Procedure of setting Reactive Power Compensation at Night with SmartLogger3000

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Version	Created by	Date	Remarks
01	m00598297	26.03.2021	Reactive Power

1. Reason of Reactive Power Consumption at Night

All inverters have an output EMI filter that prevents high frequency EMI interference inside the inverter from feeding into the grid.

During nighttime, inverter does not work, output relay is disconnected, but the capacitors of EMI filter are permanently connected to grid, which causing capacitive reactive power consumption.

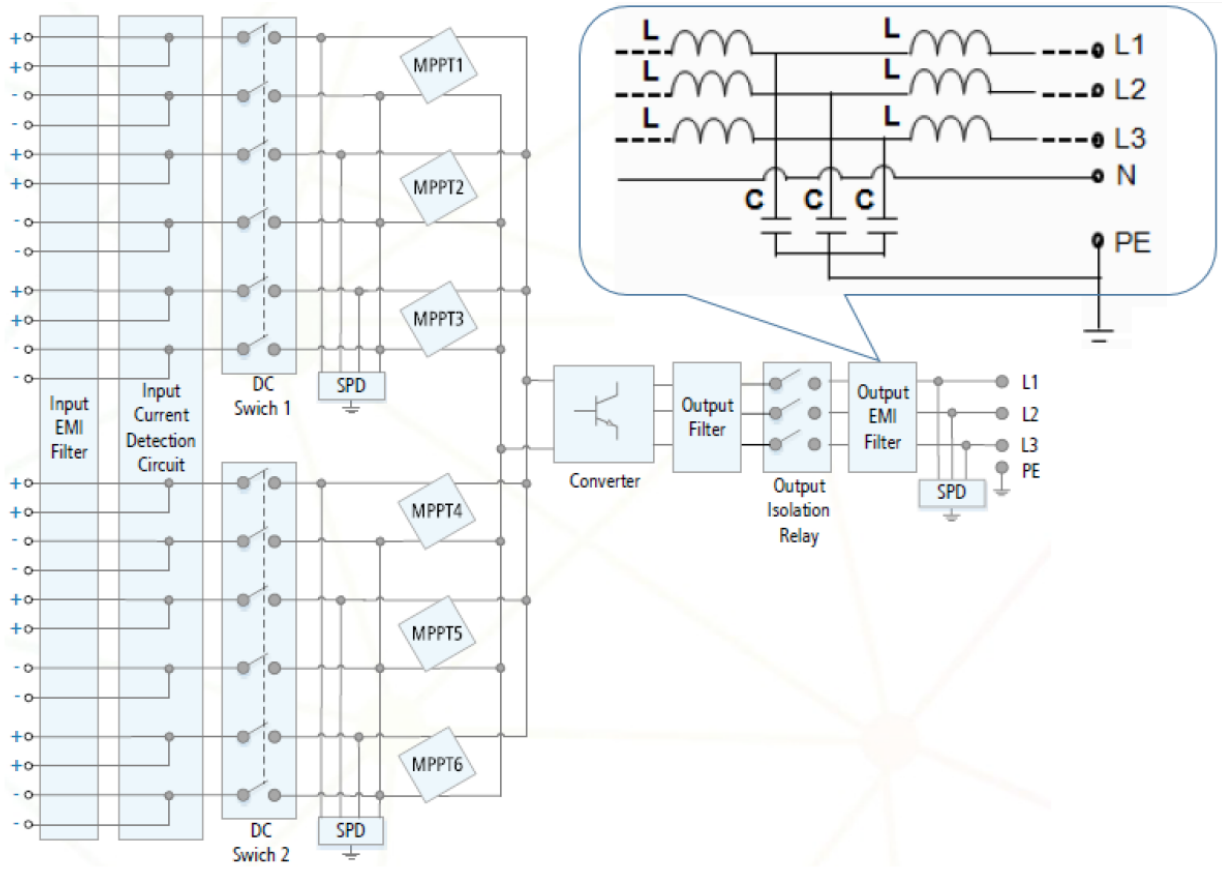


Fig. 1 Circuit Diagram of SUN2000 inverters

The formula to calculate reactive power is as below:

$$S = 3UI = 3\frac{U^2}{X_c}$$

$$X_c = \frac{1}{2\pi f c}$$

Where U is the grid voltage, U=462V for medium voltage grid connection (800V), U=230V for low voltage grid connection (400V).

