

Introduction to Decentralized Energy Systems

Active Power: The portion of electric power that does work, such as powering equipment and appliances. It is the real power flowing in an AC system and is measured in watts (W).

Alternating Current (AC): An electric current that changes direction periodically. The voltage and current in an AC system vary sinusoidally, with the voltage and current reaching their peak values at the same time.

Ancillary Services: Services required to maintain the reliability and stability of the power grid, such as voltage control, frequency regulation, and reactive power support.

Autonomous Energy Systems: Energy systems that are capable of operating independently from the main power grid, often relying on renewable energy sources and energy storage systems.

Balance of System (BOS): The components of a renewable energy system, such as inverters, wiring, and mounting systems, that are required to connect the system to the grid and make it operational.

Capacity Factor: The ratio of the actual energy produced by a power plant over a period of time to the maximum possible energy that could have been produced during that same period, if the plant had operated at full capacity.

Decentralized Energy: The generation of electricity from distributed energy resources (DERs), such as solar panels, wind turbines, and energy storage systems, located close to the point of consumption.

Decentralized Energy Systems: Energy systems that consist of distributed energy resources (DERs) and are designed to operate independently from the main power grid.

Demand Response (DR): A change in electricity usage by customers in response to changes in the price of electricity or to incentives offered by utilities or system operators.

Distributed Energy Resources (DERs): Small-scale energy generation and storage systems, such as solar panels, wind turbines, and energy storage systems, that are connected to the power grid at the distribution level.

Distribution System: The portion of the power grid that delivers electricity from the transmission system to the end-users.

Dynamic Load Management: The process of balancing the supply and demand of electricity in real-time by adjusting the load on the power grid.

Embedded Generation: The generation of electricity within the distribution system, typically from renewable energy sources.

Energy Management System (EMS): A system that monitors, controls, and optimizes the operation of a decentralized energy system.

Energy Storage: The capture of energy produced at one time for use at a later time. Energy storage systems can provide a number of services to the power grid, including frequency regulation, voltage control, and reactive power support.

Frequency Regulation: The process of maintaining the frequency of the power grid within a narrow range, typically 60 Hz in the United States and 50 Hz in Europe.

Grid-Connected Systems: Energy systems that are connected to the main power grid, allowing them to sell excess electricity back to the grid.

Grid Services: Services provided by energy systems to support the operation and stability of the power grid.

Hybrid Energy Systems: Energy systems that combine multiple energy sources, such as solar, wind, and energy storage, to provide a reliable and stable supply of electricity.

Inverter: A device that converts direct current (DC) from renewable energy sources into alternating current (AC) for use on the power grid.

Islanding: The operation of a distributed energy system in isolation from the main power grid.

Microgrid: A decentralized energy system that is capable of operating in both grid-connected and islanded modes.

Net Metering: A billing arrangement that allows customers with distributed energy systems to sell excess electricity back to the grid and receive credit for the electricity they consume.

Passive Power: The portion of electric power that does not do work, such as the power required to maintain the magnetic fields in transformers and the power required to charge energy storage systems.

Peak Demand: The maximum demand for electricity during a given period of time.

Photovoltaic (PV) System: A system that converts sunlight into electricity using solar panels.

Power Conditioning: The process of converting and regulating the electrical power produced by renewable energy sources to match the requirements of the power grid.

Power Electronics: Electronic devices that are used to control and convert electrical power.

Power Factor: The ratio of the real power flowing in an AC system to the apparent power.

Real Power: The portion of electric power that does work, such as powering equipment and appliances. It is the active power flowing in an AC system and is measured in watts (W).

Reactive Power: The portion of electric power that does not do work, such as the power required to

maintain the magnetic fields in transformers and the power required to charge energy storage systems. It is measured in volt-amperes reactive (VAR).

****Renewable Energy:**** Energy obtained from resources that are naturally replenished, such as solar, wind, and hydro power.

****Renewable Energy Certificate (REC):**** A tradable certificate that represents the environmental attributes of one megawatt-hour (MWh) of renewable energy.

****Renewable Portfolio Standard (RPS):**** A policy that requires utilities to generate a certain percentage of their electricity from renewable energy sources.

****Reserve Margin:**** The amount of generating capacity that is available above the expected peak demand for electricity.

****Scheduling:**** The process of planning the operation of a power system to meet the expected demand for electricity.

****Self-Consumption:**** The use of electricity produced by a renewable energy system for the needs of the system owner or operator.

****Smart Grid:**** An electric power system that uses advanced technologies to optimize the operation and efficiency of the power grid.

****Spinning Reserve:**** Generating capacity that is available to respond to sudden changes in the demand for electricity.

****Stand-Alone Systems:**** Energy systems that are not connected to the main power grid and are designed to operate independently.

****Synchronous Generator:**** A generator that produces electricity with a fixed frequency and phase relationship to the power grid.

****Synchronization:**** The process of matching the frequency and phase of a generator to the power grid.

****Transactive Energy:**** A system of buying and selling electricity that is based on real-time market prices and the availability of generation and storage resources.

****Transmission System:**** The portion of the power grid that transmits electricity from the generating plants to the distribution system.

****Transformer:**** A device that is used to change the voltage of electricity.

****Virtual Power Plant (VPP):**** A group of distributed energy resources that are managed and operated as a single entity, allowing them to participate in wholesale electricity markets.

****Volta-Ampere (VA):**** A unit of apparent power, equal to the product of voltage and current.

****Volt-Ampere Reactive (VAR):**** A unit of reactive power, equal to the product of voltage and reactive current.

****Voltage Control:**** The process of maintaining the voltage of the power grid within a narrow range.

****Voltage Regulation:**** The process of adjusting the voltage of electricity to maintain a constant voltage level.

****Watt (W):**** A unit of real power, equal to the product of voltage and current.

****Wholesale Electricity Market:**** A market where electricity is bought and sold in bulk quantities, typically by utilities and large energy users.

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