

Question 2.6 Regarding voltage issues resulting from RES/DER integration, are there any actual cases where the reactive power control of an inverter is applied? Are there any evaluation or consideration dealing with prioritization, or the combination of various types of voltage control methods? When trying to utilize the resources on the customer side, how should fairness between the resource owners be taken into account?

Most of the RE plants in the Southern part of India were operating the inverters at unity power factor using power factor control mode during generation hours. This operation was carried out at the inverters or through the power plant controllers or SCADA based on the facility available with the RE developer. This was the scenario till 2021. Subsequently, RE generators are operating on voltage control mode during generation hours. However, the reactive power support is observed to be limited to the value corresponding to 0.95 lag to 0.95 lead power factor. This is due to the fact that regulation mandates the reactive power capability corresponding to 0.95 lag to 0.95 lead power factor and RE generators are hesitant to support further as there could be a loss of active energy. The reactive power capability is much more which is being pursued for utilization by the system operator.

Most of the inverters are equipped with the capability to absorb/inject reactive power using a feature known as Night mode/ Static Var Generator(SVG) mode. The inverters have the reactive capability varying from 33% to 95% of active power capacity for absorption during night hours i.e., during non-generation hours. Case studies conducted in Northern Region (NR) and Southern Region (SR) of India have indicated that sufficient reactive capabilities are available in inverters to address high voltages. The night mode/SVG mode in solar plant wherever available is enabled during non-generation hours subsequent to August 2021 viz post trial operation. However, the extent of reactive power absorption is only to nullify the reactive power injection caused due to cables & other equipment within the plant. Currently the generators are not willing to extend the reactive support for the grid as there is no commercial/ regulatory mechanism.

As mentioned above, the voltage control method with a reactive support limit corresponding to 0.95 lag to 0.95 lead power is operational during generation hours. Reactive power support to the extent of nullification of reactive power injection is operational during non-generation hours at solar plants.

The customers/ RE generators have to be mandated for a certain amount of reactive support within a specified range of voltage without compensation. Any support over and above the mandated support needs to be compensated. Similarly, the mechanism shall also have the provision for compensation by the RE generator in case if reactive power support is taken from the grid by the RE generator. Other options could be introduction of voltage control ancillary services.

The commercial mechanism has to address the following for enabling utilisation of night mode/SVG facility.

- a. Incremental real power consumed during the night mode/SVG operation of plant for reactive support.
- b. Increased annual maintenance in the form of additional manpower, spares, increased frequency of maintenance etc.