

PROPOSAL TO IMPROVE THE BRAZILIAN REGULATION ON THE ELECTRIC ENERGY RELIABILITY

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ABSTRACT

The aim of this paper is to present a proposal to improve Brazilian regulation on electric energy distribution reliability. To do so, it's necessary to evaluate the incentive mechanisms currently used by the regulatory agency, to understand the progress achieved and the barriers faced during the whole process for the improvement of reliability in Brazil.

INTRODUCTION

The regulation about the electricity supply continuity in Brazil began with the publication of DNAEE Order No. 46 of April 17, 1978 [1], which established the indicators and limits of duration and frequency for long interruptions. However, there was no penalty or reimbursement mechanism to promote power supply quality.

It was only with the publication of ANEEL Resolution No. 024 of January 2000 [2] that stricter rules were established and indicators were tracked. Since then other changes have been introduced with the aim of encouraging improved supply.

Currently there are two regulatory mechanisms being used to promote the supply quality in Brazil. The first concerns monetary reimbursements for customers who are subject to long interruptions (duration and frequency) above the established limits. These amounts are credited monthly to customer bills, and therefore are like a penalty for companies. The other mechanism is the evaluation made by the regulator agency (ANEEL) at the time of the distribution tariff definition. Depending on the performance, there will be an incentive or penalty in the amount of the tariff that will be aimed at the company [3]. However, it can be seen from the chart below that in Brazil the average duration of interruption in supply is still above the regulatory limit [4].

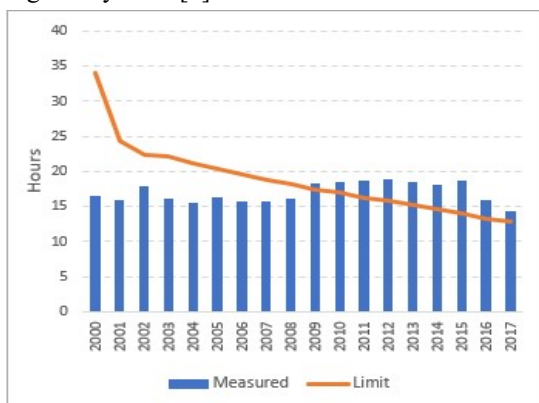


Figure 1: Regulatory limits and the average duration of supply interruption in Brazil

Although the last years show an improvement in the power supply quality, it is possible to evaluate by figure 1 that the current mechanisms are not performing the expected function. Thus, there are opportunities for regulation improvement to encourage the search for better performance.

This paper will present a proposal for adequacy in the regulation of customers' reimbursement mechanism. The objective is to mitigate the main problems observed and discussed by the companies and the national regulatory agency (ANEEL).

IMPROVEMENT ASPECTS

Three main aspects that have been discussed for some time in the national sector will be analysed below:

a) Average reimbursement value

In the current criterion it is possible to observe that the annual values of reimbursements to the customers total a high amount, impacting in the result of the companies. They are calculated from the values of individual indicators of continuity and the cost of using the distribution system (monthly cost of energy consumed), called EUSD. However, the customer ends up receiving low value reimbursement. This is due to the large amount of reimbursement that is currently paid [4]. According to the figures below it is possible to verify that the average reimbursement value is approximately € 1.00, that is, it is not a significant amount

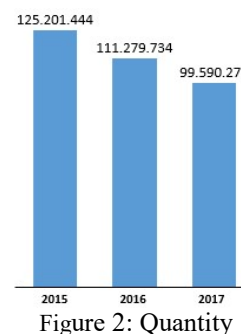


Figure 2: Quantity

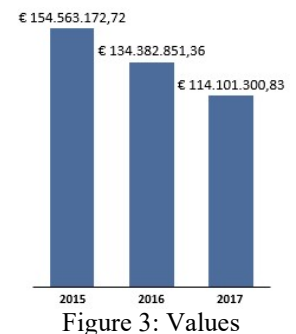


Figure 3: Values

Therefore, customers subject to low levels of supply quality haven't been paid so well comparing the interruptions they have undergone.

b) Rules Complexity

In Brazil, several indicators are used to calculate reimbursement. In addition, it should be noted that such reimbursement is assessed monthly, quarterly and

annually. This periodicity of reimbursement and indicators types increases the degree of complexity of the rules when society needs to monitor.

