As the main loads of the property are characterized as electric motors, industrial refrigerators and water heaters, it is possible to affirm that as the load increases, the current in the line increases, thus increasing the voltage drop causing the voltage fluctuation.

Note that after the installation of the photovoltaic system, the values of the Pst indicators for the three phases have decreased, because now part of the power required by the load is taken care of by the photovoltaic panels, thus reducing the required power of the grid and the voltage drop in the line. However, even with the reduction of Pst values these still remained above the value considered adequate according to the norm.

### *F. Frequency Analysis*

The nominal frequency of the measured system is 60 Hz. Therefore, according to the norm, this frequency must be between 59.9 and 60.1 Hz. Fig. 10 shows the frequency values corresponding to the analyzed week.

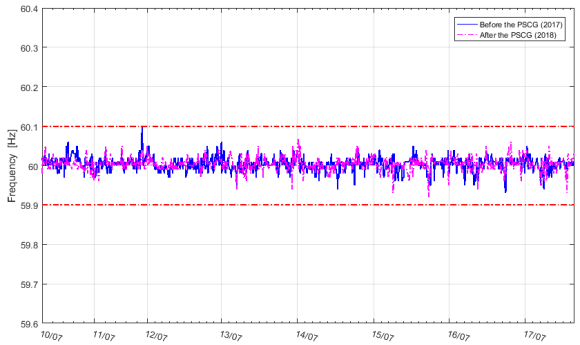


Fig. 10: Frequency indicators between 10/07 and 17/07 of the years of 2017 e 2018.

Photovoltaic systems such as the one installed in the property in question do not participate in the frequency regulation of the Brazilian electrical system. Frequency regulation is inherent in the installation of the panels given the dimensions of the system to which it is connected, so the frequency has remained within the limits in force in the standard.

### *G. Analysis of Short-Term Transitional Variations*

The SDVV be divided into six types, according to duration, magnitude and, in addition, between sinking or elevation. In the analyzed period, interruptions occurred only on 08/04 in 2018 and 08/06 in 2018. It is important to remember that the Momentary Interruption of Voltage (MIV) lasts less than or equal to 3 seconds and Temporary Interruption of Voltage (TIV) lasts longer than 3 seconds and less than 3 minutes. The SDVV are inherent to the installation of PSCG, since the installed DG does not work isolated from the network. Therefore, the shortages, MIV and TIV recorded in the periods analyzed come from COPEL's distribution network

## 5. Conclusion

From the analyzes that were made, it was possible to verify that the insertion of microgeneration generated steady state voltage rise, not exceeding the maximum limits stipulated by PRODIST. In addition, it was observed that the power factor decreased due to the reduction of the network asset consumption, thus increasing the ratio between active and reactive power consumption. Other important aspects analyzed that underwent changes were the fluctuation and the voltage unbalance, which reduced their values of the indicators Pst and FU respectively. However even with the reduction of the Pst indicators these still remained above the value considered appropriate according to the norm. Together with the harmonics present in the property, they were filtered and reduced due to the presence of the passive filter of the frequency inverter.

Aspects such as SDVV and frequency, are inherent to the insertion of the photovoltaic system connected to the network, since it does not work in an islanded way, that is, without being connected to the network.

## Acknowledgement

The authors would like to thank the people for their support during the writing: Carlos H. Beuter, Luis E. Espinosa Aranha, Layon L. Lucena Alves, Roberto L. Klein Filho.

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