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COORDINATED CONTROL AND ENERGY MANAGEMENT OF DISTRIBUTED GENERATION INVERTERS IN A MICROGRID

Limbabai K Mudake
Department of Electrical Engineering
Fabtech College of Engineering and Research,
Sangola, INDIA

Prof.Shravan Kumar Akireddy
Department of Electrical Engineering
Fabtech College of Engineering and Research,
Sangola, INDIA

ABSTRACT

This project presents a micro grid consisting of different distributed generation (DG) units that are connected to the distribution grid. The proposed micro grid consists of a photovoltaic (PV) array which functions as the primary generation unit of the micro grid and a proton-exchange membrane fuel cell to supplement the variability in the power generated by the PV array. The control design for the DG inverters employs a new model predictive control algorithm which enables faster computational time for large power systems by optimizing the steady-state and the transient control problems separately.
The integration of renewable sources can supplement the generation from the distribution grid. However, these renewable sources are intermittent in their generation and might compromise the reliability and stability of the distribution network. As a result, energy-storage devices, such as batteries and ultra-capacitors, are required to compensate for the variability in the renewable sources. The incorporation of energy-storage devices is also critical for managing peak demands and variations in the load demand.
So, in this project, a micro grid consisting of a photovoltaic (PV) array, a proton-exchange membrane fuel cell (PEMFC), and a lithium-ion storage battery (SB) is proposed. The proposed controller for the DG inverters is based on a newly developed MPC algorithm which decomposes the control problem into steady-state and transient sub problems in order to reduce the overall computation time.
The entire proposed system will be tested using MATLAB/SIMULINK and the simulation results demonstrate the attractive performance characteristics of the proposed system.

KEYWORDS: Micro grid Analysis, Energy management technique

INTRODUCTION

Over the last decade, efficient and reliable communication and control technologies, coupled with an increase in smarter electrical facilities, such as electric vehicles and smart meters, have resulted in an increasing number of consumers participating in demand response management (DRM) [1]–[5]. The current research is also focused on achieving a smarter grid through

demand-side management (DSM), increasing energy reserves and improving the power quality of the distribution system, such as harmonic compensation for nonlinear loads [5]–[8]. These new trends enable higher levels of penetration of renewable generation, such as wind and solar power into the grid. The integration of renewable sources can supplement the generation from the distribution grid. However, these renewable sources are intermittent in their generation and might compromise the reliability and stability of the distribution network. As a result, energy-storage devices, such as batteries and ultra-capacitors, are required to compensate for the variability in the renewable sources. The incorporation of energy-storage devices is also critical for managing peak demands and variations in the load demand.

In this paper, a micro grid consisting of a photovoltaic (PV) array, a proton-exchange membrane fuel cell (PEMFC), and a lithium-ion storage battery (SB) is proposed. The PEMFC is used as a backup generator unit to compensate for the power generated by the intermittent nature of the PV array. The SB is implemented for peak shaving during grid-connected operation, and to supply power for any shortage in generated power during islanded operation and to maintain the stability of the distribution network. An energy-management algorithm is designed for the micro grid to coordinate the sharing of power among different DG units. The proposed controller for the inverters of DG units is based on a newly developed model predictive control (MPC) algorithm, which optimizes the steady-state and the transient control problems separately. In this way, the computation time is greatly reduced.

In what follows, this paper provides a comprehensive solution for the operation of a microgrid which will simultaneously dispatch real and reactive power during both grid-connected and islanded operations, compensate for harmonics in the load currents, and perform peak shaving and load shedding under different operating conditions.

Centralized Control for Parallel Operation of Distributed Generation Inverters in Micro grids

This paper presents a centralized control system that coordinates parallel operations of different distributed generation (DG) inverters within a microgrid. The control design for the DG inverters employs a new Model Predictive Control algorithm that allows faster computational time for large power systems by optimizing the steady-state and the transient control problems separately. An overall energy management system is also implemented for the microgrid to coordinate load sharing among different DG units during both grid-connected and islanded operations. The design concept of the proposed control system is evaluated through simulation studies under different test scenarios [19]. The impact of the increased penetration of DG units on the distribution grid is also investigated using the proposed microgrid [20]. The simulation results show that the operations of the DG units within the microgrid can be coordinated effectively under the proposed control system to ensure stable operation of the overall microgrid.

