GoodWe Solution for Power Grid Stability and Dynamic Control

(SA-E-20220803-001)

For a long while, grids have transmitted power, usually from non-renewable energy sources such as coal, oil, and natural gas. The production of this power is according to a scheduled and centralized system, so most of the time you would expect that it would achieve grid stability easily. However, the fluctuation in power production of solar energy pose a threat to the stability of the grids. It requires a lot more to attain stability in case of interruptions. Solar power has major problems in maintaining the reliability and economic viability of the whole system.

In the past ten years, blackouts have occurred frequently in the world, which have a great impact on the social and economic development of the accident areas. Some of them are caused by imbalanced supply and demand triggered by severe weather. For example, on the afternoon of 28 September 2016, South Australia (SA) experienced a state-wide blackout. Although, most supplies are restored in eight hours, the wholesale market in SA was suspended for 13 days.

The Importance of Power Grid Stability

For renewable energy sources, there are many factors affecting the stability of power grid. The three major challenges faced by conventional grids when it comes to the adoption of renewable energy sources are:

- **Frequency and Voltage Anomalies**

Frequency and voltage are the two most important indexes in power grid. Voltage and frequency are used to measures if the reactive power and active power can meet the load requirements respectively. However, due to the nature of solar energy production that highly dependant on the time of the day and the weather conditions continuously affect the production of power.These conditions seriously affect the operation of the grids, bringing them close to their limits.

- **Overloading of Existing Transmission Lines**

Due to increased loads during peak hours, the existing transmission lines face a challenge of capacities matching the inflow and outflow of power.A transmission line has its specified capacity, and if this limit gets passed, thermal loads will build up, leading to damage. For example, power Surge, a surge can occur when producers generate too much power without warning, and the entire system would shut down.

- **Demand and Supply Mismatch**

As much as many homes, offices, and buildings need the power to run their operations, it cannot be at a time. The production of renewable energy can be very high at some points in time. But, also, it can be low under other conditions. Therefore, the power generated when it is needed may not be sufficient or may not match the demand.

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Power Control Requirements

- **Safety Code and Standards Requirement to Stabilize the Grid**

To reduce and control the grid stability problems mentioned above, safety code and grid standard of different counties and regions are set. For example, the over and under voltage protection values, over and under frequency protection values etc. These protection parameters ensure the inverter can comply with the power grid environment. To be more specific, the inverter must have the ability to keep normal operation when grid voltage and frequency fluctuates.

- **Static & Dynamic Export Power Limit**

Power controls are widely used in solar systems to prevent the risk of overloading. There are two main types of export limit control methods. The static export limit is very common in existing solar systems. The static export limit, also called anti-reverse current, is very common and easy to achieve. It is achieve through limiting the system size or putting a fixed limit on solar export level. In most residential solar systems, CT and smart meters can implement static export power limit. We only need to set the percentage or a fixed output power of the inverter.

Besides, dynamic export limit is an advanced power control method. Most of the time the system will keep a fix export power to the gird, but when needed, the solar system will be curtailed followed by command from the grid company. Dynamic power control presents to use the interoperability capabilities of modern technology to harness the full value of these devices to benefit consumers, electricity networks and the broader power system.

Australia is one of the earliest countries to apply dynamic power control due to an ever-increasing uptake of distributed energy resources – leading the world in rates of household solar and an emerging uptake of newer resources like energy storage and electric vehicles. AS4777.2:2015 has brought the requirement of Demand Response Mode (DRM) which enables the inverter to respond to signals sent to it remotely. In the most basic form, it requires these appliances to have 'demand response modes' that assist in shifting load to times when demand is low or high. For example, during the middle of the day when the sun is shining and demand for electricity is low. Excess solar power will cause power surge and even power blackout.
DRED stands for demand respond enabling device, which enables remote control of inverter export. Different modes of DRED is as following:

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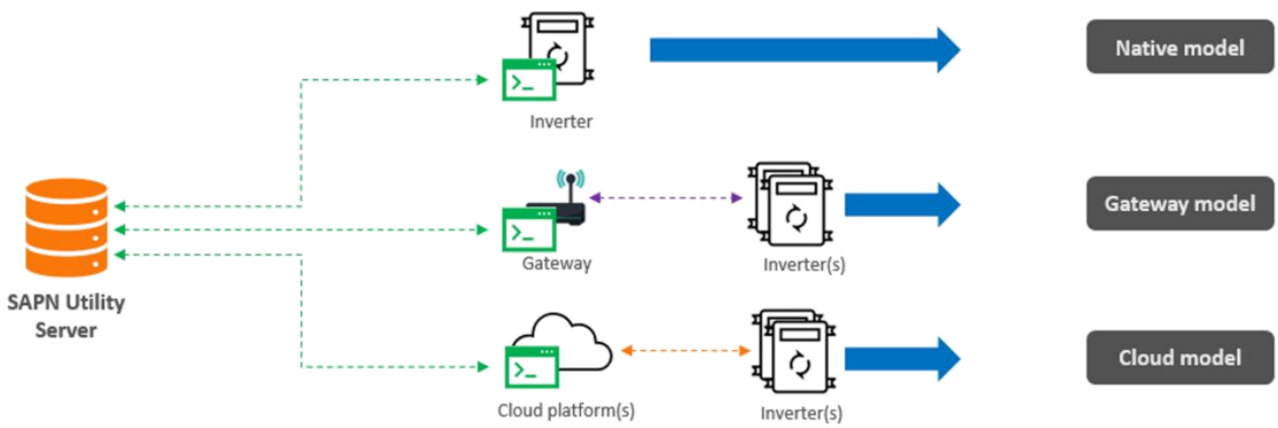
Mode	Requirement
DRM 0	Operate the disconnection device
DRM 1/5	Do not consume power/Do not generate power
DRM 2/6	Do not consume at more than 50% of rated power/Do not generate at more than 50% of rated power
DRM 3/7	Do not consume at more than 75% of rated power and source reactive power if capable/Do not generate at more than 75% of rated power and sink reactive power if capable.
DRM 4/8	Increase power consumption (subject to constraints from other active DRMs)/Increase power generation (subject to constraints from other active DRMs)

DRED also brings financial benefits for users because it can minimize the output during negative electricity price intervals.

New dynamic export requirements will come into effect from December 2022 in South Australia. There are three ways that can achieve the flexible export goals.



GoodWe Solution for Flexible Export

The Static export limit is very common in the solar industry. However, dynamic export control has just begun to be implemented in some countries.
According to the three ways of flexible export, GoodWe has provided it’s own solution to be compatible with it.

Native Mode

Native mode means the inverter means the inverter can communicate directly with utility server through IEEE2030.5 GoodWe has a new communication module called Ezlink that is compatible with IEEE2030.5 in North America. It will also be applied in SA in the near future.

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● Gateway Mode

Gateway mode means the inverter is connected to a third party devices that is acredited with IEEE2030.5 to communicate with the utility server.
The compatible DRED in AU are show as following:

SwitchDin-Droplet

Mondo-Ubi

WattWatchers-Auditor6

GoodWe is integrated with SwitchDin in Australia to be compatible with the flexible export requirement in South Australia.

● Cloud Mode

Cloud mode is achieved through cloud platforms for those inverters with Internet connections. The cloud platform like Greensync in Australia is already compatible with IEEE2030.5 and can work with inverter cloud platform through API to monitor and control the inverter output.

To sum up, the inverter manufactures are constantly adjust and upgrade according to the changes and demand of power grid environment. With an increasing number of distributed energy resources, stricter power grid code is inevitable to stabilize the gird to prevent power surge. We believe flexible export control will be required in more regions.

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