Problem description: **Line for wood chipping could not achieve the designed capacity. During operation big current spikes occur, which adversely affects power transformers and conductors, and often leads to downtime due to the tripping of overcurrent protection. Finally, a power utility demanded limitation of surrent surges, due to the high injection of disturbances in the distribution network and other customers' complaints.**

Cause of the problem: **A large voltage drops during operation of chipper.**

In the facility for wood pellet production there is a chipper of 500 kW, 0.4 kV. The operating mode was such that belt conveyer feeds the trunks and the chipper jaws crush two or three trunks at once in several crushing cycle. The cycle takes about 2-3 seconds and is repeated every couple seconds till the trunks were crushed.

During chipper operation, large current surges were reported, as well as decrease in the crushing capacity: it took too long and too many cycles to crush the trunks of average size. Additionaly, local power utility complained because of disturbance injections into the grid, under the threat of exclusion from the network.

The measurements of the characteristic parameters in representative operating modes have been performed. Figure 1. presents the results: during chrusing phase voltage has been dropping to 280 V, i.e. 28%. At the same time working current reached 3430 A, which is 4.75 In of the motor.

Due to such high voltage drops, useful motor torque was only half of the rated one, which was the reason that crushing took longer, and that drive could not operate with a nominal capacity.

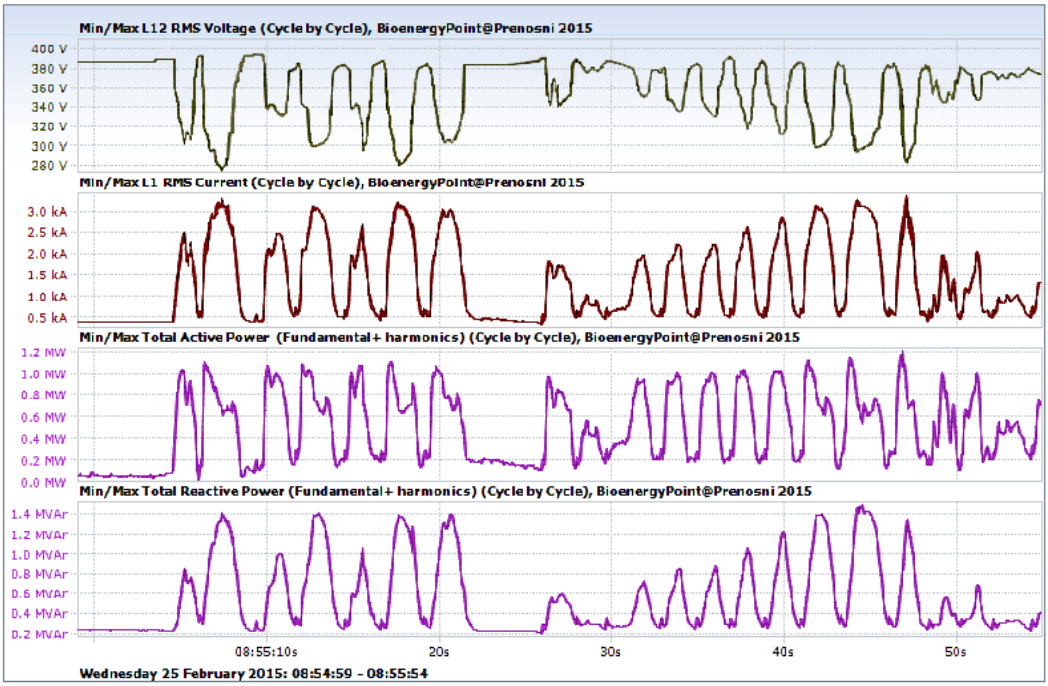

Figure 1: A typical operating modes of the chipper - the existing situation

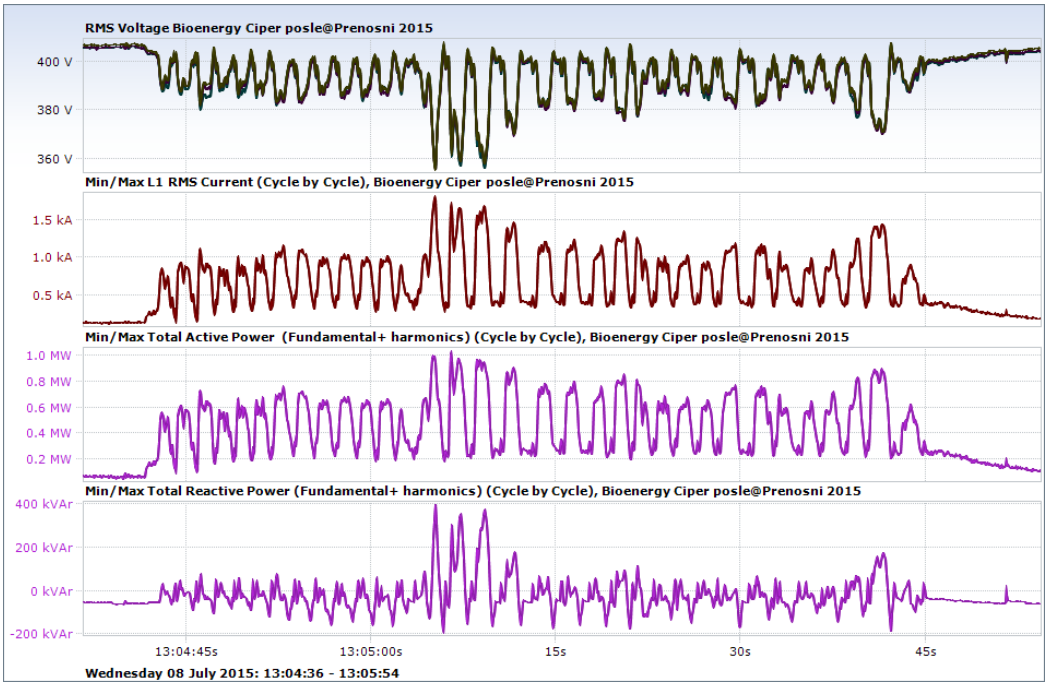

Figure 2: A typical operating modes of the chipper after the installation surge limiting equipment

