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(54) Title: A METHOD AND SYSTEM FOR DYNAMICALLY UPDATING RATING OF A POWER DISTRIBUTION DEVICE

(57) Abstract: The invention relates to a method and system for generating a digital key for dynamically reconfiguring at least one power distribution device in an electrical power distribution system having a plurality of transformers and a plurality of power distribution devices. The disclosed system and method receives an Alternating Current (AC) input signal in a power distribution system, calculates a primary X/R ratio at each of the plurality of transformers and calculates a secondary X/R ratio at each of the one or more power distribution devices associated with a corresponding transformer. The disclosed method and system dynamically reconfigures one or more power distribution devices based on the corresponding primary and secondary X/R ratios.

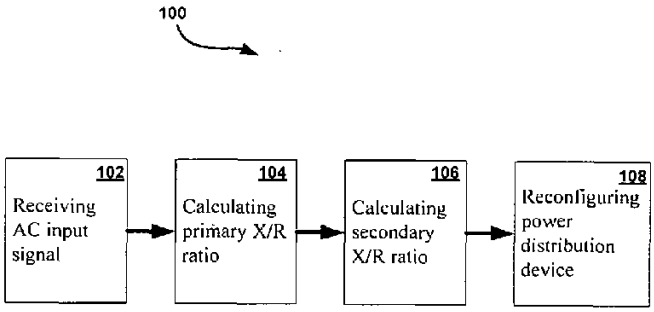

Figure 1

ABSTRACT

A Method and System for Dynamically Updating Rating of a Power Distribution Device

The invention relates to a method and system for generating a digital key for dynamically reconfiguring at least one power distribution device in an electrical power distribution system having a plurality of transformers and a plurality of power distribution devices. The disclosed system and method receives an Alternating Current (AC) input signal in a power distribution system, calculates a primary X/R ratio at each of the plurality of transformers and calculates a secondary X/R ratio at each of the one or more power distribution devices associated with a corresponding transformer. The disclosed method and system dynamically reconfigures one or more power distribution devices based on the corresponding primary and secondary X/R ratios.

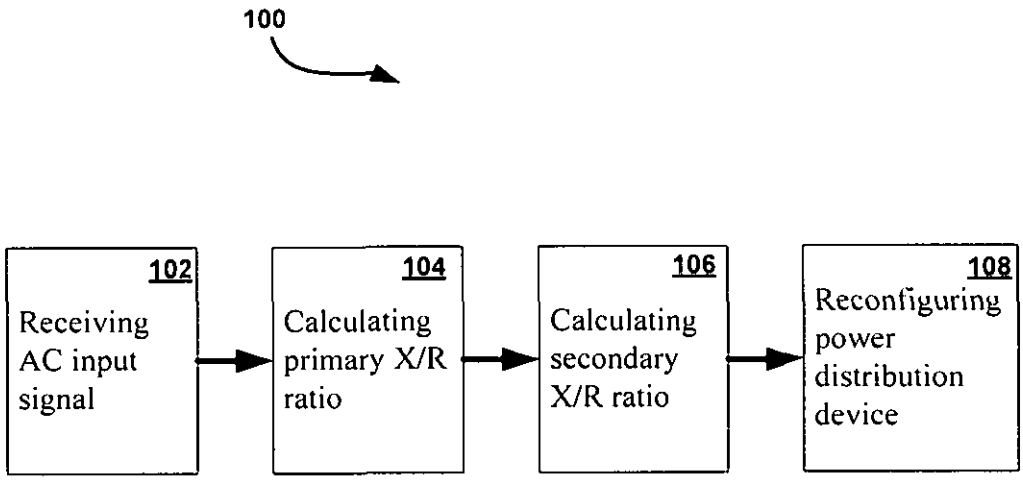

Figure 1

We Claim:

1. A method for dynamically reconfiguring at least one power distribution device in an electrical power distribution system having a plurality of transformers and a plurality of power distribution devices, the method comprising:

receiving an AC input signal in a power distribution system;

calculating a primary X/R ratio at each of the plurality of transformers in the power distribution system;

dynamically calculating a secondary X/R ratio at each of the one or more power distribution devices associated with a corresponding transformer in the power distribution system; and

dynamically reconfiguring the each of the one or more power distribution devices based on the corresponding primary and secondary X/R ratios.

