CASE STUDY: REAL TIME MV POWER FACTOR CORRECTION 35 kV/3 MVAr/20 ms

Location: Open pit mine Veliki Krivelj TS 35/6 kV, 2x4 MVA.
Consumers: Excavators, i.e. powertrains - asynchronous motors
PFC equipment: 3000 kVAr / 35 kV / responce time 20 ms

At the open pit copper mine Veliki Krivelj operates a large number of excavators that are supplied from substation TS 35/6 kV. Due to the nature of the work, load of the excavator powertrains is very dynamic, and the rate of change is particularly high. Figure 1 shows active and reactive power of the surface mine Veliki Krivelj. Power changes are significant in amplitude, as well as speed. Active power is ranging from 0.5 to 2.6 MW. Reactive power is in the range 0.9-3.2 MVAr. Average power factor was 0.64.

Such rapid and major changes of power lead to large variations in voltage, and a low power factor leads to increased voltage drop, increased losses in cables and transformers, as well as to increased costs for electricity. Local power utility is charging for every kVArh consumed, i.e. target power factor is 1.00. Therefore the investor required a power factor of 0.99 ind. to be achieved. Given the rate of change of reactive power, a classic PFC was hardly feasible, because of slow control it would lead to big fluctuations of reactive power and impermissible variations in supply voltage.

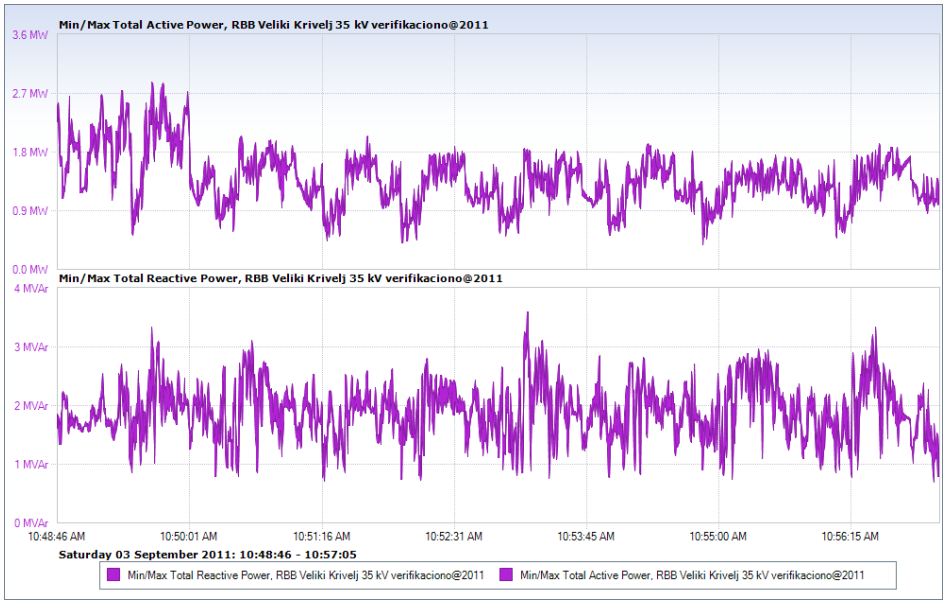

Figure 1: Active and reactive power of rotor excavators without PFC

Avalon Partner engineers designed and delivered a dedicated equipment for MV dynamic PFC with responce time of one cycle per total power of equipment i.e. 3000 kVAr/20 ms.

Figure 2. shows active and reactive power od surface mine after commissioning equpiment for dynamic MV PFC. Operating mode of excavators has remained uncahnged – active power ranged from 0.6-2.3 MW, while the change of reactive power was from -50 kVAr to +170 kVAr. Average power factor was 0,99. Current of the transformers had decreased by 36%, and the capacity was released for the connection of new consumers in the mine.

Table 1: Comparison of the results before and after the PFC

	P [kW]	Q [kW]	PF	Load reduction
Before	0,5-2,6	0,9-3,2	0,64	0
After	0,6-2,3	-0,05 – 0,23	0,99	36%

Figure 2: Active and reactive power of rotor excavators with PFC turned on

From the displayed operating modes, it is obvious that dynamic MV PFC performs its function as designed and reduces large fluctuations of reactive power of excavator motors to the minimum possible level. Power transformer has more capacity for new loads and the voltage drops were minimized. Successful power factor correction of fast variable MV loads is only possible with dynamic type of equipment.

As a result of successfully executed power factor correction, the costs of consumed reactive energy are reduced to the technical minimum, power factor and voltage drops in the system are minimized, and the power transformer is acquitted for the connection of additional consumers.