For example is given below the reimbursement formula for duration (DIC) of long interruptions [5].

$$\left(\frac{DICv}{DICp} - 1\right) DICp \times \frac{EUSD_{average}}{730} \times kei$$

DICv = duration of interruption per consumer unit or connection point, according to each case, verified during the period considered, expressed in hours and hundredths of an hour;

DICp = limit of continuity established in the period considered for the indicator of duration of interruption per consumer unit or per connection point, expressed in hours and hundredths of an hour;

EUSD_{médio} = arithmetic mean of the cost of consumption corresponding to the months of the indicator calculation period;

730 = average number of hours in the month;

kei = coefficient of increase, the value of which should be fixed at:

- i. 15 (fifteen), for consumer unit or connection point serviced in Low Voltage;
- ii. 20 (twenty), for consumer unit or connection point serviced in Medium Voltage;
- iii. 27 (twenty-seven), for consumer unit or connection point serviced in High Voltage.

c) Regulatory sign

Nowadays, the performance of companies is evaluated by the average duration and frequency of interruptions (similar to SAIDI and SAIFI). However, the offsets are based on the values of individual indicators and the cost of using the distribution system (monthly cost of energy consumed), called EUSD. As a result, the regions with greater density of customers and greater consumption become the most important for the companies, so that they avoid the greater penalties. On the other hand the most affected regions by the interruptions do not always receive the highest reimbursement values. With the data of September 2016, from Enel Distribuição São Paulo, the heat maps were made to indicate this problem.

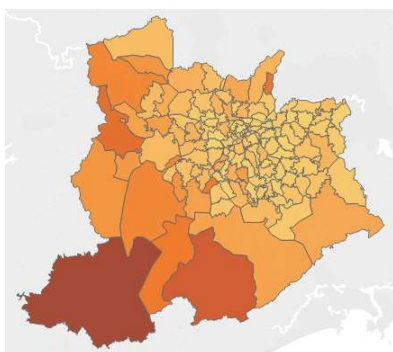


Figure 4: Duration heat map

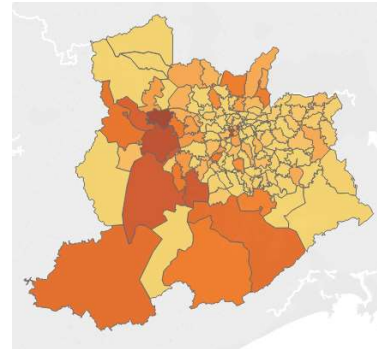


Figure 5: Reimbursement heat map

d) Reimbursement financial impact

The final tariff for the customer is composed of several costs associated with the electrical system. These costs are related to transmission services, technical losses, taxes and, finally, distribution services.

In this way, when the reimbursement is calculated by the EUSD the distribution company ends up paying for all those costs that are not their responsibility

For this reason, the distributing companies have requested the change in the reimbursement formula. It is asked to use only the portion referring to the distribution services that is called EUSD_B.

IMPROVEMENT PROPOSAL

It should be emphasized that the purpose of this work is not to present an already structured methodology, since this would require studies at a national level, that is, to apply the proposal to all companies avoiding that none be harmed or benefited by their characteristics in relation to a new regulation.

The proposal presented in this paper seeks to identify possibilities for improvement to meet the points mentioned previously.

As discussed earlier, the current reimbursement regulation for breach of continuity limits becomes complex for the customer by the number of indicators and formulas for the calculation of these offsets. At the international level, the observed experience that is presented in a simplified way and easy to understand to the customer is the procedure adopted in the United Kingdom. In summary, in this regulation already are defined values for customers reimbursement who had the electricity supply interrupted above a quantity of hours adopted as limit. It is emphasized that this limit is defined observing the severity of the event that caused the interruption.

As stated above, the following is a list of the main points to be observed as proposal detailed in this paper:

- Periodicity: exclusion of the quarterly and annual evaluations of the indicators for reimbursement calculation;
- Indicators: adoption of maximum limits for duration (DMIC) of interruptions as parameters for monthly reimbursement calculation;

The withdrawal of reimbursements related to frequency of

interruptions may seem improper. However, it is noted that the development of the power quality regulation could replace this indicator since it is intended to reimburse customers for short-term variations.

In this way, it is intended to attenuate the amount of information and research carried out by the customer to follow the reimbursements received.

By adopting a maximum duration limit the regulatory signal will be clearer for companies. Nowadays, with the use of several ranges of individual limits, urban centers have the smallest limits. With the exclusion of these ranges of limits the attention of companies will return to the entire area of operation.

At the same time, the adoption of single limits for the indicators contributes to the simplification of the current regulation and would allow the elimination of the reference tables used to define the limits of duration (DIC). Other improvement is the substitution of $EUSD_{average}$ by $EUSD_B$ in the reimbursement formula. This is an important need to adapt the regulation, as companies would no longer be exposed to other variations of the components that make up the EUSD.

With a lower amount of reimbursements and the reduction of the final value with the application of the $EUSD_B$ becomes necessary to adapt the reimbursement formula to guarantee a perceptible value to the client. This adaptation must be done through the variable kei .

SIMULATION

In order to evaluate the consistency of the presented proposal, it was attempted to carry out simulations with the Enel Distribuição São Paulo database, which was prepared to meet the request made by ANEEL through Circular Letter 020/2017.

The first possible simulation was the verification of the impact of the substitution of $EUSD_{average}$ by $EUSD_B$ in the calculation of the reimbursement.

Figure 6 below shows the impact for the year 2016 reimbursement paid by Enel Distribuição São Paulo. It is observed that the simulation shows that the simulated value with the $EUSD_B$ represents approximately 44% of the compensated value in 2016.

