

Description

Method and device for monitoring a power supply device of a traffic system

The invention relates to a method for monitoring a power supply device of a traffic system, in which a computer-based model of the power supply device is created inter alia with the aid of predetermined parameters which are relevant to the power supply device.

Furthermore, the invention relates to a device for monitoring a power supply device of a traffic system with at least one model device, which creates a computer-based model of the power supply device from predetermined parameters which are relevant to the power supply device.

The method and device of the afore-described type is known from the prior art, for instance by the simulation software Sitras Sidytrac by the company Siemens, with the aid of which an AC or DC traction power supply can be simulated. In this regard, predetermined parameters, which are relevant to the power supply device, are entered and the software then creates a computer-based model of the power supply device. Information which is relevant to the design of the power supply device, for instance, can be taken from the model. The known method and the software enable a power supply device to be better planned in the design phase, in order to guarantee an adequate and optimal design.

The planning software known from the prior art models the drive operation with the power supply such that it is designed for the application points specified at this point in time.

The simulation can last a number of hours and frequently forms the basis of the design of the power supply device.

A power supply device can inter alia contain, for instance, a feed from a higher-order network, AC switching systems for high voltage, medium voltage and low voltage, DC switching systems, transformers, rectifiers, inverters, converters, protection devices and station control technology, renewable energies, storage units, cable, contact line components and other line components for conducting the current.

However, current power supply devices can be harder to predict than before, since, for instance, not all parameters are known for the design, the power supply is sometimes not sufficiently large, timetables change frequently or their punctuality is not always possible. Furthermore, the current application of decentralized power sources, such as wind power or solar systems, energy storage systems or a load management, for instance, makes the rail networks more dynamic and more difficult to predict in the course of an energy management.

It is therefore the object of the present invention to provide a method and device of the type cited in the introduction which meet the changed requirements on a power supply device of a traffic system.

The object is achieved in accordance with the invention for the method cited in the introduction such that at least one current characteristic quantity is determined during the ongoing operation of the traffic system and the operation of the power supply device is simulated at least with the aid of the model and the characteristic quantity.

The device cited in the introduction achieves the cited object in accordance with the invention in that it has at least one detection device, which is embodied to determine at least one current characteristic quantity of the traffic system during ongoing operation, and at least one simulation device, which is embodied to simulate the power supply device with the aid of the model and the at least one characteristic quantity.

The inventive solution has the advantage that the power supply device is simulated during its operation and not only in the planning phase. As a result, the simulation is kept up to date and the current state of the power supply device can be easily taken therefrom. The inventive simulation of the power supply device allows operating parameters of the power supply device which run as required during real operation to be calculated and monitored.

Furthermore, a future behavior of the power supply device can be determined by the inventive simulation. Corresponding measures which can also be introduced automatically can be derived therefrom.

The inventive solution allows the energy requirement and energy consumption, load flows and load limits of systems and components of the power supply device of the traffic system, operating limits, usefulness of the application of storage solutions and feedback systems, as well as their application parameters, to be calculated, for instance. The results can be used in the course of SCADA and energy management systems, for instance, including load management, in order to improve these. The values currently calculated with the aid of the invention allow for higher reaction speeds for influencing and optimizing operation. With SCADA systems, what are known as

'what if queries' are supported ahead of corresponding switching operations and automatic operational recommendations, calculations and alarms in the case of unfavorable operating points, particularly with weak track sections or with special timetables.

For energy management systems, the invention produces new possibilities with respect to load flow predictions and an optimized operation of the power supply. Furthermore, automatic reports can be issued to the driver by driver advisory systems. Furthermore, an automatic influence can be implemented when limits in terms of power supply or optimization of the operational regime are achieved in accordance with an ideal energy system, for instance in order to avoid load peaks. Instead of a person-based know-how which may be problematic with a high staff turnover or a generation change, for instance, the invention enables a system-based know-how to be established for the purpose of protection and settings.

The inventive solution can be further developed by advantageous embodiments which are described below.

At least one future characteristic value can therefore be precalculated with the aid of the simulation at least in one desired future time frame and the characteristic value can be compared with at least one predetermined limit value. This is advantageous in that an imminent exceeding of limit values can be promptly identified and corresponding countermeasures can be taken.

