

Categorization Process Assignment of Transmission System Installations after 2016 Legal Reform of General Law on Electrical Services

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SUMMARY

The reforms introduced in 2016 by Law N° 20.936 to the General Law on Electrical Services (GLES) implied important modifications to the Chilean energy transmission regulatory framework. In fact, due to these legal modifications, current transmission system segments (trunk, Subtransmission and additional systems) ceased to exist as such, giving way to new segments: national, zonal, dedicated, generation development poles and international connection systems. In some cases, new segments present a strong correlation with respect to the previous ones, while in others they obey to new conceptions and paradigms (such as the systems that connects the so called “generation development poles”).

It is of particular significance the shift from a scheme in which only the expansion of trunk system was centrally planned, to a scheme in which the expansion of all public service electrical installations —national, zonal and generation development poles systems—is planned by the relevant authority, considering also the impacts of this regulatory change in terms of the categorization process of transmission systems’ installations and its payment regime.

In this context, it is necessary to point out that, despite that expansion of public service transmission systems is centrally planned, investments are exclusively private capital. In this sense, since public service transmission facilities are paid now fully by end customers, it is of vital importance to determine to which segment those assets belong, since this defines who will pay and under what regime.

According to current regulation, transmission assets are all those that have a voltage level higher than 23 kilovolts. Hence, the challenge was to establish a methodology to categorize all the transmission facilities in the different segments of the transmission system.

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This document will seek to explain the conceptual and methodological development carried out by the authors for the implementation of the legal mandates regarding categorization process of transmission systems' installations (hereinafter, "categorization process"). The topics covered by this document are the following: Section I presents description of transmission planning, categorization and payment processes before and after Law N° 20.936 entered into force. Section II describes the new transmission segments introduced by Law N° 20.936. Section III shows a description of the Chilean transmission system. Section IV outlines the stages of the process. Section V explains the development inside National Energy Commission of the methodology applied for carrying out the categorization process. Section VI describes the methodology and shows some results. Finally, section VII presents some conclusions.

KEYWORDS

Energy transmission legal reforms, categorization process, transmission planning, payment regime, transmission systems, transmission segments.

I. PLANNING, CATEGORIZATION, TARIFF AND PAYMENT REGIME PROCESSES. DIFFERENCES BETWEEN THE REGULATION BEFORE AND AFTER LAW N° 20.936

Prior to the changes introduced under Law No. 20.936 [1] [2], the General Electric Services Law defined three segments of the transmission system¹: (i) trunk transmission, (ii) Subtransmission, and (iii) additional transmission, under which the planning, categorization and charging processes were regulated.

Trunk Transmission System: Under said regime prior to the entry into force of the aforementioned Law No. 20.936, the expansion of the Trunk Transmission System (TTS) was carried out through a study called the Trunk Transmission Study [3]. The TTS considered, as a first stage, the categorization of the entire universe of existing transmission facilities that met the eligibility requirements of the Trunk Transmission System established in the current GESL. In addition, in the Transmission Trunk Study the expansion needs of the TTS for the next four years were analyzed, considering a planning horizon of at least 10 years, study that was developed by a consultant and subsequently reviewed by the National Energy Commission (indistinctly Commission.- NEC or the regulator) [3 introduced to the GESL by the 19.940 law of 2004). Then, annually the NEC had to carry out planning exercises for the TTS, consistent with an annual review of its expansion needs, determining in this process new works and expansion projects of the existing facilities in the system.

Subsequently, regarding new works, a public bidding process of the rights for its construction and exploitation is carried out, in which the private companies were the bidders, paying an annual fee according to the result of said tender. -On the other hand, regarding the extension works, a tariff study was carried out in order to determine the annuity of the investment value and the cost of operation, maintenance and administration of said networks, being the owner of the existing installation object of the extension work, the person in charge to execute it, for which it had to carry out a private tender. Finally, regarding the payment scheme, transmission facilities were paid by generators and final consumers, through allocation mechanisms based on expected use.

