4, the control circuit of the backup power supply as described above further comprises two third backup power supplies, namely a third backup power supply 300 and a third backup power supply 400. The third backup power supply 300 and the third backup power supply 400 are connected sequentially through a bus tie switch. The second backup power supply 200 is connected with the third backup power supply 300 through a fourth bus tie switch. It should be noted that, in the embodiment of the present disclosure, take two third backup power supplies as an example. In practical applications, the number of third backup power supplies may be set to one or more according to actual needs, which is not limited in the present disclosure.

In practical applications, when the number of third backup power supplies is even, the connection relationship between the load banks corresponding to every two third backup power supplies and each third backup power supply may be the same as that between the first backup power supply and the second backup power supply, so as to be cross-feeding.

In an embodiment, as shown in FIG. 4, the above third backup power supply comprises: a third bus 32; and a plurality of third generator sets being electrically connected with the third bus 32 for supplying power to the first load bank 2 and/or the second load bank 3 and/or the third load bank 6 and/or the fourth load bank 7 and/or a load bank corresponding to the third back power supply through the third bus 32.

In an embodiment, when the first backup power supply 100 and the second backup power supply 200 cannot meet a preset power supply demand for the first load bank 2 and/or the second load bank 3 and/or the third load bank 6 and/or the fourth load bank 7, the third backup power supply is used as a supplement to

supply power to the first load bank 2 and/or the second load bank 3 and/or the third load bank 6 and/or the fourth load bank 7 and/or the load bank corresponding to the third back power supply.

In an embodiment, as shown in FIG. 2, the first backup power supply 100 further comprises: a first voltage signal synchronization module 15 for detecting whether voltage signals of the plurality of first generator sets 12 are synchronized when the plurality of first generator sets 12 are started. When the voltage signals of the plurality of first generator sets 12 are not synchronized, it is necessary to synchronize the voltage signals of the plurality of first generator sets 12, and then turn on a switch of the corresponding generator set to enable the plurality of first generator sets 12, otherwise there will be safety hazards. The second backup power supply 200 further comprises: a second voltage signal synchronization module 16 for detecting whether voltage signals of the plurality of second generator sets 14 are synchronized when the plurality of second generator sets 14 are started. When the voltage signals of the plurality of second generator sets 14 are not synchronized, it is necessary to synchronize the voltage signals of the plurality of second generator sets 14, and then turn on a switch of the corresponding generator set to enable the plurality of second generator sets 14, otherwise there will be safety hazards. Of course, before the first bus tie switch 1 between the first backup power supply 100 and the second backup power supply 200 is turned on, it is also necessary to detect whether the voltage signals of the first bus 11 and the second bus 13 are synchronized by the first voltage signal synchronization module 15 and the second voltage signal synchronization module 16. When the voltage signals of the first bus 11 and the second bus 13 are not synchronized, it is necessary to synchronize the voltage signals of the first bus 11 and the second bus 13, and then turn on the first bus tie switch 1. When the third backup power supply is needed, it is also necessary to detect whether the voltage signal of the third backup power supply is synchronized with the voltage signals

of the first backup power supply 100 and/or the second backup power supply 200. Voltage signals comprise phase angle, phase and waveform, etc.

In an embodiment, as shown in FIG. 2, the first backup power supply 100 further comprises a debugging feeder switch 18, wherein the debugging feeder switch 18 may be turned on when each backup power supply needs to be debugged, so as to facilitate debugging of each backup power supply.

With the design of the above circuit, the first backup power supply 100 and the second backup power supply 200 may be cross-feeding. When the first backup power supply 100 is in maintenance or failure, the second feeder switch 8 and the second bus tie switch 5 may be turned on to make the second backup power supply 200 supply power to the first load bank 2 connected to the first backup power supply 100, and the fourth feeder switch 10 and the third bus tie switch 9 may also be turned on to make the second backup power supply 200 supply power to the third load bank 6 connected to the first backup power supply 100. When the second backup power supply 200 is in maintenance or failure, the first feeder switch 4 and the second bus tie switch 5 may be turned on to make the first backup power supply 100 supply power to the second load bank 3 connected to the second backup power supply 200, and the third feeder switch 17 and the third bus tie switch 9 may also be turned on to make the first backup power supply 100 supply power to the fourth load bank 7 connected to the second backup power supply 200. As such, even if the first backup power supply 100 or the second backup power supply 200 is in maintenance or failure, it may continuously supply power to the electrical device, thus avoiding the power supply safety hazards.