According to above formula, for SUN2000 series inverters, the reactive power consumed by each inverter during nighttime is as below.

Model	Capacity(μF)	q-ty of capacitors per phase (pcs)	Output Voltage (V)	Reactive Power (var)
SUN2000-36KTL	1.93	3	400	291
SUN2000-50/60KTL	1.8	3	400	271
SUN2000-105KTL	2.2	1	800	442
SUN2000-185KTL	0.12	1	800	24
SUN2000-215KTL	XXX	XXX	800	XXX

2. Inverter capabilities to generate reactive power

Inverter as current source working on grid voltage can supply current with any phase shift, and generate active, reactive or both types of power parallel. Additionally inverter can be power from either DC or AC side, which means it can generate reactive power also during the night.

Direct working range is described in document called Output Characteristic Curve, with characteristic curve called PQ. It describes inverter ability to generate active/reactive power vs. grid voltage, and in cross-section with horizontal axis describes ability to generate only reactive power. For 105KTL range is from 69.6 KVar inductive to 69.9KVar capacitive reactive power to be supplied to grid by one inverter during day and night.

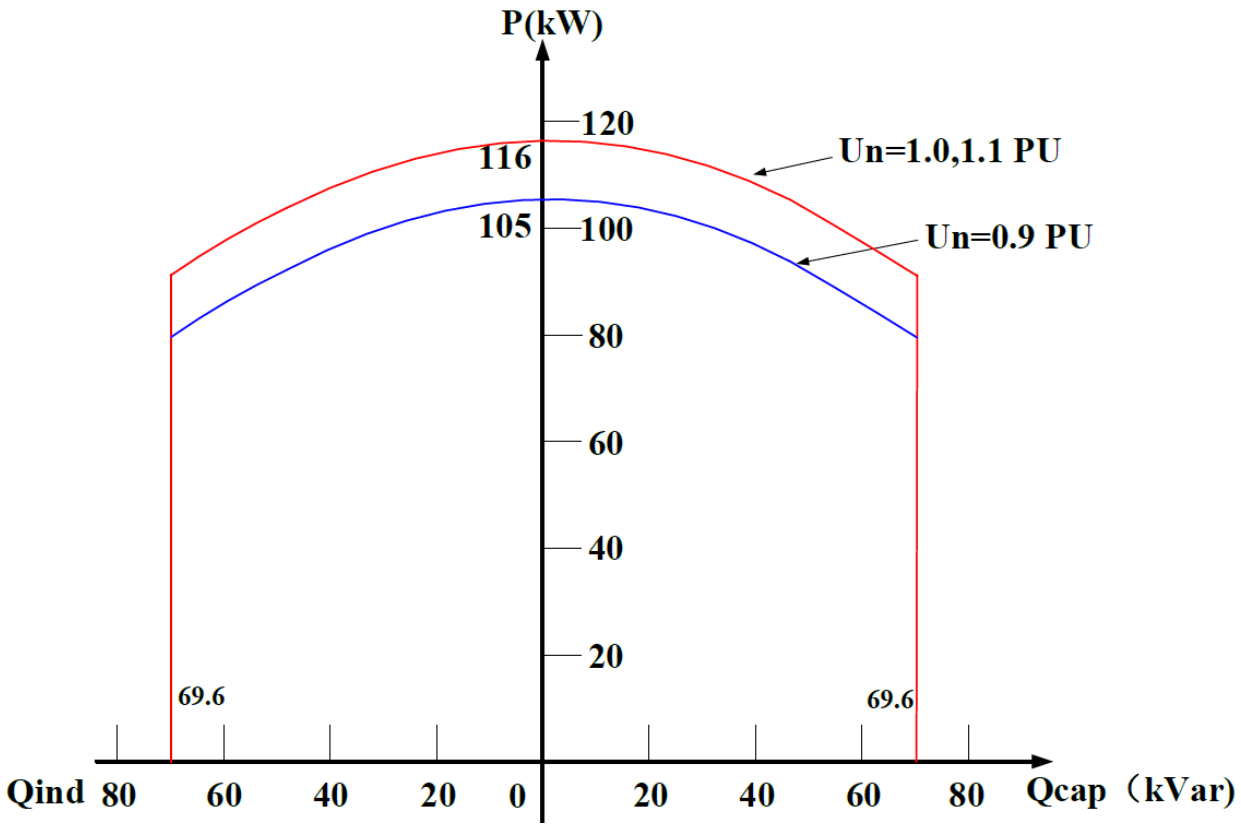


Fig2. PQ curve for 105KTL-H1 inverter

For other inverter in SUN2000 family reactive power capability is as below:

