frequency is within the deadband, but not at the set point, the action to be performed is dependent upon the frequency and the SOC. If the frequency is below the set point, the storage cells are discharged when the SOC is above range and provided with a trickle charge when the SOC is below range. If the frequency is above the set point, the storage cells are provided with a trickle discharge when the SOC is above range and charged when the SOC is below range.

[0052] The specific details of the specific aspects of the present invention may be combined in any suitable manner without departing from the spirit and scope of embodiments of the invention. However, other embodiments of the invention may be directed to specific embodiments relating to each individual aspects, or specific combinations of these individual aspects.

[0053] For instance, the foregoing examples have been described in the context of frequency regulation, in which power is added to or absorbed from the grid for purposes of load following. In this situation, the decision to add or absorb power is based upon the instantaneous value of the operating frequency relative to established threshold values, e.g. the deadband limits. The principles described herein are equally applicable to other ancillary services that respond to changes in the operating frequency of the grid. For example, to respond to a rapid drop in the operating frequency, a parameter such as the rate of change of the frequency could be employed in addition to, or in lieu of, the instantaneous value of the operating frequency, as a trigger for an instruction to add power to the grid. Within different applications for ancillary services, the set points of the device would be modified for that service using the same control and logic structure described for frequency regulation.

[0054] It will be understood that the present invention as described above can be implemented in the form of control logic using hardware and/or using computer software in a modular or integrated manner. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will know and appreciate other ways and/or methods to implement the present invention using hardware and a combination of hardware and software

[0055] Any of the software components or functions described in this application, may be implemented as software code to be executed by a processor using any suitable computer language such as, for example, Java, C++ or Perl using, for example, conventional or object-oriented techniques. The software code may be stored as a series of instructions, or commands on a computer readable medium for storage and/or transmission, suitable media include random access memory (RAM), a read only memory (ROM), a magnetic medium such as a hard-drive or a floppy disk, or an optical medium such as a compact disk (CD) or DVD (digital versatile disk), flash memory, and the like. The computer readable medium may be any combination of such storage devices.

[0056] The above description of exemplary embodiments have been presented for the purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise form described, and many modifications and variations are possible in light of the foregoing teachings. The embodiments are described to explain the principles of the invention and its practical applications to thereby enable others skilled in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated.

What is claimed is:

1. A method of responding to changes in the operating frequency of an electricity grid by means of energy storage devices that are energetically coupled with the electricity grid, the method comprising:

determining whether the operating frequency of the electricity grid is within a predetermined range of a nominal operating frequency;

if the operating frequency is determined to be outside said range, regulating the grid frequency by transferring energy between the energy storage device and the electricity grid;

if the operating frequency is within said range, determining whether a state of charge (SOC) of the energy storage device is within predetermined limits; and

transferring energy between the energy storage device and the electricity grid to bring the SOC within said predetermined limits when the operating frequency is within said range and the SOC of the energy storage device is outside said predetermined limits.

2. The method of claim **1**, further comprising:

monitoring the state of charge (SOC) with an energy storage device management system from which an SOC value is received; and

monitoring the grid frequency with a transducer from which the grid frequency is received, wherein the SOC value and the grid frequency are received at a programmable logic control.

3. The method of claim **1**, wherein energy is transferred between the grid and the energy storage device to regulate the frequency at a rate that is based upon the operating frequency of the grid.

4. The method of claim **3**, wherein said rate is a linear function of the operating frequency of the grid.

5. The method of claim **3**, wherein said rate is a non-linear function of the operating frequency of the grid.

6. The method of claim **5**, wherein said non-linear function is a polynomial of an order higher than one.

7. The method of claim **1**, wherein energy is transferred between the grid and the energy storage device to bring the SOC within said predetermined limit at a rate that is based upon the SOC.

8. The method of claim **1**, wherein energy is transferred between the grid and the energy storage device to bring the SOC within said predetermined limit at a rate that is based upon the operating frequency of the grid.

9. The method of claim **1**, wherein energy is transferred between the grid and the storage cells to bring the SOC within said predetermined limit at a rate that is based upon the capacity of the energy storage device.

10. A method of responding to changes in the operating frequency of an electricity grid by means of energy storage devices that are energetically coupled with the electricity grid, the method comprising:

determining whether a parameter of the operating frequency of the electricity grid is within a predetermined range;

if the operating frequency parameter is determined to be outside said range, adjusting the grid frequency by transferring energy between the energy storage devices and the electricity grid;

if the operating frequency is within said range, determining whether a state of charge (SOC) of the energy storage devices is within predetermined limits and whether the