ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS

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HYBRID RENEWABLE ENERGY SYSTEMS

- Hybrid Renewable Energy Systems (HRES) Are Becoming Popular As Stand-alone Power Systems For Providing Electricity In Remote Areas Due To Advances In Renewable Energy Technologies And Subsequent Rise In Prices Of Petroleum Products.
- A Hybrid Energy System, Or Hybrid Power, Usually Consists Of Two Or More Renewable Energy Sources Used Together To Provide Increased System Efficiency As Well As Greater Balance In Energy Supply. Most Of Us Already Know How A Solar/Wind Power Generating System Works, All These Generating Systems Have Some Or The Other Drawbacks (Considering Standalone System), Like Solar Panels Are Too Costly And The Production Cost Of Power
- By Using Them Is Generally Higher Than The Conventional Process, It Is Not Available In The Night Or Cloudy Days. Similarly Wind Turbines Can’t Operate In High Or Low Wind Speeds. Solar Hybrid Power Systems Are Hybrid Power Systems That Combine Solar Power From A Photovoltaic System With Another Power Generating Energy Source. This Would Create More Output From The Wind Turbine During The Winter, Whereas During The Summer, The Solar Panels Would Produce Their Peak Output.
- Hybrid Energy Systems Often Yield Greater Economic And Environmental Returns Than Wind, Solar, Geothermal Or Trigeneration Stand-alone Systems By Themselves

HYBRID SOLAR WIND PLANT

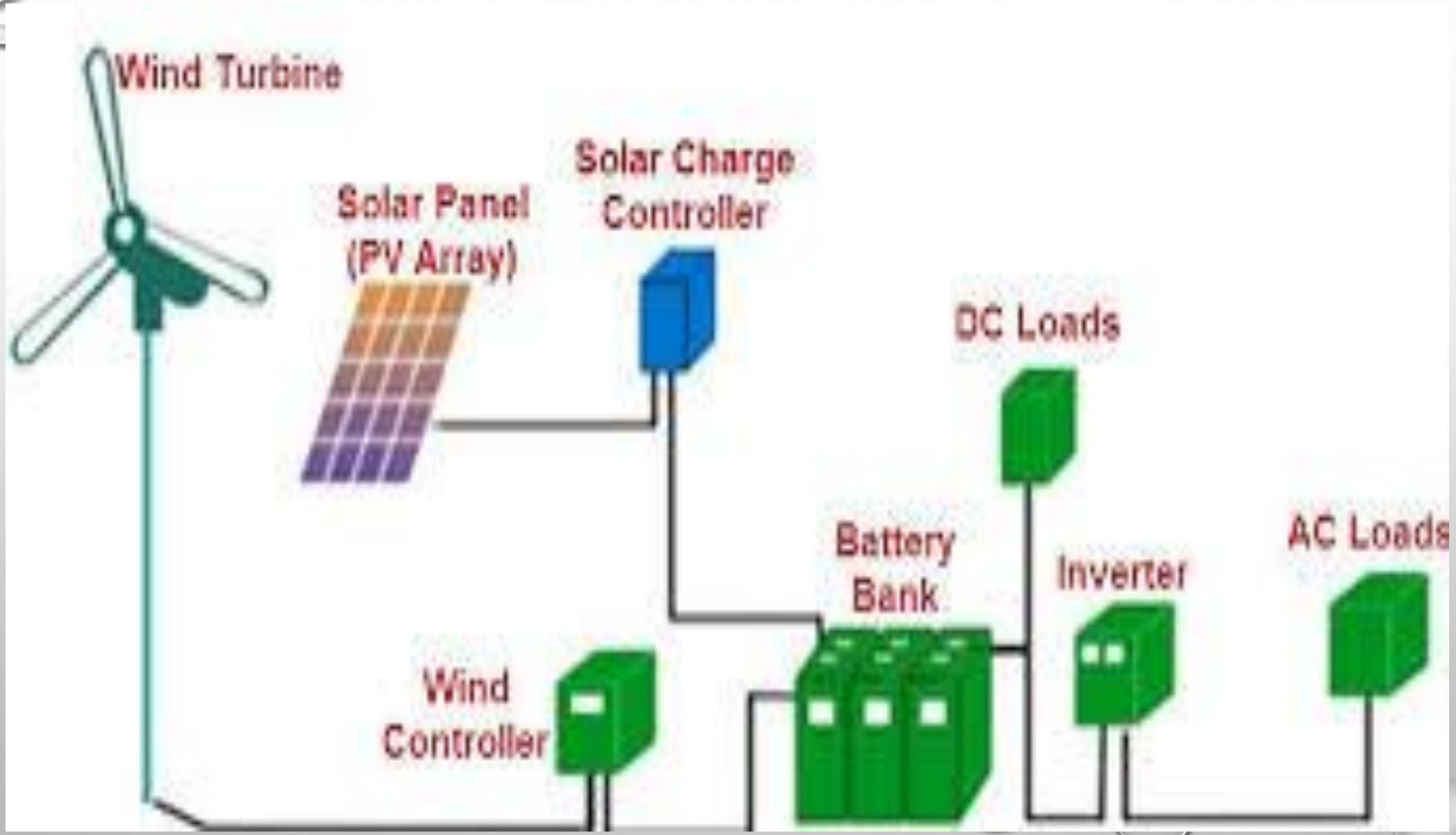
- Solar Panel: Solar Panel / PV Panel Are Used To Convert The Renewable Power Coming From The Sun Into Electrical Energy. The Principle Of Working Solar Panel Is With Semiconductors. Since, The Whole Eco-system On Planet Earth Is Dependent On Sun Energy And It's A Huge Source Of Never Ending Energy. Due To Ace Of Availability, Easily Interpretation, Amount Of Source And Popularity It Is Preferred For Project. Solar Panels Are Photovoltaic Which, Generates Electrical Energy Using Sun Light Radiations. Depending On The Position And Intensity Of The Sun Radiation The Amount Of Electrical DC Energy Will Produced
- Wind Turbine: The Wind Is Available 24 Hours In Earth's Eco System. Wind Turbine Having Large Blades Which Are Joined To Rotor Of Generator Leading To Produce Electrical Energy As Moves By Flow Of Wind. Wind Power Is Also Renewable, Never Energy Source And Easily Available Within Atmosphere. Wind Turbine Power Plants Are Much More Popular Providing Much More Efficiency Considering The Space Of Implementation. Wind Turbine Is Mechanical System/Machine Which Generates Electrical Energy From Renewable Wind Energy Source. Depending On The Speed Of The Wind The Amount Of Electrical AC Energy Will Produced.