2. The method as claimed in claim 1 wherein the calculating a secondary X/R ratio at each of the one or more power distribution devices includes calculating DC components induced in the AC input signal by the corresponding transformer in the power distribution system.

3. The method as claimed in claim 2 wherein the calculating DC components is based on formula

DC component = (RMS of AC signal at central frequency) + (Amplitude of harmonics till 15th harmonic)

4. The method as claimed in claim 1 further comprising performing a self-analysis by the one or more power distribution devices before the dynamic reconfiguration of each of the one or more power distribution devices.

5. The method as claimed in claim 1 wherein the reconfiguring the one or more power distribution devices includes adjusting a rating of the power distribution device.

6. The method as claimed in claim 1 wherein the reconfiguring the one or more power distribution devices includes removing the calculated DC component from the AC input signal.

7. The method as claimed in claim 1 wherein the power distribution device is a protective device.

8. The method as claimed in claim 1 wherein the power distribution device is a monitoring device or a controlling device.

9. The method as claimed in claim 7 wherein the protective device is a switch, fuse or circuit breaker.

10. A system for controlling the configuration of a power distribution device in a monitored system, the system comprising:

a plurality of transformers and a plurality of power distribution devices arranged in the monitored system; and

a control module configured to:

calculate a primary X/R ratio at each of the plurality of transformers in the monitored system;

dynamically calculate a secondary X/R ratio at each of the plurality of power distribution devices associated with a corresponding transformer in the monitored system; and

dynamically reconfigure the each of the plurality of power distribution devices based on the corresponding primary and secondary X/R ratios.

Dated this 24th day of March 2017

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FIELD OF INVENTION

The invention generally relates to system and methods for real time monitoring of power distribution devices in an electrical power distribution system and more particularly to adjusting rating of a power distribution device in the electrical power distribution system.

BACKGROUND

All the power distribution devices in an electrical power distribution system are rated for a better performance and safe operation in field. To calculate the rating of a power distribution device, many parameters are to be considered from system perspective in which device will be operational. According to the rating calculated for the device, system parameters are either hardcoded or configured through a human machine interface (HMI).

Rating of a device is calculated theoretically from power distribution system parameters such as Inductance/Reactance (X/R) ratio of transformer, maximum current, voltage and power etc. According to the calculated rating, settings are saved into the device. The performance of the device is based on the settings.

The configuration of the device takes time as calculations are done theoretically and then settings are saved into the device. To reduce the effort on manual settings, device can be made intelligent to calculate the system parameters dynamically and update its setting on the run.

Hence, there is a need for a method for dynamically updating the settings of the power distribution device without manual intervention.

The present invention is directed to overcoming one or more of the problems as set forth above.

SUMMARY OF THE INVENTION

Exemplary embodiments of the invention disclose a method and system for dynamically reconfiguring at least one power distribution device in an electrical power distribution system having a plurality of transformers and a plurality of power distribution devices. According to an exemplary embodiment, the disclosed method and system receives an Alternating Current (AC) input signal in a power distribution system. A primary X/R ratio is calculated at each of the plurality of transformers in the power distribution system. A secondary X/R ratio is calculated at each of the one or more power distribution devices associated with a corresponding transformer in the power distribution system. The one or more power distribution devices are dynamically reconfigured based on the corresponding primary and secondary X/R ratios.

