Renewable Energy Mix

Solar and Wind energy systems are prominent component of Renewable Energy. Energy from solar systems is obtained via two major methods viz. solar photovoltaic system and solar thermal system. In solar photovoltaic system, the solar energy is directly converted into electricity using solar PV cells/arrays. This system can be deployed in small scale as roof mounted systems to feed homes, buildings etc. and also in the form of large scale land mounted setup which can generate hundreds of MW of power at a utility level. The solar thermal system also known as concentrated solar plants (CSP) convert the heat from the sun to a suitable working medium which in turn drives electric turbines to generate power. These are generally large land based setups. Wind Energy Conversion Systems (WECS) are installed to generate power. For small scale, domestic generation micro wind turbines are used while large systems are employed for utility scale commercial generation and are primarily in grid connected mode, however installations with Integrated Energy Storage (IES) systems are also reported at many locations across globe. These systems are installed at both on shore and off shore locations based on availability of wind.

The renewable energy systems as described above can be operated in two basic modes, viz. off-Grid Mode and Grid Connected Mode. In the off-Grid mode, the power generated is stored in suitable storage mechanisms like battery and then used for supply through them as and when required deploying automated switching devices. The battery storage capacity should be sufficient to absorb the entire power being generated. This scheme ensures that the intermittency of the power generation is kept at bay form effecting the connected loads, but the cost economics hinder its large-scale applications. In grid connected mode, however the system is linked up with the utility grid and the local loads directly.

The power being generated is directly consumed by the loads through inverter mechanism in case of AC loads. Whenever the generated power exceeds the local connected load requirements the excess power is exported into the utility grid. This scheme facilitates revenue generation for the involved stakeholders thereby turning them into “Prosumers” (Producer + Consumer).

OPERATIONAL CONSTARINTS

As already stated, renewable energy sources are the need of hour from both economic as well as environmental point of view. When seen from an isolated frame of reference, these power sources seem to be an efficient and friendly systems. But when the entire power system dynamics is taken into consideration the overall picture is very complex with still many areas to be explored and developed to ensure a safe grid integration of such sources. The variability and intermittency of renewable energy sources is matter of great concern for today’s grid operators. Such persistent variations and perturbations constantly threat the overall security of the entire grid. Keeping the generation load balance is one of the prime factor of a safe grid operation. One method of taking care of such variability is by connecting energy storage systems. Whenever there is reduction in power generation the storage system can be brought into picture to supplement the deficiency and thereby maintaining the system profile.

Another alternative is to link the system with other RE sources such as pumped hydro storage systems or Biomass systems. These systems can be kicked in as and when required to assist in maintaining stable operating conditions. Since the time response of energy storage and pumped hydro systems is very fast, they can effectively help in achieving the intended task. Nevertheless, these counter measures are cost intensive and require very accurate and fast controllers to function. A condition may also arise when the power generated by the RE sources may exceed the local load requirements. Under such cases, a reverse power flow will occur to feed the power into the grid. The conventional distribution transformers are not suitable and not recommended to be used under reverse power flow conditions as it may damage the equipment.

Both solar PV systems and wind turbine systems only deliver real power to the system. The

requirement and supply of reactive power is a matter of debate and discussion in the technological community. As on date it is planned to be supplemented locally at the point of generation which involves implementation of local controllers at each point of connectivity with the grid. This scheme exposes the grid to multiple points of interactions. Also, if the requirement of reactive power is not met locally, the system may start drawing it from the grid. This excess demand of reactive power may cause numerous disturbances and losses in the system such as overheating of line conductors and transformer core. It may also result in reduction in ATC of the entire system which may in turn block the evacuation of the generated solar power. If such a situation arises the connected solar PV panels or the wind turbine system may get adversely effected. The concentrated effort on all issues is supposed to be taken up in collaborative mode.