As a percentage of total daily losses, losses due to fundamental frequency and their harmonics were expressed in Fig. 4-A. Note that for harmonics above 9 the percentage losses tend to zero.
Fig. 4-B shows a comparison between the mean of losses due to only to the fundamental frequency, as recommended by ANEEL, and the total losses considering the harmonic components.

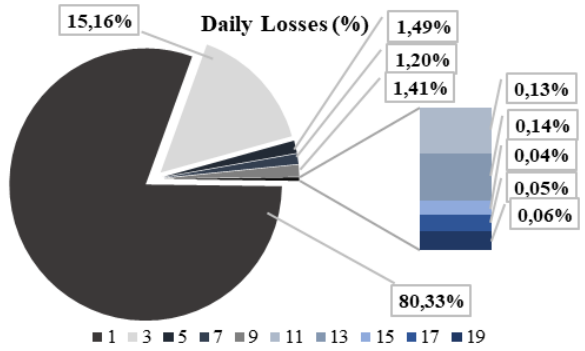

Fig. 4-A. Mean of daily losses displayed in percentage, due to fundamental and harmonics.

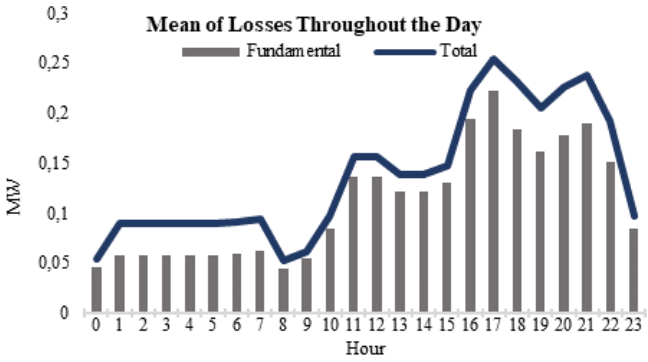

Fig. 4-B. Losses throughout the day for the fundamental frequency and total losses. The values are means of the three cases. (MW)

7. Conclusion

In this study, losses due to the influence of harmonic components in a low voltage distribution system were analyzed, using an IEEE model for simulations. The analyzes were performed on three different cases, each with specific load curves obtained by fuzzy logic.
It was observed that the losses obtained in the third case were higher, as expected, since the load shapes used predicted this behavior for hot days. In addition, analyzing the losses hourly, considering the mean between the cases, it was found that the losses are more significant at times when consumption is higher, according to the load curves.
From the plotted graphs, it was observed that the third order harmonics are the ones that represent greater losses within this group, as well as it is noticed that the losses of very high orders, in percentage, are irrelevant. It was also verified that the technical losses due to harmonics correspond to about 19.6% of the total technical losses for this system.
It is noted that the losses obtained are relevant, however, these were hypothetical situations that do not fully correspond to reality, because despite the curves obtained by fuzzy to represent well, the spectrum were randomly distributed for loads already existing in the model.
Finally, it ensures that the calculation of these losses, beyond being necessary, is liable to be recommended by ANEEL. However, the difficulty would be in defining reliable harmonic spectrum for each consumer unit, and a survey should be made of these for precise results.

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