According to an exemplary embodiment, the disclosed method and system calculates a secondary X/R ratio at each of the one or more power distribution devices by calculating Direct Current (DC) components induced in the AC input signal by the corresponding transformer in the power distribution system.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 illustrates a block diagram of a process for dynamically reconfiguring at least one power distribution device in an electrical power distribution system, according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments of the invention as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

According to embodiments of the invention, a system and method for dynamically reconfiguring at least one power distribution device in an electrical power distribution system is disclosed. According to an embodiment, the power distribution device may be a protective device. According to another embodiment, the power distribution device may be a monitoring

device or a controlling device. According to yet another embodiment, the power distribution device may be a switch, fuse or circuit breaker. According to a further embodiment, the power distribution device may be a substation breaker, reclosing substation breaker or line recloser.

FIG. 1 illustrates a block diagram of the process 100 for dynamically reconfiguring at least one power distribution device in an electrical power distribution system, according to an embodiment of the invention. The power distribution system may include a plurality of transformers and a plurality of power distribution devices.

According to an embodiment, the power distribution devices (PDDs) associated with a particular location may be provided with a common configuration that defines operating parameters for the PDDs. According to an exemplary embodiment, the operating parameters may include such as, but not limited to, X/R ratio, maximum current, voltage and power. Similarly, groups of PDDs such as PDDs associated with a particular service, application, or customer, may be provided with a common configuration that defines operating parameters for the PDDs associated with a group. Thus, when PDDs are configured or have a configuration update, all of the PDDs associated with a location may be configured or updated by pushing configuration information to each PDD. Such action may occur automatically, such as when a PDD is discovered on a network, or may occur manually when an operator initiates configuration or update of PDD(s) at a particular location. The PDDs may be remotely configured, according to one embodiment of the invention.

According to another embodiment, different configuration files may be provided to different PDUs according to one of a number of criteria, such as PDU location, PDU customer requirements, power infeed related to a PDU, etc.

At step 102, an AC input signal is received in a power distribution system.

At step 104, a primary X/R ratio is calculated at each of the plurality of transformers in the power distribution system. According to an embodiment, one or more sensors may be configured to provide real-time measurement of primary X/R ratio at transformer.

At step 106, a secondary X/R ratio is calculated dynamically at each of the one or more PDDs associated with a corresponding transformer in the power distribution system. According to an embodiment, the secondary X/R ratio calculation at each of the one or more PDDs may include calculating DC components induced in the AC input signal by the corresponding transformer in the power distribution system. According to another embodiment, the DC components may be calculated using formula

DC component = (RMS of AC signal at central frequency) + (Amplitude of harmonics till 15th harmonic)

According to an embodiment, one or more sensors may be configured to provide real-time measurements of secondary X/R ratio from PDDs.

According to an embodiment, the sensors may provide measurement/output data in an analog format. According to another embodiment, the sensors may provide the output data in digital format. According to another embodiment, the sensors may be configured to capture the output data at split-second intervals to effectuate "real time" data capture. For example, in one embodiment, the sensors may be configured to generate hundreds of thousands of data readings per second.

At step 108, the one or more PDDs are dynamically reconfigured based on the corresponding primary and secondary X/R ratios. According to an embodiment, the one or more PDDs may perform a self-analysis before the dynamic reconfiguration of each of the one or more power distribution devices. According to another embodiment, the dynamic reconfiguration of the one or more PDDs may include adjusting a rating of the power distribution device. According to yet another embodiment, the adjusting of rating of the one or more PDDs may include updating one or more operating parameters of the PDDs. According to an embodiment of the invention, the adjusting/updating of rating of the PDDs may include performing a short circuit analysis of the PDDs. According to an exemplary embodiment, the PDD may be analysed for short-circuit current, under current and over current to adjust/update the rating of the PDD. According to yet another embodiment, the reconfiguration of the one or more PDDs may include removing the calculated DC component from the AC input signal. According to an exemplary embodiment, the actual AC current may be calculated after removing the DC component from the AC signal.