The embodiment of the present disclosure further provides a control method for a control circuit of a backup power supply. As shown in FIG. 3, the control method is applied to the control circuit of the backup power supply as described above and comprises:

Step S1: determining whether the power-supply sources corresponding to the

first load bank 2, the second load bank 3, the third load bank 6 and the fourth load bank 7 are in an abnormal operation state; when the power-supply sources are in the abnormal operation state, it means that the corresponding first load bank 2, second load bank 3, third load bank 6 and fourth load bank 7 cannot be powered normally. At this time, it is necessary to turn off the switches between the load banks and the corresponding power-supply sources.

Step S2: when the power-supply sources are in the abnormal state, determining the number of the power-supply sources in the abnormal state;

Step S3: when the number of the power-supply sources in the abnormal state is less than or equal to a first preset threshold, determining whether the first backup power supply 100 is in a maintenance mode; wherein the first preset threshold is a value set by workers according to operation demands, and the first preset threshold is greater than zero;

Step S4: when the first backup power supply 100 is not in the maintenance mode, turning on a first feeder switch 4 or turning on the first feeder switch 4 and a second bus tie switch 5, and/or turning on a third feeder switch 17 or turning on the third feeder switch 17 and a third bus tie switch 9, to enable the first backup power supply 100 to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

Through the above steps S1 to S4, the control method for the control circuit of the backup power supply provided by the embodiment of the present disclosure can determine the number of the power-supply sources in the abnormal state, and can flexibly select the backup power supply to be used according to the state of the backup power supply, thus achieving uninterrupted power supply for the electrical device, avoiding the occurrence of the abnormal operation of the device due to power failure and further effectively avoiding the occurrence of the power supply safety hazards.

It should be noted that before turning on a feeder switch between the load

bank corresponding to the power-supply source in the abnormal state and the backup power supply, a generator set has been started, and after turning on the feeder switch, the generator set may directly supply power to the load bank that has lost electricity.

5 In an embodiment, when the number of the power-supply sources in the abnormal state is greater than the first preset threshold, and the first backup power supply 100 and the second backup power supply 200 are not in the maintenance state, the first backup power supply 100 and the second backup power supply 200 are enabled to supply power to the load banks corresponding to the power-supply
10 sources in the abnormal state. As such, when one backup power supply is not sufficient to supply power to the load bank corresponding to the power-supply source in an abnormal state, two backup power supplies will be sufficient to supply power to the load in the abnormal state.

Specifically, enabling the first backup power supply 100 and the second
15 backup power supply 200 to supply power to the load bank corresponding to the power-supply source in the abnormal state comprises: turning on the first feeder switch 4, the second feeder switch 8 and the second bus tie switch 5, and/or turning on the third feeder switch 17, the fourth feeder switch 10 and the third bus tie switch 9 according to the number of the power-supply sources in the abnormal
20 state, to enable the first backup power supply 100 and the second backup power supply 200 to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

In an embodiment, when the first backup power supply 100 is in the maintenance mode, it is determined whether the second backup power supply 200
25 is in the maintenance mode. When the second backup power supply 200 is not in the maintenance mode, the second feeder switch 8 and the second bus tie switch 5 are turned on, and/or the fourth feeder switch 10 and the third bus tie switch 9 are turned on to enable the second backup power supply 200 to supply power to the

load banks corresponding to the power-supply sources in the abnormal state.

Therefore, when there is a backup power supply in the maintenance mode, other backup power supplies may be used to supply power to the load bank corresponding to the backup power supply in the maintenance mode, and an electrical device corresponding to the backup power supply in the maintenance mode will not be in a power-off state. Therefore, the problem that the load bank cannot operate normally will not occur.

In an embodiment, as shown in FIG. 4, when the control circuit of the backup power supply further comprises two third backup power supplies, the above control method further comprises: when the number of the power-supply sources in the abnormal state is greater than a second preset threshold being greater than the first preset threshold, enabling the first backup power supply 100, the second backup power supply 200 and the two third backup power supplies to supply power to the load banks corresponding to the power-supply sources in the abnormal state according to the number of the power-supply sources in the abnormal state. Wherein, the first preset threshold and the second preset threshold refer to the number of the power-supply sources in the abnormal state, which may be set according to the number of generator sets of each backup power supply and the number of load banks corresponding to the power-supply sources in practical applications.

