



Reactive Control of the Electricity Transmission System in Scotland

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Two properties of the British electricity supply system are regulated by statute - frequency and voltage.

Electrical power generator output into the Grid can be resolved into two components, real power (measured in megawatts (MW)) and reactive power (measured in megavoltamperes reactive (MVAR)). MW and MVAR are controlled independently. The real power output (MW) of synchronous AC generators is determined by the mechanical power of the prime mover driving the generator. The reactive power output (MVAR) is determined by the setting of the machine's DC exciter, a DC generator on the the same shaft as the main generator.

The frequency of the whole system is determined by the balance between the instantaneous sum of the MW outputs of all the generators on the system and the simultaneous MW demand of all the loads plus losses.

The voltage of each point on the transmission system is determined by the reactive power (MVAR) supplied or absorbed at that point. Most reactive power is derived from synchronous generators whose automatic voltage regulators deliver the correct reactive power for prevailing conditions. Capacitors (including capacitance inherent in overhead lines and cables) also supply reactive power. Reactors, induction motors and induction generators absorb reactive power.

Historically, there was no reason to provide auxiliary sources of reactive power to keep voltage within required limits. All the MVARS needed could be supplied by generators. By the 1960s, however, significant lengths of 275kV cable were being installed on the system. When load was light, capacitance of circuits, in particular the new cable circuits, dominated the load and raised the voltage too high. Strategically placed switchable shunt reactors were provided that could absorb excess MVARS generated by capacitive components of the system.

Nowadays in Scotland we have a different situation. There are many induction generators that put an inductive load on the system, lowering the volts. There are fewer synchronous generators capable of providing the required MVAR. The plant out on the system capable of controlling voltage is practically all inductive, and cannot be used to deal with a low voltage condition. With the retirement of Longannet, and later Hunterston B, Torness and Peterhead the main source of MVARS will be greatly diminished,

Static VAR compensators, and similar devices, can be installed to provide the necessary MVARS. They can be set to provide a range of reactive power from inductive through to capacitive. The devices are expensive, and would likely have to be paid for by the transmission system owner.

In summary, grid control engineers require resources to play their part in keeping voltage within statutory limits. If present sources (as provided mainly by synchronous generators at Longannet, Hunterston B, Torness and Peterhead), are lost considerable expenditure by transmission system owners will be required to provide alternative sources of MVARS.