According to an embodiment, there may be a system that is monitored for controlling the configuration of a power distribution device in an electrical power system. According to an embodiment, the monitored system may be an electrical power generation plant. In another embodiment, the monitored system may be an electrical power transmission infrastructure. In still another embodiment, the monitored system may be an electrical power distribution system. In still another embodiment, the monitored system may include a combination of one or more electrical power generation plant(s), power transmission infrastructure(s), and/or an electrical power distribution system.

The system may include a plurality of transformers, a plurality of PDDs and a control module. According to an embodiment, there may be one or more control modules. The control module may be a part of a transformer, PDD or both. According to another embodiment, there may be one control module at the transformer and another control module at the PDD. The control module may include one or more processors.

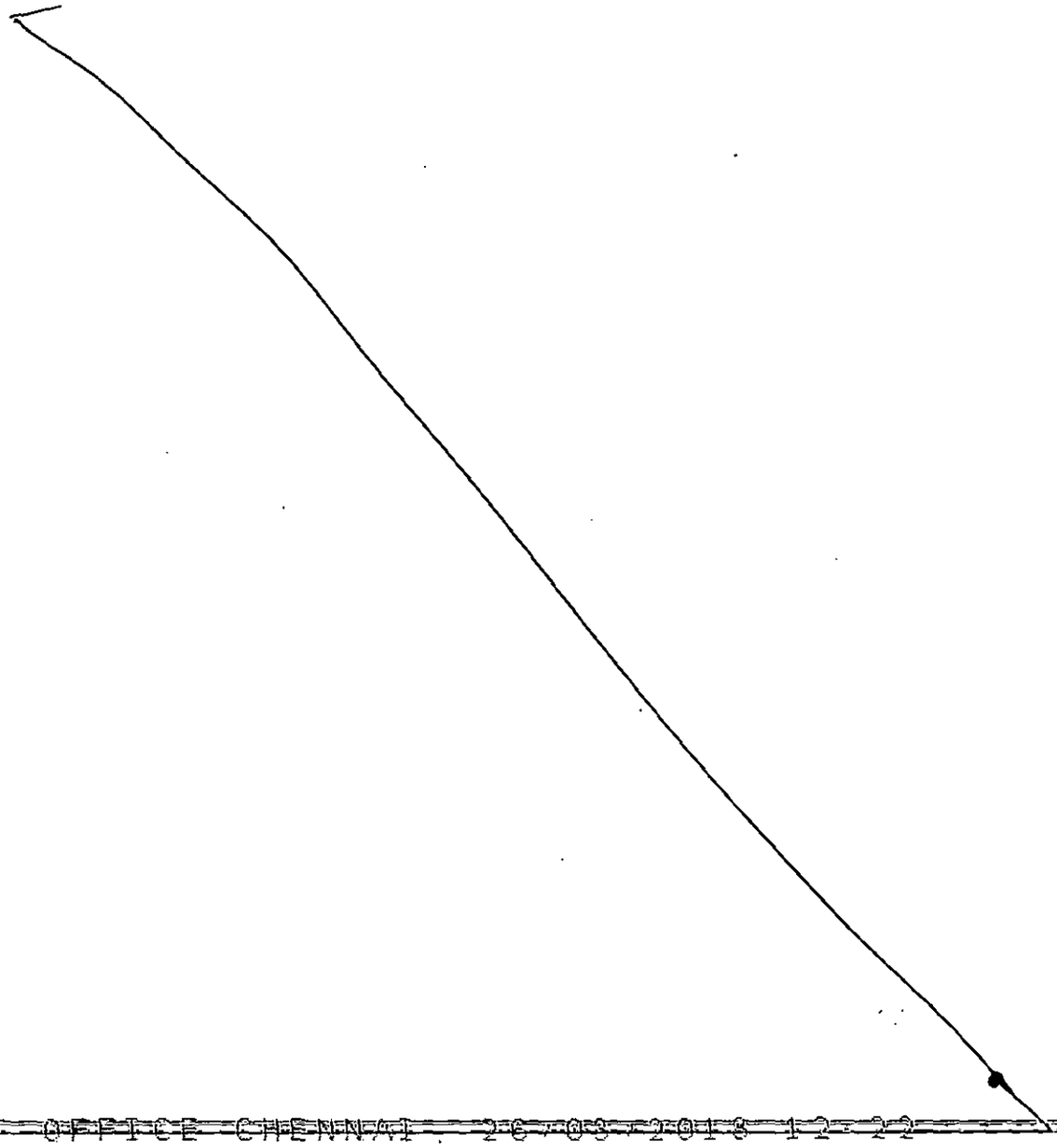
According to an embodiment, the one or more processors may calculate a primary X/R ratio at each of the plurality of transformers in the monitored system. According to another embodiment, the one or more processors may dynamically calculate a secondary X/R ratio at each of the plurality of PDDs associated with a corresponding transformer in the monitored system. According to yet another embodiment, the one or more processors may dynamically reconfigure each of the plurality of PDDs based on the corresponding primary and secondary X/R ratios.