Distributed control of hybrid AC-DC microgrid with solar energy, energy storage and critical load

In this paper, a novel power flow control method for a hybrid AC-DC microgrid with solar energy, and energy storage is proposed for the integration of a pulse load. This micro grid works in islanding mode with a synchronous generator and PV farm supplying power to the system's AC and DC sides, respectively. A bidirectional AC-DC inverter is used to link the AC and DC sides by controlling the active and reactive power flow between them[21]. The PV farm is connected to the DC bus through a DC-DC boost converter with maximum power point tracking (MPPT) functionality. A Battery bank is connected to the DC bus through a bidirectional DC-DC converter[22]. The system is tested with a pulse load connected to the AC side. Simulation results verify that the proposed topology is coordinated for power management in both the AC and DC sides under critical loads with high efficiency, reliability and robustness in islanding modes.

Coordinating Storage and Demand Response for Microgrid Emergency Operation

Microgrids are assumed to be established at the low voltage distribution level, where distributed energy sources, storage devices, controllable loads and electric vehicles are integrated in the system and need to be properly managed. The microgrid system is a flexible cell that can be operated connected to the main power network or autonomously, in a controlled and coordinated way[23]. The use of storage devices in microgrids is related to the provision of some form of energy buffering during autonomous operating conditions, in order to balance load and generation. However, frequency variations and limited storage capacity might compromise microgrid autonomous operation. In order to improve microgrid resilience in the moments subsequent to islanding, this paper presents innovative functionalities to run online, which are able to manage microgrid storage considering the integration of electric vehicles and load responsiveness[24]. The effectiveness of the proposed algorithms is validated through extensive numerical simulations.

Control Strategies of a DC Microgrid for Grid Connected and Islanded Operations

This paper proposes an algorithm for coordinated control of the distributed generators integrated to a dc microgrid (DCMG), in islanded and grid connected modes of operation [25]. The proposed DCMG connects various types of nonconventional energy sources, storage system to the dc, and three-phase, as well as single-phase ac loads. A control strategy for three-phase voltage source inverter to integrate the three-phase load, as well as utility grid into the DCMG, under various operating scenarios, has also been proposed[26]. The proposed control strategy uses a combination of the feed-back and feed-forward control loops. Dual proportional integral controllers for ac voltage regulation and inner current control have been suggested in two rotating direct- and quadrature- axis synchronous reference frames for controlling the respective positive and negative sequence components. Simulations are carried out to verify the robustness of the proposed algorithm and control strategy under different operating conditions including fault scenario and its effectiveness in maintaining the dc voltage of the microgrid.

An improved control method of power electronic converters in low voltage micro-grid

With the increasing acceptance, micro-grid, combined with distributed generation (DG), may be operated in two modes: grid-connected mode and island mode. In grid connected mode, energy management is the control objective[27]. While in island mode, the control of Voltage and frequency will take the place. The conventional droop control can perform the energy management in grid-connected mode, but may not so effective when micro-grid transferring between grid-connected mode and island mode. The paper analysis the micro-grid in different modes (Conventional droop control, Voltage reference compensation, Constant power output mode, Phase adjustment mode), and then proposes an overall control strategy for the micro-grid. The voltage reference compensation would minimize the steady-state error on the nominated operation point; the coordinate control of voltage and frequency with a feed forward control of the voltage and frequency deviation added to power references could achieve secondary regulation of the voltage and frequency[28]. In this paper, the authors take the steady and transient transition of grid connecting and disconnecting of the micro-grid as an example, and demonstrate that compensation on voltage reference is effective, and voltage and frequency coordination control can well perform not only energy management in grid-connected mode, but also the secondary regulation of voltage and frequency when micro-grid separates from the main grid, and furthermore the strategy can perform well in the transition states between the operation modes. The new droop control method has been validated through simulations by PSCAD software and experiments.

Control Methods of Inverter-Interfaced Distributed Generators in a Microgrid System

Microgrids are a new concept for future energy distribution systems that enable renewable energy integration and improved energy management capability[29]. Microgrids consist of multiple distributed generators (DGs) that are usually integrated via power electronic inverters. In order to enhance power quality and power distribution reliability, microgrids need to operate in both grid-connected and island modes. Consequently, microgrids can suffer performance degradation as the operating conditions vary due to abrupt mode changes and variations in bus voltages and system frequency. This paper presents controller design and optimization methods to stably coordinate multiple inverter-interfaced DGs and to robustly control individual interface inverters against voltage and frequency disturbances [30]. Droop-control concepts are used as system-level multiple DG coordination controllers, and control theory is applied to device-level inverter controllers. Optimal control parameters are obtained by particle-swarm-optimization algorithms, and the control performance is verified via simulation studies.