CONTD…

- Batteries: The Electrical Energy Produced By The System Is Need To Be Either Utilized Completely Or Stored. Complete Utilization Of All The Energy Produced By The System For All The Time Is Not Possible. So, It Should Be Store Rather Than Useless Wasting It. Electrical Batteries Is The Most Relevant, Low Cost, Maximum Efficient Storage Of Electrical Energy In The Form Of Chemical Reaction. Hence, Batteries Are Preferred.
- Inverter: Inverter Is A Electronic System, Converters Direct Current Into Alternating Current, I.E. DC Into AC. The Stored Electrical Energy In The Batteries Is DC In Nature. And It Cannot Utilized For Various Kinds Of Load. So, For Delivering AC Supply To The Load Inverter System Is Required. Inverter Is Either Analog Or Digital Kind. Digital Inverter Is Microcontroller Based Which Increase The Buildup Cost Of The System Also, Is Uses MOSFET Technology Providing More Efficiency.

CONTD…

- Maximum Charged Battery Selection: Maximum Charged Battery Selection, A Specially Designed Circuit Used To Detect The Maximum Amount Of Stored Electrical Energy In Each Batteries. It Is Attached Within The Inverter Circuit. So, The Inverter Box/Block Will Enclosed This. The Circuit Is Made Up Of Transistor Family Device Like Bjt’s, Mosfet’s Along With Diodes, Resistors And Capacitors.


Wind Turbine
Solar Panel
(PV Array)
Solar Charge
Controller
DC Loads
Battery
Bank
Inverter
AC Loads
Wind
Controller

SOLAR PV BEHAVIOUR DURING GRID DISTURBANCE

- HIGH INSTALLATION COST
- LOW GENERATION CAPACITY
- UNCERTAINTY OF SOLAR RADIANCE
- POWER FLUCTUATION DUE TO INTERMITTENCY BEHAVIOR OF SUNLIGHT
- SOLAR PENETRATION ALSO CHANGES THE VOLTAGE FLUCTUATION AND FREQUENCY RESPONSE.

WIND FARM BEHAVIOUR DURING GRID DISTURBANCES

- HIGH PENETRATION OF WIND ENERGY CREATES STABILITY PROBLEMS AND POSSIBLE BLACKOUTS
- FREQUENCY BEHAVIOR ALSO CHANGES WITH WIND PENETRATION.
- REDUCES OVERALL EFFICIENCY AND POWER QUALITY

POWER QUALITY ISSUES

- Voltage Regulation The Droop Characteristics Are Used, Particularly For Dfigs To Control The Voltage Magnitude And Frequency. This Can Be Extended To WECS By Doing A Voltage Sensitivity Analysis To Achieve Voltage Regulation. To Improve Voltage Quality. For Wind Generators Is Landed Micro Grid. Here, The Complex Power Droop The Unbalances Control Systems Use A Virtual Impedance Loop To Compensate.

