Of course, the most interesting are the time courses of the total active and reactive consumption of the rolling mill at its inlet. The whole active consumption P_1 during the rolling cycle varies from 8.7 MW to 12.5 MW.

The time course of reactive consumption Q_1 is not favourable. In order to achieve minimum losses on the supply lines and supply transformers, it is necessary that the absolute value of reactive consumption is as small as possible. However, this is not the case here. The value of Q_1 varies from 0.7 Mvar of capacitive reactive consumption to 2.3 Mvar of inductive reactive consumption.

For most of the rolling cycle, the rolling mill is inadequately compensated. The possibility of the capacitive reactive consumption of the synchronous condenser is far from being used.

For the rest of the rolling cycle, the rolling mill is unnecessarily overcompensated. The time courses of the active consumption P_1 is shown in Fig. 4 and the reactive consumption Q_1 is shown in Fig. 9. The Fresnel diagram showing all voltages and currents at the moment of the 37th second is in Fig. 10. The positions of the phasors clearly prove capacitive character of consumption at this moment.

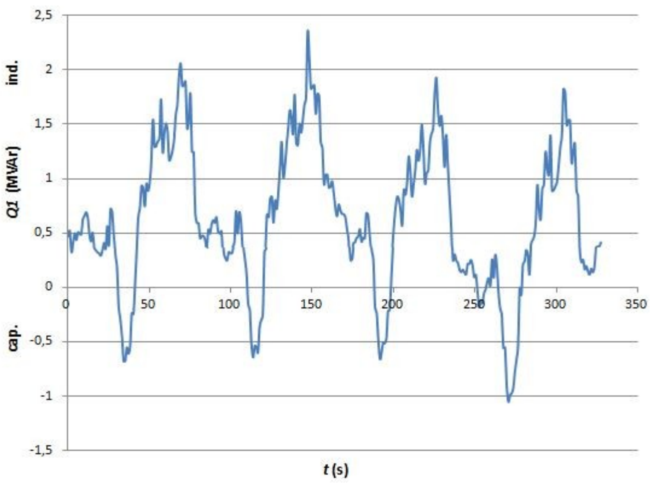

Fig. 9. Total reactive consumption Q_1 of the rolling mill

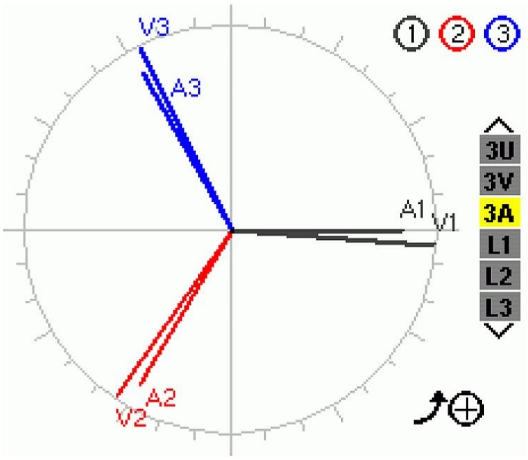

Fig. 10. Fresnel diagram of the voltages and currents in 37th s

7. Possible improvement

The excitation current of the synchronous condenser (synchronous condenser) is not controlled here and probably not even stabilized. It would certainly be possible to control the excitation current of the synchronous condenser so that the values of the reactive consumption of the rolling mill were as small as possible. Working range of the compensating possibility of the synchronous condenser is 6.5 Mvar of the reactive consumption. In the above-mentioned longer part of the cycle, 2 Mvar of capacity consumption are missing, so the required reactive consumption of the compensator would not exceed 3 Mvar, which is only about half of the achievable value of its possible reactive consumption. In the shorter part of the cycle, when the rolling mill is overcompensated, it would be possible to eliminate this unnecessary overcompensation by reducing the reactive consumption of the synchronous condenser Q_4 by about 0.7 Mvar. This is less than the minimum measured value of the reactive consumption of the synchronous condenser Q_4.

8. Conclusion

It is possible to conclude that the available control range of the synchronous condenser during the monitored operation of the rolling mill could be used to put down the unfavourable reactive consumption of the rolling mill. With a different profile of the final rolled product, the individual consumption values may probably be quite different. Therefore, it would be necessary to verify whether the findings on the possibility of suppressing unfavourable consumption are always valid by long-term monitoring of the total consumption of the rolling mill.

In the next step, it would be necessary to verify the possibility of setting the required value of the excitation current online. Then it would be possible to design, implement and tune a suitable stable controller.

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