In practical applications, a prior art may also be adopted. When the feeder switch between the load bank corresponding to the power-supply source in the abnormal state and the backup power supply is turned on to enable the corresponding generator set to supply power to the load bank that loses power, if the corresponding backup power supply cannot supply power to the load bank that loses power, the bus tie switch between the backup power supply and another backup power supply can be turned on to enable the generator set on the adjacent backup power supply to supply power to the load bank that loses power at the

same time.

For ease of understanding, as shown in FIG. 4, in the embodiment of the present disclosure, a total of four sets of backup power supplies are taken as an example to describe the above control method for the control circuit of the backup power supply in details, the control circuit comprising a first backup power supply 100, a second backup power supply 200, a third backup power supply 300 and a third backup power supply 400;

the third backup power supply 300 is connected with the third backup power supply 400 through an eighth bus tie switch 35; the first backup power supply 100 may be connected with the third backup power supply 400 through a seventh bus tie switch 19; and the second backup power supply 200 may be connected with the third backup power supply 300 through a fourth bus tie switch 20;

the third backup power supply 300 is correspondingly provided with at least one fifth load bank 21 and at least one sixth load bank 22, the third backup power supply 300 is connected with the fifth load bank 21 through a fifth feeder switch 23, and the sixth load bank 22 is connected with the fifth load bank 21 through a fifth bus tie switch 24;

the third backup power supply 400 is correspondingly provided with at least one seventh load bank 25 and at least one eighth load bank 26, the third backup power supply 400 is connected with the sixth load bank 22 through a sixth feeder switch 27, the seventh load bank 25 is connected with the third backup power supply 300 through a seventh feeder switch 28, the seventh load bank 25 is connected with the eighth load bank 26 through a sixth bus tie switch; and the third backup power supply 400 is connected with the eighth load bank 26 through an eighth feeder switch 30.

The first backup power supply 100 comprises a plurality of first generator sets 12, all of which are connected with a first bus 11; the first load bank 2 corresponds to a first power-supply source 36 and the second load bank 3

corresponds to a second power-supply source 37.

The second backup power supply 200 comprises a plurality of second generator sets 14, all of which are connected with a second bus 13; the third load bank 6 corresponds to a third power-supply source 38, and the fourth load bank 7
5 corresponds to a fourth power-supply source 39.

The third backup power supply 300 comprises a plurality of third generator sets 31, all of which are connected with a third bus 32; the fifth load bank 21 corresponds to a fifth power-supply source 40 and the sixth load bank 22 corresponds to a sixth power-supply source 41.

10 The third backup power supply 400 comprises a plurality of fourth generator sets 33, all of which are connected with a fourth bus 34; the seventh load bank 25 corresponds to a seventh power-supply source 42, and the eighth load bank 26 corresponds to an eighth power-supply source 43.

Specifically, when the first backup power supply 100, the second backup
15 power supply 200, the third backup power supply 300 and the third backup power supply 400 are not in the maintenance mode, the following situation is taken as an example to illustrate: the first power-supply source 36, the second power-supply source 37, the third power-supply source 38 and the fourth power-supply source 39 corresponding to the first backup power supply 100 and the second backup
20 power supply 200, respectively, are in the abnormal state, such that the first backup power supply 100, the second backup power supply 200, the third backup power supply 300 and the third backup power supply 400 are enabled to supply power to the load banks corresponding to the first power-supply source 36 and/or the second power-supply source 37 and/or the third power-supply source 38
25 and/or the fourth power-supply source 39 in the abnormal state. It specifically comprises the following four operating conditions:

In the first operating condition, when the first preset threshold is set to 2 and the number of the power-supply sources in the abnormal state is 1, if the first

power-supply source 36 corresponding to the first load bank 2 is in the abnormal state, it is necessary to turn on the first feeder switch 4 and turn off the second bus tie switch 5, so that a plurality of first generator sets 12 of the first backup power supply 100 may supply power to the first load bank 2. In an alternative
5 embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first load bank 2, the second bus tie switch 5 may also be turned on, so that the second power-supply source may supply power to the first load bank 2.