Voltage Sags/ Swells

- Voltage Sags/ Swells The Operation Of Sensitive Loads Connected To The Grid Is Influenced By The Voltage Dips.
- To Overcome This Disadvantage A Series Compensator Is Used Which Requires Considerably Less Active Power And Is Able To Restore The Voltage At The Load Side.
- Grid-interfacing Power Quality Compensator For Three-phase Four-wire Micro-grid Applications Was Developed Using The Sequence Components To Inject Voltages As A Complementary Measure Under The Net-metering Scenario A Power Quality Control Center (PQCC) Would Regulate Voltage Due To The Reversal Of Power Flows From The DG And The Increase In Short Circuit Current.

HARMONICS

- Harmonics The Grid Interaction And Grid Impact Of Wind Turbines Have Been Focused On During The Past Few Years. The Reason Behind This Interest Is That Wind Turbines Are Among The Utilities Considered To Be Potential Sources Of Bad Power Quality.
- Especially, Variable-speed Wind Turbines Have Some Advantages Concerning Flicker. But, A New Problem Arose With Variable-speed Wind Turbines. Modern Forced-commutated Inverters Used In Variable-speed Wind Turbines Produce Not Only Harmonics But Also Interharmonics.

- Real And Reactive Power The Seasonal Patterns And The Diurnal Variations Of Wind Are To Be Addressed For Grid Connected Wind Turbine (GCWT) Systems To Achieve High-quality Power From Inverters Meeting The Specifications Of Grid Codes

POWER SYSTEM STABILITY

- The Power System Stability Can Be Classified Into:
- Rotor (Or Power) Angle Stability;
- (Ii) Frequency Stability
- (Iii) Voltage Stability.
- Hence, Different Viewpoints Are Introduced Concerning The Stability Issues Raising Different Types Of Stability Problems Including "Rotor Angle Stability", "Frequency Stability" And "Voltage Stability".
- Rotor Angle Stability Is Concerned With The System Ability To Maintain The Equilibrium Between Electromagnetic Torque And Mechanical Torque Of Each Generator In The System.
- Instability That May Result Occurs In The Form Of Increasing Angular Swings Of Some Generators Leading To Their Loss Of Synchronism With Other Generators
- Voltage Stability Is Concerned With The Ability Of A Power System To Maintain Its Steady Voltage At All Buses In The System Under Normal Operating Conditions, And After Subjecting To A Disturbance

APPLICATION OF FACTS DEVICES

- Application Of FACTS Devices: The Application Of FACTS Device (STATCOM) For Power Quality Improvement In Grid Connected Wind Generating System And With Nonlinear Load
- The System Has The Capability To Cancel Out The Harmonic Parts Of The Load Current And Maintains The Source Voltage And Current In-phase And Support The Reactive Power Demand. The Need For Network Management Under Dynamic State And To Provide A Cost Effective Solution For Mitigating The PQ Problems Can Be Addressed Using FACTS Devices

TECHNICAL ISSUES

- 1. Gird Integration Issues For Small Scale Generation:
- Cost, Reliability & Efficiency Of Grid Interface
- Grid Congestion, Weak Grids • Variability Of Renewable Production
- Low Power Quality
- Protection Issues O Change Of Short Circuit Levels O Reverse Power Flow O Lack Of Sustained Fault Current O Islanding
- Bidirectional Power Flow In Distribution Network,
- Localized Voltage Stability Problems
- 2. Issues Related To Grid Integration Of Large Scale Generation: Recent Rapid Growth Of Wind Energy Generation Has Resulted In The Development Of Large Wind Farms With Capacities In Excess Of 100 MW. Such Large Scale Wind Farms Are Generally Interconnected To The Grid

- The Requirement Of Reactive Power For Voltage Support Is One The Key Issues Related To Wind Power Generation.
- Turbine Power Electronic Design And Controller Optimization.
- Problems Of Wind Farms Connected Into Series Compensated Systems.
- Power Quality Issues Including Voltage Flicker.
- Starting And Synchronizing Of Wind Farms To The Grid.
- Sub Synchronous Resonance Issues Due To Interaction Of The Electric Network

B. NON-TECHNICAL ISSUES

1. LACK OF TECHNICAL SKILLED MAN POWER

2. LESS AVAILABILITY OF TRANSMISSION LINE TO ACCOMMODATE RES.

3. RES TECHNOLOGIES ARE EXCLUDED FROM THE COMPETITION BY GIVING THEM PRIORITY TO DISPATCH WHICH DISCOURAGE THE INSTALLATION OF NEW POWER PLANT FOR RESERVE PURPOSE.