In order to still better indicate or actively respond to an imminent exceeding of the limit values, at least one warning

message can be output automatically or at least one measure can be introduced automatically when the limit values are reached and/or exceeded. The warning message can be transmitted to a control room of the traffic system or the power supply device, for instance.

Furthermore, at least one simulated characteristic value can be calculated with the aid of the simulation and the simulated characteristic value can be compared with a characteristic value determined during ongoing operation of the traffic system.

Simulated and future characteristic values are for instance electric characteristic values such as current, voltage and variables which can be derived therefrom such as impedances, resistances, output or energy.

In an advantageous embodiment, the current characteristic quantities and/or the characteristic values can be determined in real time. This is advantageous in that the inventive method operates particularly quickly and as a result measures can be taken quickly and at short notice. The method is therefore particularly suited to the current dynamic energy networks.

According to a particularly preferred development of the invention, specifications for the future operation of the traffic system can be calculated with the aid of the simulation. This is advantageous in that an improved operational planning of the traffic system is possible.

The invention finally also relates to a railway system, which comprises an inventive device according to the afore-cited

embodiment.

A traffic system may be for instance a railway system with track-bound vehicles or also a system with e-trucks, in other words trucks with an electric power supply.

The invention will be described below making reference to the accompanying drawings,

in which:

Figure 1 shows a schematic representation of an exemplary embodiment of an inventive device for monitoring a power supply device of a traffic system;

Figure 2 shows a schematic representation of an exemplary embodiment of an inventive traffic system.

The traffic system shown by way of example in Figure 1 is a railway system 1, which by way of example here has a real existing part 2 and a digitally existing part 3.

The real part 2 contains, for instance, the rail network, the rail vehicles, the power supply device 15, the signaling technology, the stations etc. The power supply device 15 makes available the energy required for the railway system 1 and is a traction power supply, for instance.

In the embodiment in Figure 1, the digital part 3 comprises a number of function devices 10, a computing device 17, and a simulation device 6, which has a parameter device 4 and a model device 5.

A communication device 7 connects the real part 2 with the digital part 3. A number of detection devices 8 which convey the characteristic quantities KG1 and characteristic values KG2 of the railway system 1 via the communication device 7 to the digital part 3 are also available in the real part 2 of the railway system 1.

The traffic system 1 has an inventive monitoring device 9, which comprises the detection devices 8, the communication device 7, and the simulation device 6 with the model device 5 and the parameter device 4.

The detection devices 8 can be a variety of types of sensors or devices, which detect and/or supply the characteristic quantities KG1 and/or characteristic values KG2 of the real part 2 of the railway system 1. The characteristic quantities KG1 can be a current timetable, current data of the rail vehicles, GPS positions and suchlike, for instance. The characteristic values KG2 are for instance electric characteristic values such as current, voltage and variables which can be derived therefrom such as impedances, resistances, output or energy. During operation the characteristic quantities KG1 and characteristic values KG2 are transmitted by way of the communication device 7 to the digital part 3.

The parameter device 4 has predetermined parameters which are relevant to the power supply device 15, such as, for instance, a topography or limits of the network components, target timetables or an expected behavior of loads and network components. The parameters are stored in the parameter device, for instance.

The model device 5 is embodied to create a model of the power supply device 15 and is connected to the parameter device 4. The model device 5 uses parameters and possibly also characteristic quantities KG1 available in the parameter device 4 to create the model. The model of the power supply device produced by the model device 5 is used by the simulation device 6 to simulate the power supply device 15. The model device 5 and the parameter device 4 need not be embodied as separate units.

The simulation device 6 receives the determined characteristic quantities KG1 as actual values of the railway system 1 in real time or virtually in real time via the communication device 7. In contrast to the characteristic values KG2, here the characteristic quantities KG1 are those which are used to simulate the power supply device 15, such as, for instance, a current timetable, current data of the rail vehicles or GPS positions or also current switching states. The simulation device 6 simulates the power supply device 15 with the simulation model created by the model device 5 and the characteristic quantities KG1.

The monitoring device 9 comprises a number of function devices 10, which compare characteristic values KG3, KG4, KG5 calculated in the simulation device 6 with predetermined limit values 11 and/or the current characteristic values KG2. The current characteristic values KG2 are, for instance, electric characteristic values such as current, voltage and variables which can be derived therefrom such as impedances, resistances, output or energy. The current characteristic values KG2 are the current comparison values relating to the simulated characteristic values KG3, KG4, in order to be able to draw a comparison between the characteristic values KG3,

KG4 calculated in the simulation and the real existing characteristic values KG2. The calculated characteristic values KG3, KG4, KG5 can also be a time curve of values in the form of a curve, for instance. A distinction can be made here between a current area 12 and a preview area 13.