If the second power-supply source 37, the third power-supply source 38, and
10 the fourth power-supply source 39 corresponding to the second load bank 3, or the third load bank 6, or the fourth load bank 7 are in the abnormal state, the way of selecting the backup power supply for them is the same as the above when the first power-supply source 36 corresponding to the first load bank 2 is in the abnormal state, which will not be described in detail here.

15 In the second operating condition, when the first preset threshold is set to 2, the second preset threshold is set to 3, and the number of power-supply sources in the abnormal state is 2, the following situations will be explained.

Firstly, if the first power-supply source 36 and the second power-supply source 37 corresponding to the first load bank 2 and the second load bank 3,
20 respectively, are in the abnormal state, it is necessary to turn on the second bus tie switch 5 and the first feeder switch 4, so that a plurality of first generator sets 12 of the first backup power supply 100 supply power to the first load bank 2 and the second load bank 3.

If the third power-supply source 38 and the fourth power-supply source 39
25 corresponding to the third load bank 6 and the fourth load bank 7, respectively, are in the abnormal state, the way of selecting the backup power supply is the same as the above when the first power-supply source 36 and the second power-supply source 37 corresponding to the first load bank 2 and the second load

bank 3, respectively, are in the abnormal state, which will not be described in detail here.

Secondly, if the first power-supply source 36 and the third power-supply source 38 corresponding to the first load bank 2 and the third load bank 6, respectively, are in the abnormal state, it is necessary to turn on the first feeder switch 4 and the third feeder switch 17, so that a plurality of first generator sets 12 of the first backup power supply 100 may supply power to the first load bank 2 and the third load bank 6. In an alternative embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first load bank 2, the second bus tie switch 5 may also be turned on, so that the second power-supply source 37 may supply power to the first load bank 2, and if the fourth power-supply source 39 has sufficient capacity to supply power to the third load bank 6, the third bus tie switch 9 may also be turned on, so that the fourth power-supply source 39 may supply power to the third load bank 6.

If the second power-supply source 37 and the fourth power-supply source 39 corresponding to the second load bank 3 and the fourth load bank 7, respectively, are in the abnormal state, the way of selecting the backup power supply is the same as the above when the first power-supply source 36 and the third power-supply source 38 corresponding to the first load bank 2 and the third load bank 6, respectively, are in the abnormal state, which will not be described in detail here.

Thirdly, if the first power-supply source 36 and the fourth power-supply source 39 corresponding to the first load bank 2 and the fourth load bank 7, respectively, are in the abnormal state, it is necessary to turn on the first feeder switch 4 and the third bus tie switch 9, and turn off the second bus tie switch 5 and the switch between the third power-supply source 38 and the third load bank 6, such that a plurality of first generator sets 12 of the first backup power supply 100 may supply power to the first load bank 2, the third load bank 6 and the

fourth load bank 7. In an alternative embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first load bank 2, the second bus tie switch 5 may also be turned on, so that the second power-supply source may supply power to the first load bank 2, and if the third power-supply source 38 has sufficient capacity to supply power to the fourth load bank 7, the third bus tie switch 9 may also be turned on, so that the third power-supply source 38 may supply power to the fourth load bank 7.

If the second power-supply source 37 and the third power-supply source 38 corresponding to the second load bank 3 and the third load bank 6, respectively, are in the abnormal state, the way of selecting the backup power supply is the same as the above when the first power-supply source 36 and the fourth power-supply source 39 corresponding to the first load bank 2 and the fourth load bank 7, respectively, are in the abnormal state, which will not be described in detail here.

In the third operating condition, when the first preset threshold is set to 2, the second preset threshold is set to 3, and the number of the power-supply sources in the abnormal state is equal to 3, if the first power-supply source 36, the second power-supply source 37 and the third power-supply source 38 corresponding to the first load bank 2, the second load bank 3 and the third load bank 6, respectively, are in the abnormal state, it is necessary to turn on the first feeder switch 4, the second feeder switch 8 and the third feeder switch 17, and turn off the second bus tie switch 5 and the third bus tie switch 9, such that a plurality of first generator sets 12 of the first backup power supply 100 supply power to the first load bank 2 and the third load bank 6, and a plurality of second generator sets 14 of the second backup power supply 200 supply power to the second load bank 3.