105 – 69.6 KVar

185 – 110 KVar

215 – 129 KVar

3. Case study for 1MWp installation

Reactive Power calculation for typical 1MWp PV plant:

In example: 7 inverters 105KTL connected to 1MVA transformer.

The no-load current of transformer Io% is 0.2, and the inductive reactive power of transformer is Qo =2KVar, when there is no load during the night.

The capacitive reactive power produced by 7pcs 105KTL inverters at night is 7*442 = 3094var

Then the capacitive reactive power of entire 1MVA block is 3.094 -2 = 1.094KVar needs to be compensated.

Reactive Power real case scenario typical 1MWp PV plant:

In example: 15 inverters 60KTL connected to 1MVA transformer and 10km SN line to SN connection point.

Night time reactive power consumption in connection point rises to 215KVar, reasoning high penalty fees.

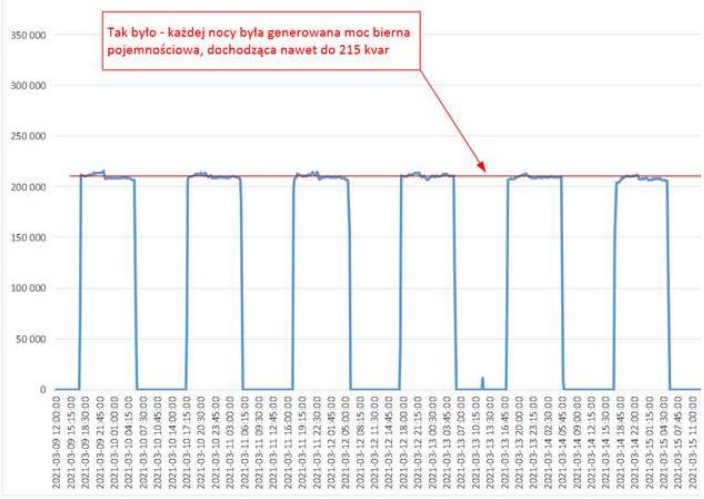
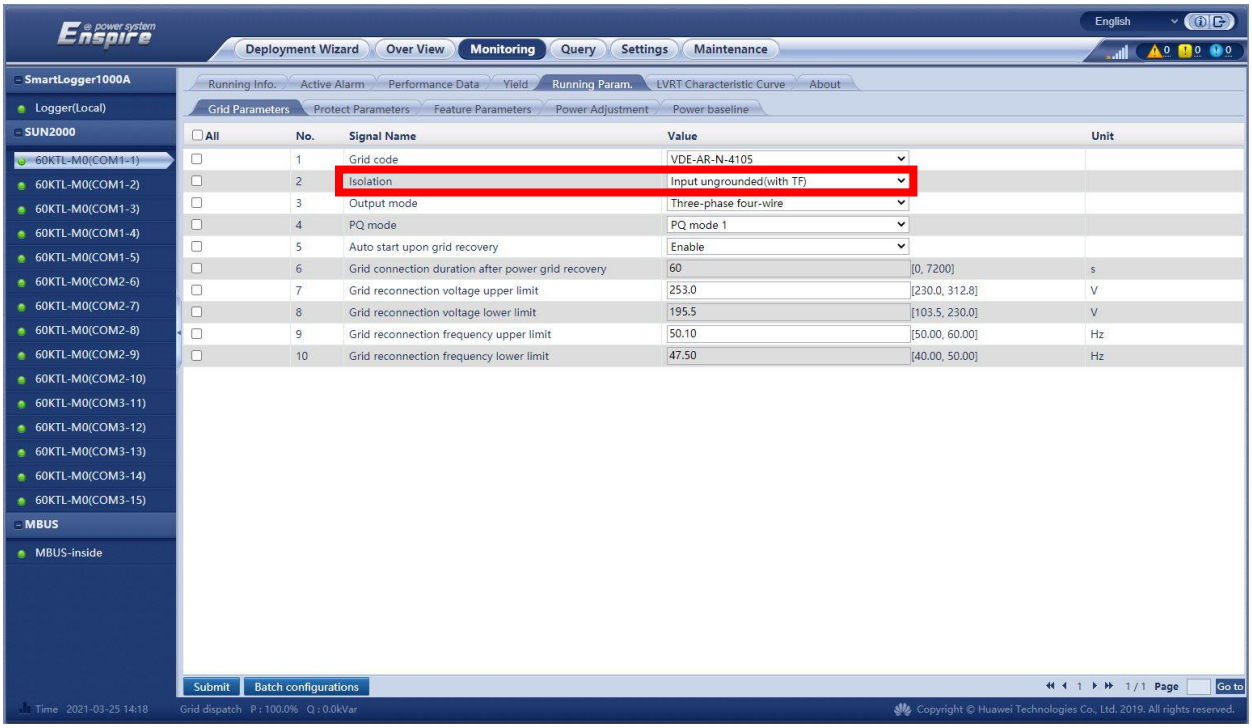


