Streszczenie w języku angielskim rozprawy doktorskiej
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zatytułowanej: Sterowanie predykcyjne-SVM trójfazowym przekształtnikiem AC/DC współpracującym z odnawialnymi źródłami energii

Technological development in the field of obtaining and processing electricity resulted in significant changes in the model of the power grid. A crucial factor causing this metamorphosis is the constantly increasing share of renewable energy sources in the electricity production structure. Many micro-sources installations, resulting from both economic and ecological aspects, create new challenges in the design of algorithms that control AC/DC grid converters that connect renewable energy sources with the power grid. The correct selection of the method for controlling the grid converter allows for achieving low values of harmonic distortions coefficient of the current generated to the power grid, which translates directly into the possibility of using smaller inductances of L-type input filters. Using more advanced methods of controlling the AC/DC converter, using input filters in the LCL configuration is possible. Using the indicated topology of the input filter allows better suppression of higher harmonics in the current fed to the supply network. Thus, significantly lowering the dimensions of the filter components and reducing the entire device's price. The second essential and inseparable aspect of the applied methods of controlling AC/DC grid converters cooperating with renewable energy sources is ensuring the safety of devices and the safety of power line workers. The aforementioned potential threats result from the lack of detection of unintentional island operation, i.e., the creation of a separate area of the network from the entire power grid, in which there are AC/DC grid converters cooperating with renewable energy sources and electrical loads simultaneously. The algorithms that detect the occurrence of the unintentional island operation state should be characterized by a short detection time of a power supply failure when introducing the smallest possible number of additional harmonic distortions of current fed to the power grid generated by the grid converter. This dissertation covers two mutually inherent issues concerning controlling AC/DC power converters cooperating with renewable energy sources. Therefore, the work has been divided into two main parts. The first one introduces the issue and describes the novel solution of the AC/DC grid converter control method using the so-called continuous control set method using space vector modulation. On the other hand, the second part of the dissertation is devoted to anti-islanding methods. It describes the principles of designing unintentional island operation detection algorithms. Then, the innovative solution offers the same rate of detection of the unintentional island operation state using the current distortion with a lower harmonic distortion coefficient and a more favourable spectrum of the generated signal than the standard method of active frequency drift. The subject matter presented in this doctoral dissertation has many applications. It fits perfectly into the global trends of reducing harmonic emissions, equipment production costs, and operation of the power grid and increases the operational safety of modern power grids.