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Paper ID XX: Evaluation of Photovoltaic Systems for Reactive Power Compensation in Low Voltage Power Systems

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Abstract

The four-quadrant operation ability of photovoltaic (PV) inverters makes them promising candidates for reactive power compensation in low voltage systems. In this paper, utilization of PV inverters instead of conventional reactive power compensation units is evaluated. The use of PV inverters for reactive power compensation as well as active power supplying is investigated considering a real life system.

Problem Definition

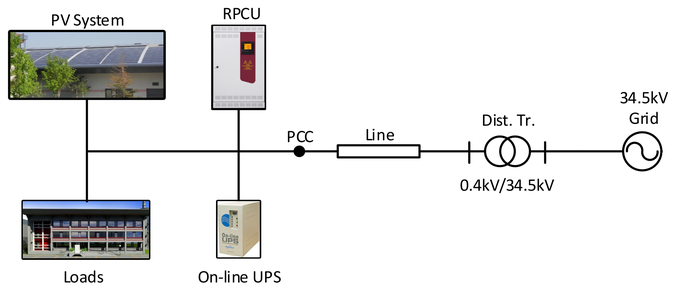

Figure 1. Ayaslı Research Center single line diagram

The real-life system suffers from capacitive reactive power problem. Reactive power compensation units (capacitor banks) did not work for 5 years due to system operation is capacitive.

Methodology

PV inverters can be used for reactive power compensation. In this way, capacitive reactive power can also be compensated.

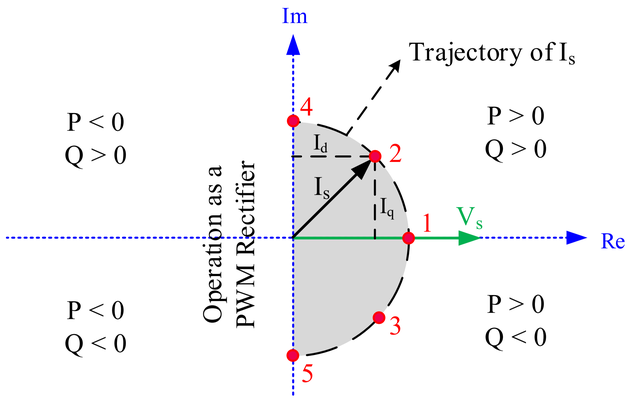

Figure 2. Phasor diagram of a PV inverter

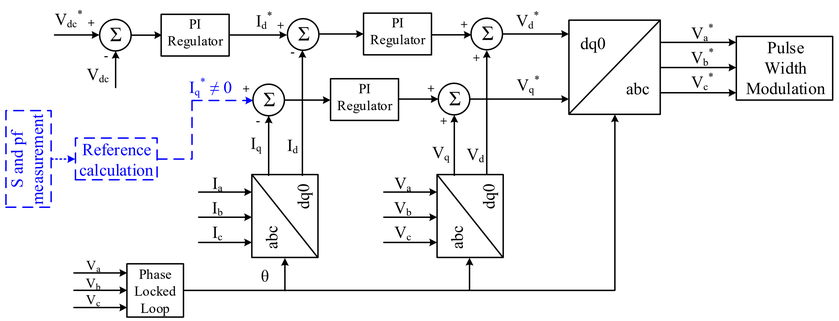

Figure 3. The conventional control block diagram of a PV inverter and modification for RPC

Results and discussion

Cases for PV Inverter	P_{out}	Q_{out}	Inverter Size	Q (MVArh)	CostQ ($)	E (MWh)	CostP ($)
Case - 1	50 kW	0	Same	156	4848	1.500	97
Case - 2	40 kW	30 kVAr	Same	0	0	3.154	205
Case - 3	50 kW	50 kVAr	Increased	0	0	2.751	179

Table 1. Cases considered for loss calculation and long term cost evaluation

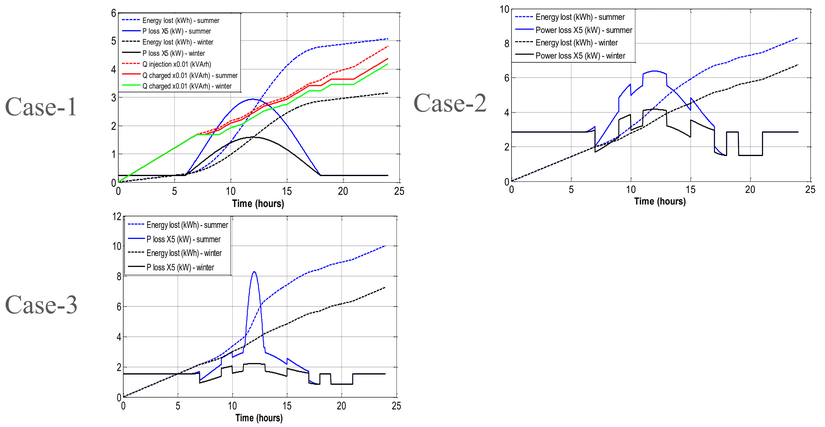

Figure 4. Daily power losses and reactive power charges for cases

Conclusion

Utilization of the same PV inverter (Case-2) gives the best result for the reactive power compensation. Increasing PV inverter size (Case-3) causes higher installation costs.