Fig3. Reactive Power at night in connection point 215KVar

4. Setting reactive power compensation at Night

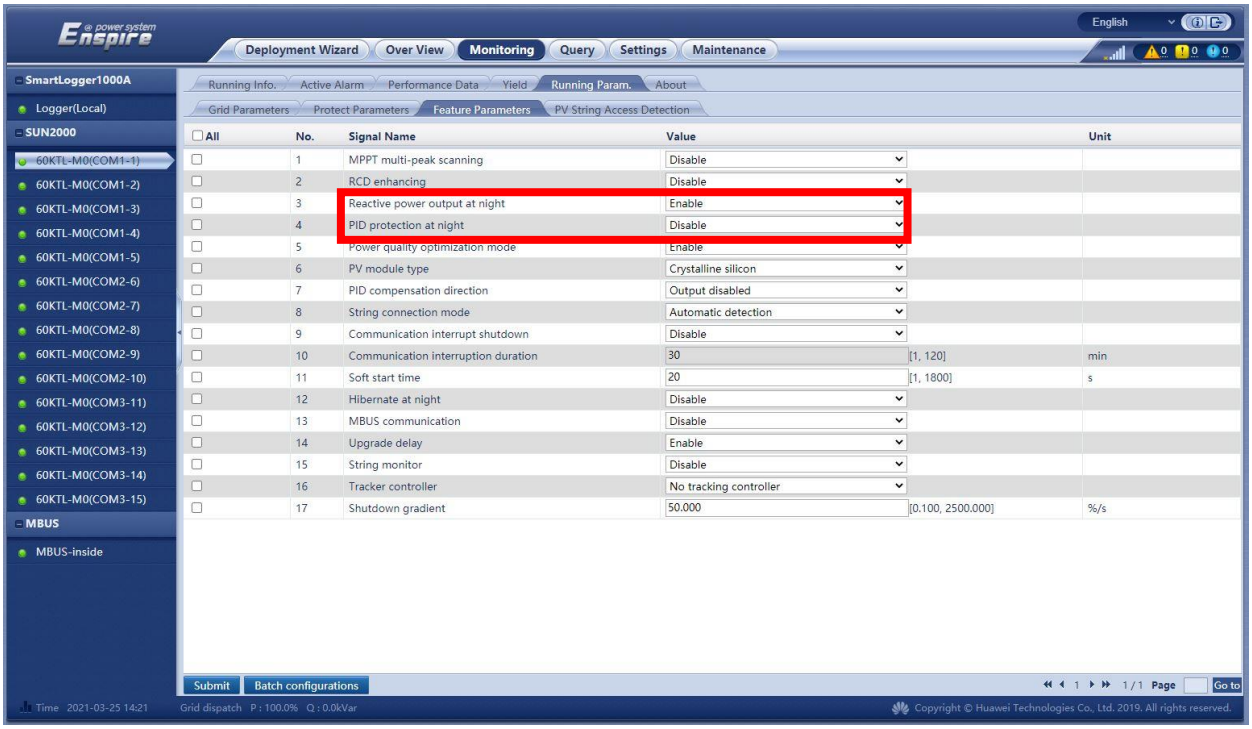
In order to compensate reactive power first some settings needs to be Enabled. Place of each parameter can differ according to Smart Logger type, software version and inverter type connected.