If the first power-supply source 36, the second power-supply source 37 and the fourth power-supply source 39 corresponding to the first load bank 2, the

second load bank 3 and the fourth load bank 7, respectively, are in the abnormal state, or if the second power-supply source 37, the third power-supply source 38 and the fourth power-supply source 39 corresponding to the second load bank 3, the third load bank 6 and the fourth load bank 7, respectively, are in the abnormal state, the way of selecting the backup power supply is the same as the above when the first power-supply source 36, the second power-supply source 37 and the third power-supply source 38 corresponding to the first load bank 2, the second load bank 3 and the third load bank 6, respectively, are in the abnormal state, which will not be described in detail here.

In the fourth operating condition, when the first preset threshold is set to 2, the second preset threshold is set to 3, and the number of power-supply sources in the abnormal state is 4, it is necessary to start the first backup power supply 100, the second backup power supply 200, the third backup power supply 300 and/or the third backup power supply 400. If the first power-supply source 36, the second power-supply source 37, the third power-supply source 38 and the fourth power-supply source 39 corresponding to the first load bank 2, the second load bank 3, the third load bank 6 and the fourth load bank 7, respectively, are in the abnormal state, it is necessary to turn on the first feeder switch 4, the second feeder switch 8, the third feeder switch 17 and the fourth feeder switch 10, and turn on the fourth bus tie switch 20 or the seventh bus tie switch 19, such that a plurality of first generator sets 12 of the first backup power supply 100, a plurality of second generator sets 14 of the second backup power supply 200, a plurality of third generator sets 31 of the third backup power supply 300 and/or a plurality of fourth generator sets 33 of the third backup power supply 400 supply power to the first load bank 2, the second load bank 3, the third load bank 6 and the fourth load bank 7.

It should be noted that when the power-supply sources corresponding to the third backup power supply 300 and the third backup power supply 400 are in the

abnormal state so as to enable the third backup power supply 300 and the third backup power supply 400, and when the first backup power supply 100 and the second backup power supply 200 supply power to the load bank corresponding to the power-supply source in the abnormal state, the way of selecting the backup power supply is the same as the above when the power-supply source corresponding to the first backup power supply 100 and the second backup power supply 200 is in the abnormal state, which will not be described in detail here.

Specifically, when the first backup power supply 100, or the second backup power supply 200, or the third backup power supply 300, or the third backup power supply 400 are in the maintenance mode, it will be explained by taking the first backup power supply 100 in the maintenance mode as an example.

Firstly, when the first power-supply source 36 corresponding to the first load bank 2 is in the abnormal state, the second feeder switch 8 is turned on, and meanwhile the switch between the second power-supply source 37 and the second load bank 3 is turned off and the second bus tie switch 5 is turned on, so that a plurality of generator sets of the second backup power supply 200 can supply power to the first load bank 2 and the second load bank 3 at the same time; in an alternative embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first load bank 2, the second bus tie switch 5 may be turned on so that the second power-supply source 37 may supply power to the first load bank 2.

If the third power-supply source 38 corresponding to the third load bank 6 is in the abnormal state, the way of selecting the backup power supply is the same as the above when the first power-supply source 36 corresponding to the first load bank 2 is in the abnormal state, which will not be described in detail here.

Secondly, when the first power-supply source 36 corresponding to the first load bank 2 and the second power-supply source 37 corresponding to the second load bank 3 are in the abnormal state, it is necessary to turn on the second feeder

switch 8 and the second bus tie switch 5, so that a plurality of second generator sets 14 of the second backup power supply 200 may supply power to the first load bank 2 and the second load bank 3.

Thirdly, when the first power-supply source 36 and the third power-supply source 38 corresponding to the first load bank 2 and the third load bank 6, respectively, are in the abnormal state, the second feeder switch 8 and the second bus tie switch 5 are turned on, and meanwhile the switch between the second power-supply source 37 and the second load bank 3 is turned off, so that a plurality of second generator sets 14 of the second backup power supply 200 supply power to the first load bank 2 and the second load bank 3, and the fourth feeder switch 10 and the third bus tie switch 9 are turned on, and meanwhile the switch between the fourth power-supply source 39 and the fourth load bank 7 is turned off, so that a plurality of second generator sets 14 of the second backup power supply 200 supply power to the third load bank 6 and the fourth load bank 7; in an alternative embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first load bank 2, the second bus tie switch 5 may be turned on so that the second power-supply source 37 may supply power to the first load bank 2; when the fourth power-supply source 39 has sufficient capacity to supply power to the third load bank 6, the third bus tie switch 9 may be turned on, so that the fourth power-supply source 39 may supply power to the third load bank 6.