A microgrid energy management system with demand response

A new renewable and demand side coordinative energy management system is developed for microgrid with demand response[31]. The microgrid is grid-connected, including photovoltaic power generator (PV), energy storage device, and several industrial customers with adjustable load. With the imported external power on time-of-use (TOU) price, an internal-dynamic-price-based renewable and demand side coordinative energy management model is proposed based on load and PV power forecasting results to maximize the profit of the renewable industrial park with a microgrid. T he electricity demands of the rational customers interact mutually with the day-ahead internal dynamic prices[32]. The customers' responsive behaviors are modeled

using the matrix of self-elasticity and cross-elasticity. To solve the optimization model, a newly proposed fruitfly optimization algorithm is adopted. Finally, simulation results of numerical tests for a microgrid demonstrate the effectiveness of the model with demand response.

Energy management system for multi-microgrid

EMS of microgrid (I-IEMS) is developed to monitor and control distributed generator (DG). It i s necessary to research practical I-IEMS for large-scale multi-microgrid. Energy Management System for microgrid in this paper is based on Smart Grid Dispatching Technical Support System (SGDTSS) which has been widely used in dispatching system of provincial or regional power grid[33]. The secure operating system, database, SOA function, application interface and mes sage bus are all included in special dispatching technical support platform for μEMS. The functionalities of μEMS advanced application are presented, including topology engine with multi-microgrid, power flow control, economic operation for microgrid, DGs & loads forecast, demand response based on microgrid, "Seamless Transfer" between grid and island mode, etc.

Microgrid energy management system: A study of reliability and economic issues

Microgrid (MG) is a prospective power system that addresses the renewable energy technologies (RET) accompanying necessary growing deployment of distributed energy resources (DER) and small-scale renewable energy sources (RES). This paper deals with the economic and reliability issues in a MG[34]. A simulation model has been developed to optimize the operation of MG economically. The objective function and constraints related to the operation of MG are formulated and mathematical model is presented. A reliability study has also been performed using a scenario-based approach to determine reliability index of the system. The proposed formulation and model is validated with a case study followed by conclusions and remarks.

Renewable based DC microgrid with energy management system

This paper explores the need for renewable based DC microgrid and proposes characteristic features of a standalone DC microgrid[35]. The need for energy management system and its role in DC microgrid has been emphasized. Renewable generating sources such as wind turbine generator and photovoltaic panel require stringent control for harnessing maximum available energy, energy storage system demands efficient management, and DC-link voltage must be maintained constant. These requirements are fulfilled by energy management system, thus it provides intelligence to the system and makes the microgrid reliable. An isolated renewable DC microgrid having proposed features and energy management system has been simulated using MATLAB/SIMULINK. The designed system sustains dynamic conditions and simulation results validate feasibility of DC microgrid and energy management algorithm.

Energy management of a multi-agent based multi-microgrid system

This paper presents a model-based optimization algorithm for short-term energy trading in a multi-microgrid system. The multi-microgrid system has a hierarchical design architecture which is based on the Multi-Agent System (MAS) concept. Mixed-integer linear programming (MILP) which takes into consideration multiple constraints is used to obtain the optimum amount of power that will be generated, sold, or stored for the Energy Management System

(EMS) of the multi-microgrid system at different time intervals[36]. By using the proposed optimization algorithm, the EMS will ensure that power balance in the multi-microgrid system is achieved through energy trading between different interconnecting microgrids. The proposed optimization algorithm and hierarchical multi-microgrid system design architecture have the capability to ensure that the multi-microgrid system operates in a coordinated and economic manner. The design concept is demonstrated through different test case scenarios and the results obtained are discussed.

Evaluating microgrid management and control with an implementable energy management system

A microgrid can be characterized by its integration of distributed energy resources and controllable loads. Such integration brings unique challenges to the microgrid management and control which can be significantly different from conventional power systems[37]. Therefore, a conventional energy management system (EMS) needs to be re-designed with consideration of the unique characteristics of microgrids. To this end, we propose a microgrid EMS named a microgrid platform (MP). We take into account all the functional requirements of a microgrid EMS (i.e., forecast, optimization, data analysis, and human-machine interface) and address the engineering challenges (i.e., flexibility, extensibility, and interoperability) in the design and development of the MP. Moreover, we deploy the prototype system and conduct experiments to evaluate the microgrid management and control in real-world settings at the UCLA Smart Grid Energy Research Center. Our experimental results demonstrate that the MP is able to manage various devices in the test bed, interact with the external systems, and perform optimal energy scheduling and demand response.