Set Insolation Input ungrounded (withTF)



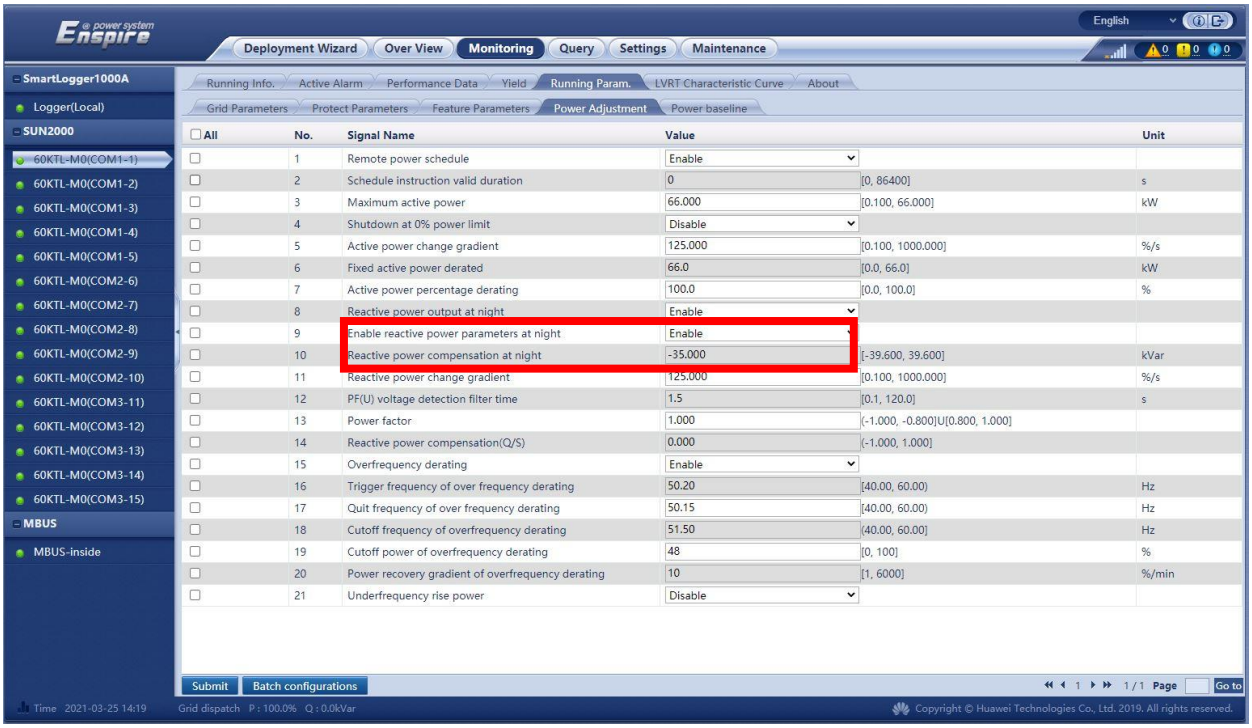
Reactive power output at night Enable

PID protection at night Disable



Enable reactive power parameters at night

Set Range of Reactive Power compensation at night



5. Reactive Power Control

FusionSolar Distributed Reactive Power Compensation Solution offers different type of plant management according to reactive power setting. Full list of options below.

Fig. 5 Full list of available options to control reactive power.

More information's according Reactive Power Control can be found in links

SmartLogger Manual
https://support.huawei.com/enterprise/en/doc/EDOC1100108365/fdf170ec/setting-reactive-power-control

FusionSolar Distributed Reactive Power Compensation Solution
https://support.huawei.com/enterprise/en/doc/EDOC1100154247