In the current area 12, the characteristic values KG3, KG4 calculated in the simulation device 6 are compared with the current characteristic values KG2.

In the preview area 13, precalculated future characteristic values KG5 are compared with the limit values 11 and as a result a prognosis is given for the future operation of the power supply device 15.

The function devices 10 forward their comparison results 16 to a computing device 17, which transmits a warning message 18 in the real part 2 when the limit values 11 are exceeded, for instance to a control center of the railway system 1.

Alternatively or in addition to the warning messages 18, automatic measures can also be introduced. The performance of the trains can therefore be influenced by way of an automatic train control system, for instance.

The function devices 10 and/or the computing device 17 can also be embodied by the simulation device 6 or external systems, as are shown for instance in Figure 2.

Figure 2 shows a schematic representation of a railway system 1 and a possible replacement of the inventive monitoring device 9 with other devices in the railway system 1. Here the inventive monitoring device 9 is in contact with a timetable management system 18, a load management system 19, a SCADA

system 20 and possibly an analysis device 21. A real-time capable controller 22 is connected to the load management 19, for instance. The inventive monitoring device 9 communicates in both directions with the timetable management system 18, the load management system 19 and the SCADA system 20. The communication can take place with a cycle time of seconds, approx. 3 s for instance, or also more rapidly. The SCADA system 20 can have a decision support function, for instance, which allows an operator to check for test scenarios ('what if'). In this regard the operator can enter a possible change in the railway system 1 into the SCADA system 20, which, with the aid of the inventive monitoring device 9, provides the operator with feedback with respect to the test.

Claims

1. A method for monitoring a power supply device (15) of a traffic system (1), in which a computer-based model of the power supply device (15) is inter alia created with the aid of predetermined parameters relevant to the power supply device (15),

wherein

at least one current characteristic quantity (KG1) is determined during ongoing operation of the traffic system (1) and the operation of the power supply device (15) is simulated at least with the aid of the computer-based model of the power supply device (15) and the at least one determined current characteristic quantity (KG1) and at least one future characteristic value (KG5) is precalculated at least in one desired future time frame with the aid of the simulation and the at least one precalculated future characteristic value is compared with at least one predetermined limit value and the at least one precalculated future characteristic value is compared with a characteristic value (KG2) determined during ongoing operation of the traffic system (1) and a response is output based on the comparisons of the at least one precalculated future characteristic value (KG5).

2. The method as claimed in claim 1,

wherein

the characteristic value (KG2) determined during ongoing operation of the traffic system is determined in real time.

3. The method as claimed in claim 1,

wherein

when the limit value (11) is reached and/or exceeded, at least one warning message (18) is output automatically.

4. The method as claimed in claim 1 or 3,
wherein
when the limit value (11) is reached and/or exceeded, at least
one measure is introduced automatically.

5. The method as claimed in claim 1,
wherein
the at least one current characteristic quantity (KG1) is
determined in real time.

6. The method as claimed in one of the afore-cited claims,
wherein
parameters for the future operation of the traffic system (1)
are calculated with the aid of the simulation.

7. Device (9) for monitoring a power supply device (15) of a
traffic system (1), having at least one model device (5),
which creates a computer-based model of the power supply
device (15) from predetermined parameters which are relevant
to the power supply device (15),
comprising
at least one detection device (8), which is embodied to
determine at least one current characteristic quantity (KG1)
of the traffic system (1) during ongoing operation, and by
means of at least one simulation device (6), which is embodied
to simulate the power supply device (15) with the aid of the
computer-based model and the at least one current
characteristic quantity (KG1) and to precalculate at least one
future characteristic value (KG5) at least in one desired
future time frame with the aid of the simulation and to
compare the at least one precalculated future characteristic
value with at least one predetermined limit value and a

characteristic value (KG2) determined during ongoing operation of the traffic system (1) and the at least one simulation device is further configured to output a response based on the comparisons of the at least one precalculated future characteristic value (KG5).

8. A traffic system (1),

wherein

the system comprises a device (9) as claimed in claim 7.