Optimal energy management of a rural microgrid system using multi-objective optimization

Electrification of rural areas has always been a challenge. In addition, large livestock farms such as dairy farms, also face environmental problems due to inappropriate treatment of animal wastes. Therefore, improvement of the electrical system in farms vis-a-vis efficient waste management is of great importance to industry[38]. In this paper, a combined cooling, heating, and power (CCHP) microgrid model was built to improve system efficiency of energy utilization and lessen environmental problems caused by animal wastes based on multi-objective optimization. In this proposed model, the animal manure is used to produce biogas, which is used to feed internal combustion engines (ICEs), gas boilers, and absorption chillers. The generated electricity would offset that would otherwise be bought from main grids. PV generation is introduced to further increase the renewable fraction of energy contents. The electrical storage is also included to balance power demand and power supply. To increase system efficiency of energy utilization, coolant water from ICEs, plus their exhaust, could be utilized based on the thermal storage modeled, by inclusion of absorption refrigerator and heat exchanger. The final goal is to maximize energy output from distributed energy resources (DERs) and meanwhile minimize daily system operating cost. Extra electricity generated beyond the load demand could be used to charge battery storage. In this way, system energy cost is reduced with energy system improvement and reconfiguration, and surrounding environmental problems due to animal wastes are also lessened.

Voltage and power management in a microgrid system with diesel generator and energy storage

This paper presents results of the development of a voltage and power management system for a microgrid. The microgrid under study is a power system located on the island with a peak load of 1.8 MW connected to the main power grid via two submarine cables. Due to a long radial network configuration with a high ratio of resistance to reactance, the system experiences low voltages problems at remote locations. In addition, during peak load conditions, thermal ratings of the submarine cables can be violated. Integration of the local diesel generator and energy storage system is proposed to overcome existing problems. The proposed voltage and power management scheme coordinates the on-load tap-changing (OLTC) transformer, diesel generator and energy storage system of the microgrid. The scheme ensures that the voltage profile of the microgrid is maintained within Electricity Code under peak conditions. Results of the study are presented and discussed.

Microgrid wireless energy management with energy storage system

The penetration of renewable energy sources in small-scale power production gives the opportunity parts of the grid to work as microgrids. The microgrid should be able to work both in grid-connected and island mode, while its voltage and frequency deviations follow the EN 50160 standard. The use of energy storage system is generally recommended in order to absorb the mismatches between the demand and the generation side and to preserve the quality of the microgrid voltage [39]. While the up to day research is mainly concentrated on energy management based on communication, this paper proposes a wireless method for keeping the voltage and the frequency within the limits, using a battery as an energy storage system (ESS). An analytical expression for calculating the battery capacity is also proposed. The active and reactive power sharing among the parallel resources is achieved using the droop control method and an algorithm proportional to droop characteristic and the rated apparent power of each resource. According to the values of frequency and voltage and the State of Charge (SoC), the battery is connected in the microgrid, working in charging or discharging mode. A microgrid consisting of two inverter-interfaced power resources, a battery and a constant power load is investigated. Simulation results demonstrate that the proposed wireless control method provides the load with a high quality voltage in both grid-connected and islanded mode under several load scenarios.

Optimal Energy Management for a Residential Microgrid Including a Vehicle-to-Grid System

An optimization model is proposed to manage a residential microgrid including a charging spot with a vehicle-to-grid system and renewable energy sources. In order to achieve a realistic and convenient management, we take into account: (1) the household load split into three different profiles depending on the characteristics of the elements considered; (2) a realistic approach to owner behavior by introducing the novel concept of range anxiety; (3) the vehicle battery management considering the mobility profile of the owner and (4) different domestic renewable energy sources. We consider the microgrid operated in grid-connected mode. The model is executed one-day-ahead and generates a schedule for all components of the microgrid. The results obtained show daily costs in the range of 2.82 C = to 3.33 C =; the proximity of

these values to the actual energy costs for Spanish households validate the modeling. The experimental results of applying the designed managing strategies show daily costs savings of nearly 10%.

