Ward equivalent power system

What is the extended Ward equivalent approach?

A complete extended Ward equivalent approach is proposed for on-line security assessment of a power system. This new approach combines the off-line topological modelling of the extended Ward equivalent with on-line updating of the parameters of the equivalent model for representing real time topology changes of the external system.

What is a ward-PV equivalent?

The Ward-PV equivalent has a basic Ward equivalent of external PQ buses and retained PV buses. The extended Ward equivalent combines the simplicity of the basic Ward equivalent with the reactive power response of the Ward-PV equivalent; the approach is summarised in the following four steps: 9 1. Step 1: Obtaining a Ward equivalent vEq of tlle ~.

What is a ward equivalent?

The Ward equivalent is composed of a linear part and anonlinearone. The issue of this equivalent is that the physical behavior of the internalsystem (which is accurate) and the behavior of the external system (which isapproximated),cannot be simulated by the same algorithm process. REI stands for Radial,Equivalent and Independent.

How accurate is Ward equivalencing?

Since the loads are not governed by differential equations,static-type equivalencing techniques are employed. In this paper,the Ward equivalent is considered. The equivalent injection currents are derived from piecewise linearization of the system model. Simulation results show that the method is accurate for wide changes in the operating point.

What is the extended Ward equivalent approach for on-line static security analysis?

5. Conclusions In this paper, an extended Ward equivalent approach for on-line static security analysis has been presented The proposed approach can update the equivalent parameters, representing the topology changes of the external system according to the line status in the buffer zone.

Can the extended Ward equivalent model reflect the load condition changes?

The extended Ward equivalent model can reflect the load condition changesof the external system by matching the boundary equiv- alent power injections,but fail to simulate significant configuration changes since it is very difficult to obtain all the on-line topology information from the external system.

System planning on a large-scale electric power system is computationally challenging. Network reduction into a small system can significantly reduce the computational expense. The Ward equivalent technique is widely used for the reduction; however, it may not yield the same flow pattern as the original network. In this paper, a new methodology for ...

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This implies the calculation of all the areas of interest by means of the Ward equivalent method, as proposed in . The main goal of the Ward equivalent methodis to reduce the complexity of a large power system model while preserving its essential characteristics and ensuring accurate representation of load flow and voltage profiles.

a Interconnected power system. b Improved Ward-PV equivalent model. The boundary bus i is employed to illustrate the estimation method. In Fig. 1b, when the fictitious generator E 1 and fictitious branch are neglected, the bus i has power flow equations (1) where ...

This paper investigates the extended Ward equivalent method. A new equivalent modelling, with sparsity technique, for on-line power system security analysis is presented. The extended Ward equivalent has been tested by simulation on the IEEE 30-bus, IEEE 118-bus load flow test system, and the 706-bus interconnected power system of the NGC.

Topology method can simplify the system external network under power frequency, such as Ward equivalent and other improved static equivalent methods . The admittance matrix is very important in the equivalence reduction and stability analysis of the system.

TL;DR: In this paper, a complete extended Ward equivalent approach is proposed for on-line security assessment of a power system, which combines the off-line topological modelling of the extended ward equivalent with online updating of the parameters of the equivalent model for representing real time topology changes of the external system.

To simplify the interconnected power system, the current power flow calculation depends too much on computer performance and storage capacity. In this paper, equivalent modeling is carried out for IEEE39 node system with reactive power generator set. Firstly, the conventional Ward equivalent model (C-Ward) and the extended Ward equivalent model (E ...

In order to improve the Ward-type equivalent against such poor accuracy, the extended Ward-type equivalent is adopted later to retain the reactive power response of the power system. As a matter of fact, the coupled single-port model can be treated as a particular Ward-type equivalent in which each load bus is considered as the boundary bus, as ...

complex power system. The construction of equivalent diagrams for steady states (power flow and flow of steady short-circuit currents) was based on the reduction of the external system to a sim- ple equivalent system. Methods for reducing complex systems for steady-state analysis

dynamic equivalent of power system network are described. Static equivalents are only useful for the static programs, i.e., load flow, short circuit analysis, optimization, planning, and ... approach was originally presented by J. B. Ward in 1949 [7]. The power system under consideration is divided into two parts: the study

system and the ...

This paper proposes a methodology to estimate equivalent inertia in large power systems based on measurements provided by Phasor Measurement Units (PMUs). Considering the availability of PMUs spread on the system, the Ward equivalent method is proposed to reduce the system around the measurement points, and dynamic equivalents are built around the selected buses. ...

A generalised Ward-type external-system equivalent for static security analysis is presented. The well-known standard and extended Ward equivalents can be obtained by simplifying this generalised Ward equivalent. Special attention is given to the representation of external generating units with primary voltage regulation. The equivalent requires no real-time ...

A novel hybrid Artificial Neural Network and extended Ward-type equivalent approach for fast on-line voltage security assessment of power systems that maintains the desirable properties of the Ward equivalent method and can update online the parameters of the equivalent model when the topology of the external system changes. This paper presents a ...

A modified-Ward equivalent is proposed to address this limitation such that the external generators are moved wholesale to some internal buses based on electrical distance. This proposed equivalencing procedure is designed so that the retained-line power flows in the equivalent match those in the unreduced (full) model exactly.

Ward Equivalent Model of a Real Power System. In this case, a real 1209-bus power system operating in China is considered, and a portion of the system with a voltage level below 110 kV is replaced with a Ward equivalent model. A total of 56 buses are to be reduced, and the Ward equivalent model involves 6 boundary buses and 66 parameters to be ...

Calculation of TTC for multi-area power systems based on improved Ward-PV equivalents ISSN 1751-8687 Received on 29th June 2016 Revised on 2nd October 2016 ... Fig. 1 Interconnected power system and its improved Ward-PV equivalent model a Interconnected power system b Improved Ward-PV equivalent model f1(i, t) = (Pi eq -P i(t)) -V i(t) j[S1 ...

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