Based on the measured modes of Figure 1, it was concluded that reactive component of the motor current was excessively high, cousing significant voltage drops over transformer reactance. Our engineers designed the equipment for reducing current surges with enough capacity and speed in

order to reach main goals: increasing motor torque and reducing disturbance injections to the grid to acceptable level – max. 2000 A a limit set by local utility. New operating modes are presented in Figure 2.

Figure 2 shows that the situation has considerably improved. The biggest voltage drop was 12%, i.e. 357 V. The maximum operating current recorded was aprox. 1840 A, i.e. about 2.5xIn_motor. At the same time useful motor torque has increased to 0.77 Mn of the motor. Therefore crusher can perform more work cycles for the same time interval, which led to an increase in capacity of 33%, which corresponds to the nominal capacity of the drive. Injection of the disturbances into utility network had considerably reduced, and power utility allowed new operating mode of the factory.

Table: Before/After comparison of main parameters

	Max power [kW]	Motor current [A]	Motor current [In]	Voltage drop [V]	Voltage drop [%]	Motor torque [%Mn]	Cycle duration [sec]
Before	1180	3430	4.75	280	28%	0.52	2.5
After	980	1840	2.5	357	12%	0.77	1.67

Conclusion

Transients (starting, overload) in asynchronous motors are characterized by an extremely high value of the motor current. Depending on the power of the network, such large current values create significant voltage drops during the transient process. Due to the voltage drop, the asynchronous motor is running with significantly reduced torque, in this case with half the rated torque. Therefore crushing cycle lasts longer, and current loads are very high. After the installation of equipment for current surge limitation, the drive is working as designed. Voltage drops and surges are limited, and the motor torque is 48% higher than before the intervention. This results in faster crushing of materials, higher productivity, lower operating costs and reducton of disturbance injection into the grid.