An advanced energy management of microgrid system based on genetic algorithm

Immense growth has happened in the field of microgrid (MG) and the energy management system (EMS) methods in the past decade. It is estimated that there is still a huge potential of growth remaining in the field of EMS in the coming years. The main role of EMS is to autonomously determine hour-by-hour the optimum dispatch of MG and main grid energy to satisfy load demand needs. This paper is focused on developing an advanced EMS model able to determine the optimal operating strategies regarding to energy costs minimization, pollutant emissions reduction, MG system constraints and better utilization of renewable resources of energy such as wind and photovoltaic through daily load demand. The proposed optimization model of EMS is formulated and solved based on genetic algorithm (GA). The efficient performance of the algorithm and its behavior is illustrated and analyzed in detail considering winter load demand profile.

Environmental and economical optimization of microgrid long term operational planning including PV-based active generators

Large scale penetration of Renewable Energy-Based Generators (REBG) and Distributed Energy Resources (DER) requires an evolution of the classical dispatching of conventional generators in power systems. A step towards the Smart Grid is to integrate locally REBG, conventional generators and loads in clusters called microgrids. This paper presents a microgrid energy management optimization in the presence of PV-based active generators. Based on predictions of the available energy from PV generators, energy storage availability and the power demand from the loads, the Microgrid Central Energy Management System (MCEMS) elaborates a 24 hour ahead operational planning using the approach of unit commitment by dynamic programming. The optimization objective function is the CO2 equivalent emissions (environmental criteria), the fuel consumption (economical criteria) or a tradeoff between these two. In order to reduce uncertainty in forecasted values for PV production or load demand, a medium term energy management recalculates the generators power references one hour ahead if necessary.

Real-Time Energy Storage Management for Renewable Integration in Microgrid: An Off-Line Optimization Approach

Microgrid is a key enabling solution to future smart grids by integrating distributed renewable generators and storage systems to efficiently serve the local demand. However, due to the random and intermittent characteristics of renewable energy, new challenges arise for the reliable operation of microgrids. To address this issue, we study in this paper the real-time energy management for a single microgrid system that constitutes a renewable generation system, an energy storage system, and an aggregated load[40]. We model the renewable energy offset by the load over time, termed net energy profile, to be practically predictable, but with finite errors that can be arbitrarily distributed. We aim to minimize the total energy cost (modeled as sum of time-varying strictly convex functions) of the conventional energy drawn from the main grid over a finite horizon by jointly optimizing the energy charged/discharged

to/from the storage system over time subject to practical load and storage constraints. To solve this problem in real time, we propose a new off-line optimization approach to devise the online algorithm. In this approach, we first assume that the net energy profile is perfectly predicted or known ahead of time, under which we derive the optimal off-line energy scheduling solution in closed-form. Next, inspired by the optimal off-line solution, we propose a sliding-window based online algorithm for real-time energy management under the practical setup of noisy predicted net energy profile with arbitrary errors. Finally, we conduct simulations based on the real wind generation data of the Ireland power system to evaluate the performance of our proposed algorithm, as compared with other heuristically designed algorithms, as well as the conventional dynamic programming based solution.

Practice of microgrid control system

The system is based on the characteristics of microgrid and energy storage power plant control system, combined with engineering practice, providing monitoring for the island-based independent power supply systems, science parks, research institutes, laboratories microgrid, energy storage power stations, control, protection and energy management integration solutions[41]. For system integration process, control equipment and integrated communication protocol differences difficulties brought by reference to IEC61850 specifications for device modeling and functionally related logical nodes (Logical Node, LN) carried out the necessary expansion of the unified communications follow IEC61850 specification. System uses a multi-division, multi-modal coordination and management structures and ways of using programmable logic and network operation, as well as isolated operation mode switching operation mode strategies to build the library organized package to meet the needs of different projects and projects[41]. Through various forms of microgrid internal energy and load forecasting and scientific precision scheduling, coordination and optimization of microgrid and microgrid, microgrid and large grid network to achieve energy efficient use of energy to meet a variety of user needs, improve supply reliability and other purposes.

Energy Management in the Decentralized Generation Systems Based on Renewable Energy—Ultra capacitors and Battery to Compensate the Wind/Load Power Fluctuations

This paper presents the energy management for the decentralized generation systems (DGS) using the wind turbine with photovoltaic (PV) panels and the energy storage devices. For a high penetration level of the wind/PV generation, the energy storage device with a fast response is necessary to cover the shortfall or overflow of generation due to sudden variations of the wind or the sun. In addition, the requested energy by the residential appliances presents random behaviour, which can be lower or higher than the produced energy from the renewable sources. Using the wind turbine and the PV power generation system with energy storage will reduce the fluctuations of the wind power and the load ones. The energy storage system requires capital investment; thus, it is important to estimate the reasonable storage capacities without an overflow size for the desired applications. In addition, a good strategy for energy management is necessary to reduce the variation impacts of the wind energy and the load for the battery and the residential appliances. The contribution of this paper is focused on energy management based on the frequency approach using the wind/load's fluctuating power sharing and the polynomial controllers. First, this method enables reducing for the battery and the microgrid the impacts of the micro cycles due to the wind/load's power fluctuations. Second, it

allows estimating the energy storage capacity without the overflow size. The performances of the proposed method are evaluated through some simulations and experimental tests using the summer load profile and the winter ones.