In the drawings and specification there has been set forth preferred embodiments of the invention, and although specific terms are employed, these are used in a generic and descriptive sense only and not for purposes of limitation. Changes in the form and the proportion of parts, as well as in the substitution of equivalents, are contemplated as circumstances may suggest or render expedient without departing from the spirit or scope of the invention.

Throughout the various contexts described in this disclosure, the embodiments of the invention further encompass computer apparatus, computing systems and machine-readable media configured to carry out the foregoing systems and methods. In addition to an embodiment consisting of specifically designed integrated circuits or other electronics, the present invention may be conveniently implemented using a conventional general purpose or a specialized digital

computer or microprocessor programmed according to the teachings of the present disclosure, as will be apparent to those skilled in the computer art.

Appropriate software coding can readily be prepared by skilled programmers based on the teachings of the present disclosure, as will be apparent to those skilled in the software art. The invention may also be implemented by the preparation of application specific integrated circuits or by interconnecting an appropriate network of conventional component circuits, as will be readily apparent to those skilled in the art.



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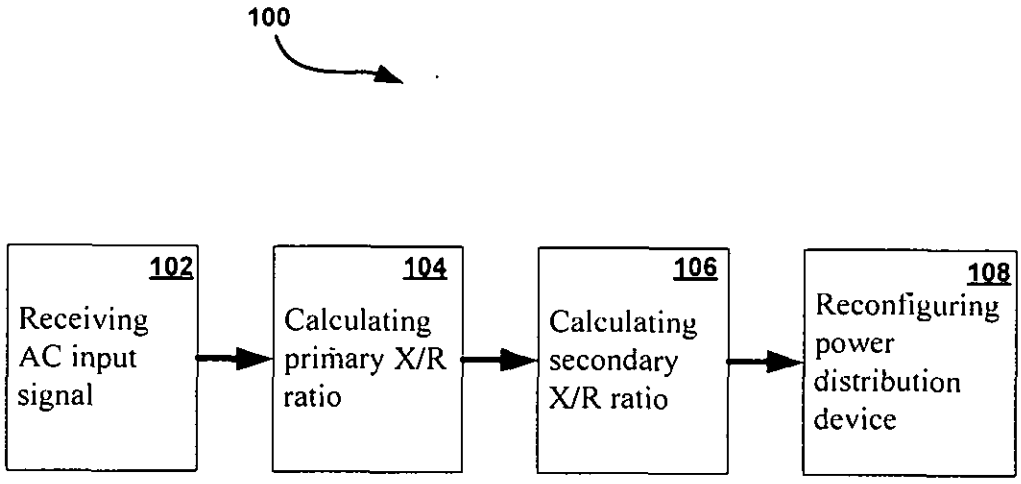

Figure 1

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