Youtube Channel FusionSolar Service

https://www.youtube.com/watch?v=DPSIsSCvyuw

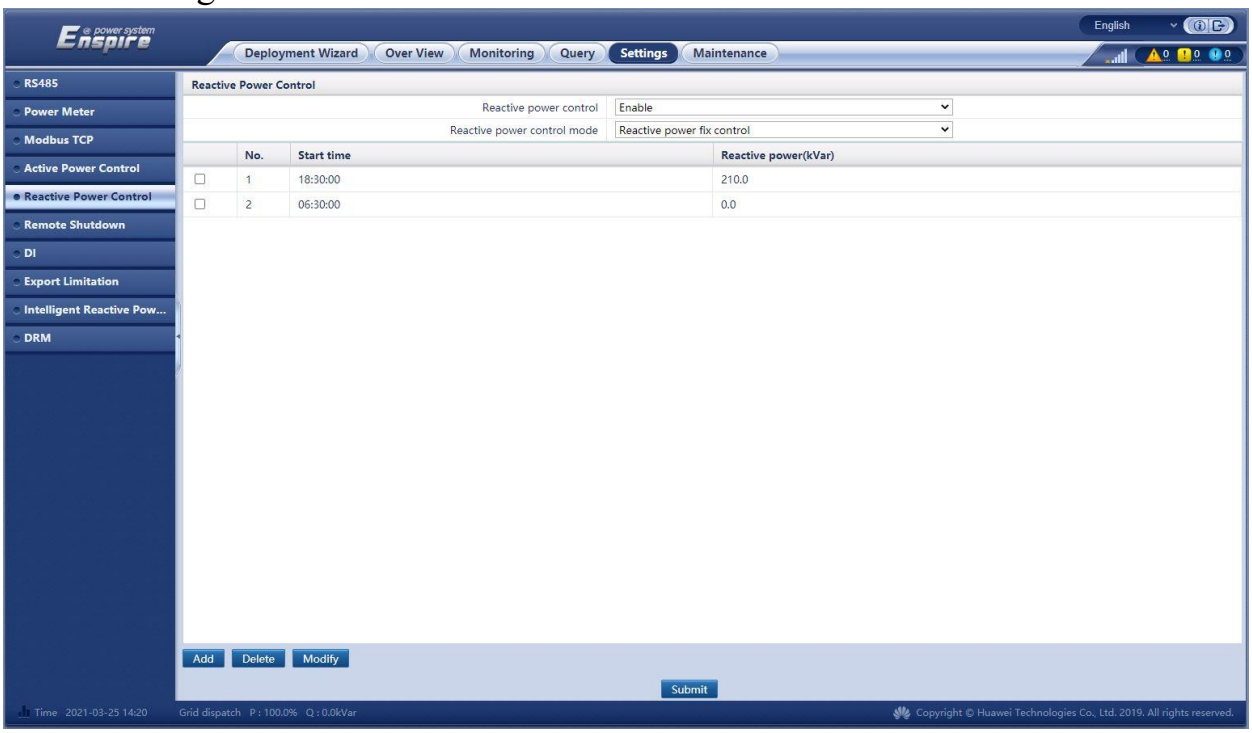
https://www.youtube.com/watch?v=iUeKh7GTKcc