Coordination of Generation Scheduling with PEVs Charging in Industrial Microgrids

Conventional industrial microgrids (IMGs) consist of factories with distributed energy resources (DERs) and electric loads that rely on combined heat and power (CHP) systems while the developing IMGs are expected to also include renewable DERs and plug-in electric vehicles (PEVs) with different vehicle ratings and charging characteristics. This paper presents an electricity and heat generation scheduling method coordinated with PEV charging in an IMG considering photovoltaic (PV) generation systems coupled with PV storages. The proposed method is based on dynamic optimal power flow (DOPF) over a 24-hour period and includes security-constrained optimal power flow (SCOPF), IMG's factories constraints, PV storage constraints and PEVs dynamic charging constraints. It will utilize the generators waste heat to fulfill thermal requirements while considering the status of renewable DERs to decrease the overall cost of IMGs. To demonstrate the effectiveness of the proposed method, detailed simulation results are presented and analyzed for an 18-bus IMG consisting of 12 factories and 6 types of PEVs without/with PV generation systems operating in grid-connected and stand-alone modes. The main contribution is including PEVs with dynamic constraints that have changed the nature of scheduling formulation from a simple hourly OPF to a dynamic OPF.

Control Methods of Inverter-Interfaced Distributed Generators in a Microgrid System

Microgrids are a new concept for future energy distribution systems that enable renewable energy integration and improved energy management capability. Microgrids consist of multiple distributed generators (DGs) that are usually integrated via power electronic inverters. In order to enhance power quality and power distribution reliability, microgrids need to operate in both grid-connected and island modes. Consequently, microgrids can suffer performance degradation as the operating conditions vary due to abrupt mode changes and variations in bus voltages and system frequency. This paper presents controller design and optimization methods to stably coordinate multiple inverter-interfaced DGs and to robustly control individual interface inverters against voltage and frequency disturbances. Droop-control concepts are used as system-level multiple DG coordination controllers, and control theory is applied to device-level inverter controllers. Optimal control parameters are obtained by particle-swarm-optimization algorithms, and the control performance is verified via simulation studies.

Coordinated Energy Management of Networked Microgrids in Distribution Systems

This paper proposes a novel control strategy for coordinated operation of networked microgrids (MGs) in a distribution system. The distribution network operator (DNO) and each MG are considered as distinct entities with individual objectives to minimize the operation costs. It is assumed that both the dispatch able and nondispatchable distributed generators (DGs) exist in the networked MGs. In order to achieve the equilibrium among all entities and take into account the uncertainties of DG outputs, we formulate the problem as a stochastic bi-level problem with the DNO in the upper level and MGs in the lower level. Each level consists of two stages. The first stage is to determine base generation set points based on the load and

nondispatchable DG output forecasts and the second stage is to adjust the generation outputs based on the realized scenarios. A scenario reduction method is applied to enhance a tradeoff between the accuracy of the solution and the computational burden. Case studies of a distribution system with multiple MGs of different types demonstrate the effectiveness of the proposed methodology. The centralized control, deterministic formulation, and stochastic formulation are also compared.

Coordination of control and energy management methods for microgrid systems

Microgrid is a promising paradigm for the large scale integration of DER in distribution networks. This paper addresses the state of the art in the conception, operation and design of microgrids. It also discusses the impact and contributions to distribution grids of multiple microgrids, coordinated through an aggregator agent. Microgrids may operate as isolated electrical systems in case of contingency in the distribution network; a comprehensive analysis on the energy management system and stabilizing control for such operation mode, as well as for the grid connected mode, is provided. This paper reflects the vision of the Catalonia Institute for Energy Research (IREC) for near future microgrids based on the experience of its laboratory test bed.

CONCLUSION

In this project, a control system that coordinates the operation of multiple distributed generation inverters in a microgrid for grid-connected and islanded operations will be presented. The proposed controller for the distributed generation inverters is based on a newly developed model predictive control algorithm which decomposes the control problem into steady-state and transient sub problems in order to reduce the overall computation time.

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