Fourthly, when the first power-supply source 36 and the fourth power-supply source 39 corresponding to the first load bank 2 and the fourth load bank 7, respectively, are in the abnormal state, the second feeder switch 8 and the second bus tie switch 5 are turned on, and meanwhile the switch between the second power-supply source 37 and the second load bank 3 is turned off, so that a plurality of second generator sets 14 of the second backup power supply 200 supply power to the first load bank 2 and the second load bank 3, the fourth feeder

switch 10 is turned on and the third bus tie switch 9 is turned off, so that a plurality of second generator sets 14 of the second backup power supply 200 supply power to the fourth load bank 7; in an alternative embodiment, if the second power-supply source 37 has sufficient capacity to supply power to the first
5 load bank 2, the second bus tie switch 5 may be turned on so that the second power-supply source 37 may supply power to the first load bank 2; when the third power-supply source 38 has sufficient capacity to supply power to the fourth load bank 7, the third bus tie switch 9 may be turned on, so that the third power-supply source 38 may supply power to the fourth load bank 7.

10 If the second backup power supply 200, or the third backup power supply 300 or the third backup power supply 400 is in the maintenance mode, the way of selecting the backup power supply for the corresponding load bank is the same as the above when the first backup power supply 100 is in the maintenance mode, which will not be described in detail here.

15 In an embodiment, when the bus tie switches between the above buses are turned on and when the generator sets are started, it is necessary to determine whether the voltage signals between the buses and the voltage signals between the generators are consistent or not, and when the above voltage signals are inconsistent, the voltage signals need to be adjusted until the voltage signals are
20 consistent, and then the corresponding bus tie switch and the switch between the generator set and the bus may be turned on; otherwise hazards will occur.

It should be noted that a plurality of generator sets arranged on each backup power supply are diesel generator sets, and of course, other types of generators may be adopted without affecting the use of the present disclosure. With the
25 control method for the control circuit of the above backup power supply, when there is a backup power supply in the maintenance mode, the other backup power supplies may be used to supply power to the load bank corresponding to the backup power supply in the maintenance mode, and an electrical device

corresponding to the backup power supply in the maintenance mode will not be in a power-off state. Therefore, the problem that the load bank cannot operate normally will not occur.

As an optional implementation of the embodiment of the present disclosure,
5 in practical applications, when the backup power supply for supplying power to the load bank corresponding to the power-supply source in the abnormal state is in a fault state, the power supply demand for the load bank corresponding to the power-supply source in the abnormal state may be left out of consideration, and other fault-free backup power supplies may be directly selected to supply power
10 to the load bank in a power-off state, which is not limited in the present disclosure.

The above are the preferred embodiments of the present disclosure, and it should be noted that, for those ordinarily skilled in the art, some improvements and modifications may be made without departing from the principles of the
15 present disclosure, and these improvements and modifications should also be regarded as within the protection scope of the present disclosure.

Claims

1. A control circuit of a backup power supply, characterized in that, comprising a first backup power supply (100) and a second backup power supply
5 (200), wherein

the first backup power supply (100) is connected with the second backup power supply (200) through a first bus tie switch (1);

the first backup power supply (100) is correspondingly provided with at least one first load bank (2) and at least one second load bank (3) and is connected with
10 the first load bank (2) through a first feeder switch (4), and the first load bank (2) is connected with the second load bank (3) through a second bus tie switch (5); and

the second backup power supply (200) is correspondingly provided with at least one third load bank (6) and at least one fourth load bank (7) and is connected
15 with the second load bank (3) through a second feeder switch (8), the third load bank (6) is connected with the first backup power supply (100) through a third feeder switch (17) and is connected with the fourth load bank (7) through a third bus tie switch (9), and the second backup power supply (200) is connected with the fourth load bank (7) through a fourth feeder switch (10),

20 the control circuit is configured that when the number of power-supply sources in an abnormal operation state which correspond to the first load bank (2), the second load bank (3), the third load bank (6) and the fourth load bank (7), is less than or equal to a first preset threshold and when the first backup power supply (100) is not in a maintenance mode, turning on the first feeder switch (4),
25 or turning on the first feeder switch (4) and the second bus tie switch (5), and/or, turning on the third feeder switch (17), or turning on the third feeder switch (17) and the third bus tie switch (9), to enable the first backup power supply (100) to supply power to the load banks corresponding to the power-supply sources in the

abnormal state.