6. 215 KVar compensation scenario

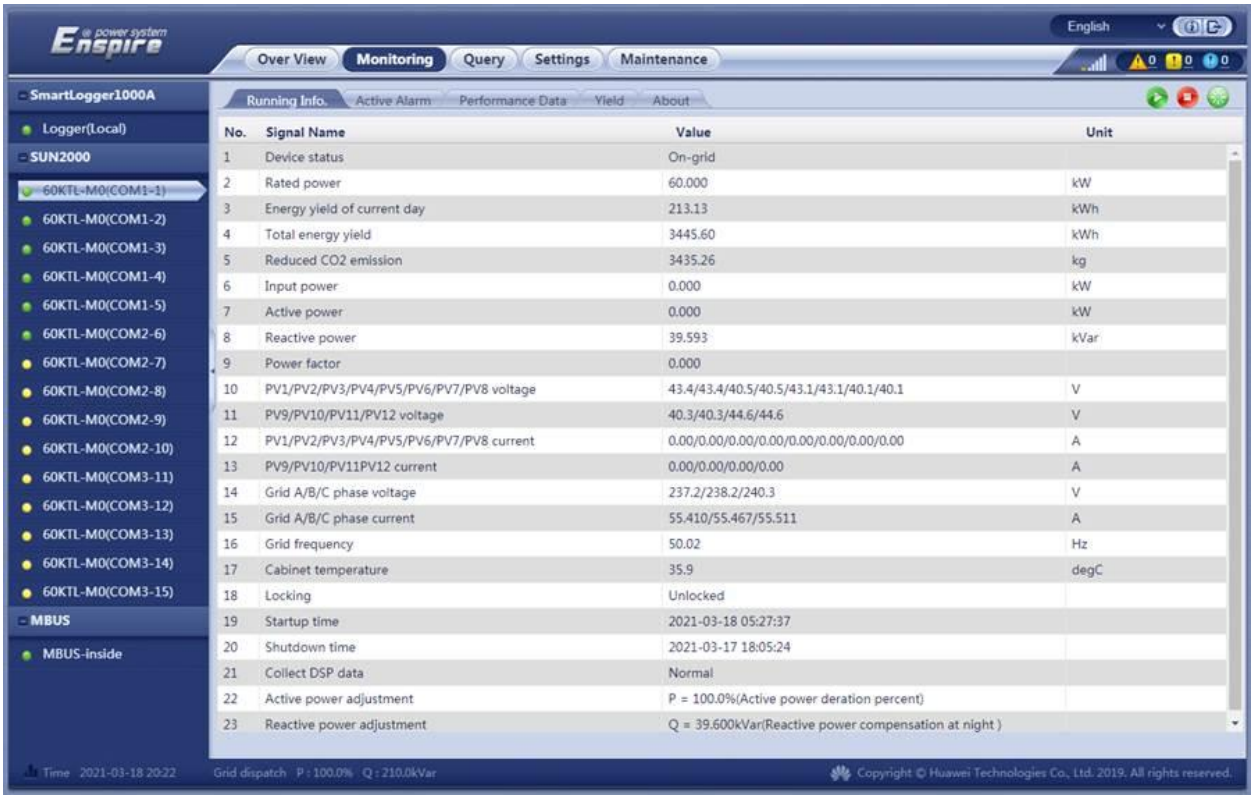
In example: 15 inverters 60KTL connected to 1MVA transformer and 10km SN line to SN connection point.

Night time reactive power consumption in connection point rises to 215KVar, reasoning high penalty fees.

For this real case scenario client used **Reactive power fixed control** set for 210 KVar working between 18.30 and 6.30.



In SmartLogger 6 inverters was set to work during nighttime according to presented suggestion in instruction. Those devices were visible during night with green dot and Reactive power production around 36kVar.



According to customer measurement active compensation increased reactive power at first night due to incorrect positive compensation sign. After changing sign value to negative next night decrease of reactive power consumption was observed.

Needles in picture represents time between end of inverters work to start compensation. In future compensation values will be set automatically by customer SCADA system in closed loop with measured parameters in connection point.

For simple cases we suggest to use Power Factor Close-loop Control (old policy) option which measures Power Factor at connection point and automatically set inverter to keep constant value.

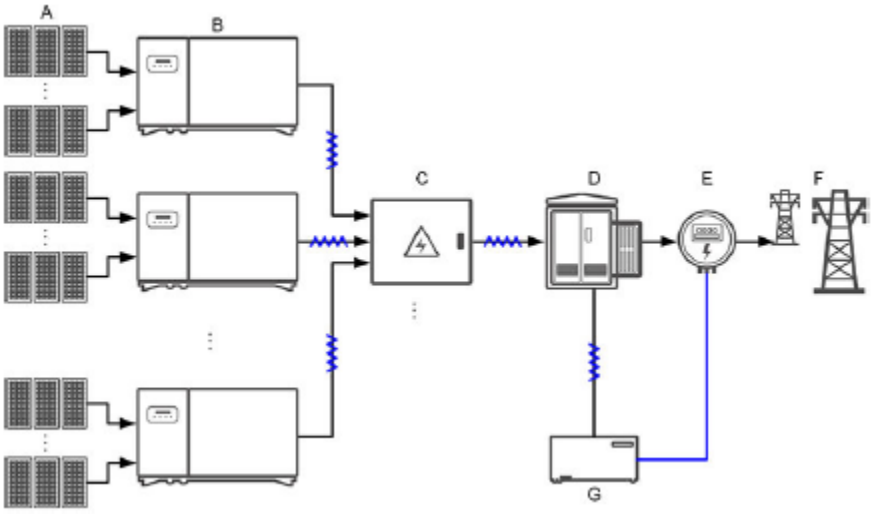


Fig. 6 Closed loop control scenario