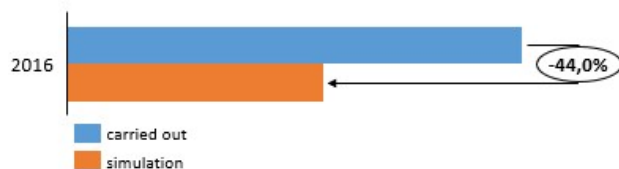


Figure 6: 2016 reimbursements simulation with $EUSD_B$

The first evaluations of this proposal are then presented for the simplification of the regulation and the consequent reduction in the amount of reimbursement paid. For this first moment, the limit values presented in table 3 below were adopted.

Table 1: Values adopted for maximum duration

Indicator	Urban area	Non-urban area
DMIC	6	8

The reimbursement formulas are based on the current DMIC formula.

$$\left(\frac{DMIC_v}{DMIC_p} - 1\right) DMIC_p \times \frac{EUSD_B}{730} \times kei$$

The values adopted were proposed after an evaluation of the DIC and FIC reference tables and with the purpose of reducing the amount of reimbursement. In this way, it was tried to compensate for more severe situations and, for this reason, it will be necessary to re-evaluate the increase of the reimbursement values in order to have a reimbursement compatible with the event observed in each month.

Using the proposed improvements, it is possible to observe in the heat map of figure 7 that the distribution of reimbursements was more balanced compared to carried out in 2016.

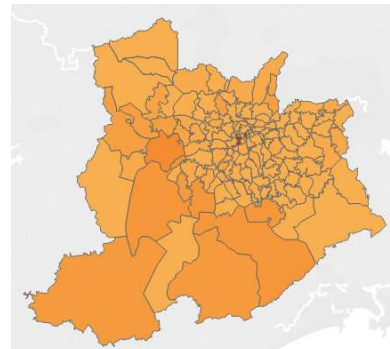


Figure 7: Simulated reimbursement heat map

Concerning about the proposals that tend to increase the value of the reimbursement paid to each customer it's required a deeper study using a database of other concessionaires in Brazil. For this reason, it is understood that it's appropriate to wait for a wide discussion to present the results of simulations that may help in this point, not adopting only a single situation as a reference.

However, it should be noted that previous simulations show that a balance can be struck between the regulator's desire to improve the reimbursement values and the need to maintain the economic-financial health of the concession.

With the adoption of maximum limits for the calculation of reimbursements, as presented above, it is understood that the regulatory signs observed today would be attenuated. Even so, seeking a greater conformity of the indicators of continuity in the electrical assemblies of the distributors proposes the adoption of a new modality, the

aperiodic reimbursement.

In this modality the consumer units would receive a certain amount of reimbursement for emergency interruption that occurred after exceeding the limits of the collective indicators of the electric region of that consumer unit.

The objective of this new modality is precisely to reimburse customers who are severely affected by the interruptions and to strengthen the regulatory signal of maintaining the regulatory limits of all electric regions. In addition, this is an opportunity to make a reconciliation of the collective indicators, which have already been followed for a long time, with a type of individualized monitoring and work with the desire to make society aware of the values referring to reimbursements.

CONCLUSIONS

This paper aimed to present a new approach to the methodology for calculating reimbursement for continuity indicators. The main characteristics to be achieved are:

- Simplify the current regulation
- Increase the average reimbursement value
- Reduce the large volume of reimbursement currently paid
- Adapt the regulatory signal imposed by the reimbursement
- Maintain the economic-financial balance of concessions

The proposed methodology shows that the reduction of continuity indicators for the calculation of reimbursement, as well as the change in the frequency of application of these reimbursements, would help to simplify the regulation and, in this way, encourage society to follow the evolution of service quality. It is also worth noting that the proposal addresses values at national level, that is, they would apply to all electricity companies in the country.

Another point presented was the impact in relation to the substitution of the EUSD value, currently used in the reimbursements, by the EUSD_B thus avoiding that the companies remain exposed to the variations of the other parcels that compose the tariff, but they are not the responsibility of the distribution of electric power.

The reductions observed by the applications of these proposals (reduction of indicators, periodicity and EUSD_B) opens the possibility of discussing the increase of the values to be compensated without this could indicate a risk to the financial health of the companies. That is, with fewer reimbursement it will be possible to review the increase amounts as well as the application of a new modality of reimbursement that would be aperiodic.

The main objective of aperiodic reimbursement is to correct the current regulatory signal, since it would be applied in those regions in which the collective limits of continuity have already been violated. As the proposal is to apply a certain amount by interruption, it seeks to direct the attention of the companies to all the regions of their concession.

It should be emphasized that this new modality will bring a great financial impact that should be considered in the studies of increase of the other reimbursement.

Finally, it is worth emphasizing once again that the simulations and proposals presented in this paper need to be widely discussed to evaluate applicability and consistency in the other companies.

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