2. The control circuit of the backup power supply according to claim 1, characterized in that, the first backup power supply (100) comprises:

5 a first bus (11); and

a plurality of first generator sets (12) being electrically connected with the first bus (11) and configured to supply power to the first load bank (2) and/or the second load bank (3) and/or the third load bank (6) and/or the fourth load bank (7) through the first bus (11).

10 3. The control circuit of the backup power supply according to claim 1, characterized in that, the second backup power supply (200) comprises:

a second bus (13); and

15 a plurality of second generator sets (14) electrically connected with the second bus (13) and configured to supply power to the first load bank (2) and/or the second load bank (3) and/or the third load bank (6) and/or the fourth load bank (7) through the second bus (13).

20 4. The control circuit of the backup power supply according to claim 1, characterized by further comprising at least one third backup power supply;

each of the third backup power supplies is connected in sequence through a bus tie switch; and

the second backup power supply (200) is connected with a first of the third backup power supplies through a fourth bus tie switch.

25 5. The control circuit of the backup power supply according to claim 4, characterized in that, the third backup power supply is configured to supply power to the first load bank (2) and/or the second load bank (3) and/or the third load

bank (6) and/or the fourth load bank (7) when the first backup power supply (100) and the second backup power supply (200) are not capable of meeting preset power supply demands for the first load bank (2) and/or the second load bank (3) and/or the third load bank (6) and/or the fourth load bank (7).

5

6. A control method for a control circuit of a backup power supply, characterized in that, the control method is applied to the control circuit of the backup power supply according to any one of claims 1-5, and comprises:

10 determining whether power-supply sources corresponding to the first load bank (2), the second load bank (3), the third load bank (6) and the fourth load bank (7) are in an abnormal operation state;

when the power-supply sources are in an abnormal state, determining the number of the power-supply sources in the abnormal state;

15 when the number of the power-supply sources in the abnormal state is less than or equal to a first preset threshold, determining whether the first backup power supply (100) is in a maintenance mode;

20 when the first backup power supply (100) is not in the maintenance mode, turning on the first feeder switch (4), or turning on the first feeder switch (4) and the second bus tie switch (5), and/or, turning on the third feeder switch (17), or turning on the third feeder switch (17) and the third bus tie switch (9), to enable the first backup power supply (100) to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

25 7. The control method for the control circuit of the backup power supply according to claim 6, characterized in that,

when the first backup power supply (100) is in the maintenance mode, determining whether the second backup power supply (200) is in the maintenance mode;

when the second backup power supply (200) is not in the maintenance mode, turning on the second feeder switch (8) and the second bus tie switch (5), and/or turning on the fourth feeder switch (10) and the third bus tie switch (9), so as to enable the second backup power supply (200) to supply power to the load banks
5 corresponding to the power-supply sources in the abnormal state.

8. The control method for the control circuit of the backup power supply according to claim 6, characterized in that,

when the number of the power-supply sources in the abnormal state is
10 greater than the first preset threshold, enabling the first backup power supply (100) and the second backup power supply (200) to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

9. The control method for the control circuit of the backup power supply
15 according to claim 8, characterized in that, enabling the first backup power supply (100) and the second backup power supply (200) to supply power to the load banks corresponding to the power-supply sources in the abnormal state comprises:

selecting to turn on the first feeder switch (4), the second feeder switch (8) and the second bus tie switch (5), and/or to turn on the third feeder switch (17),
20 the fourth feeder switch (10) and the third bus tie switch (9) according to the number of the power-supply sources in the abnormal state, to enable the first backup power supply (100) and the second backup power supply (200) to supply power to the load banks corresponding to the power-supply sources in the abnormal state.

25

10. The control method for the control circuit of the backup power supply according to claim 6, characterized in that, when the control circuit of the backup power supply further comprises at least one third backup power supply, the

control method further comprises:

when the number of the power-supply sources in the abnormal state is greater than a second preset threshold which is greater than the first preset threshold, the first backup power supply (100), the second backup power supply
5 (200) and the at least one third backup power supply are enabled according to the number of the power-supply sources in the abnormal state, so as to supply power to the load banks corresponding to the power-supply sources in the abnormal state.