Subtransmission System: On the other hand, the Subtransmission System (STx) was planned both by the companies that own the networks and by the authority, on this last case, within the framework

¹ Until 2017, the National Electric System was composed by two large systems that worked in isolation: the Northern Interconnected Power System (BNIS) and the Central Interconnected System (CIS). Then, through Exempt Resolution No. 668 of the National Energy Commission of November 21, 2017, the National Electric System was declared formed by the interconnection of the (CIS) and the (BNIS).

of the process of valorisation of the facilities of said system, in which expansion works were defined in an indicatively way.

The categorization of the Subtransmission System facilities was carried out every four years by the Commission, with a two-year lag with respect to the Transmission Trunk Study, (within the framework of which the TTS categorization was made). This time lag between the two categorization processes led to the installations being transferred from one segment to another in a short period of time, causing difficulties in the payment assignment regarding these as well as little regulatory certainty with respect to the applicable regime.

The pricing of these networks was determined from a model company, within the framework of a four-year tariff study, in which, and for a 10-year horizon, theoretical exercises were carried out: (i) expendability, (ii) optimization, and (iii) expansion of Subtransmission networks. The exercise of disregard was to determine which facility was not useful in the Subtransmission System, for which analyzes were performed based on simulations of expected use of transmission facilities, in order to quantify if disregarding a particular installation involved, regarding a base case: (a) Energy Not Provided (ENP), (b) decreased security, and/or (c) non-compliance with current technical regulations [4]. Then, once those facilities that were expendable were defined, an optimization exercise was carried out in which they were not considered, in order to determine which existing networks of the system had gaps, in the evaluation horizon, between their use and their maximum capacity.

In this way, a theoretical exercise was carried out on which the payment of a network optimally adjusted to its expected use would be considered for tariff purposes, eliminating inefficient gaps. Regarding the payment regime, the facilities were mostly paid by the final customers, and the generators concurred to a lesser extent.

Additional Transmission System: The growth of the Additional Transmission System is entirely private initiative. Regarding the categorization, the facilities of the Additional Transmission System were categorized as residual, that is, it was determined that those facilities that were not categorized as part of the STT or as part of the STx belonged to the Additional Transmission System. These facilities were identified as those that were essentially and primarily intended for the supply of electricity to users not subject to price regulation, and those whose main purpose was to allow generators to inject their production into the electric system.

During the development of the processes described above, carried out according to the previous regulation, the existence of various inconveniences was perceived. In particular, there were noticed as main problems of the transmission system expansion process, the consideration of a more medium-sized than long-term view, what in turn influenced the transmission development to be delayed with respect to generation development, at a time when the paradigm was beginning to change in terms of the commissioning times of generating plants with respect to those of transmission facilities, partly, as a result of the insertion of renewable energy sources and difficulties in developing projects of large-scale transmission.

Thus, a slightly robust transmission system, with few clearances and with low supply quality indexes, did not adequately favor the development of competition in the generation segment, resulting in an uncompetitive market system. On the other hand, the remuneration mechanism of the STT facilities, also did not generate incentives for the generation development. As a consequence of the above, modifications were introduced to the GLES, which consisted, in broad strokes, of the redefinition of the transmission segments, so it could be consistent with the new paradigms of the electrical system, in particular, that the new National Transmission (former trunk) allows the formation of a common electricity market and the transmission of signals to the generation for its development.

Likewise, the expansion of the National and Zonal transmission systems was carried out through a centralized planning developed by the NEC, based on a process that includes instances of observation by relevant actors and resolution of controversies between said actors and the regulator before a specialized entity in the subject called Panel of Experts. This process considers a more extensive planning horizon of at least 20 years, and takes into account environmental, territorial and social aspects.

Regarding the remuneration system, the modifications introduced by Law No. 20.936 consisted of the recognition of all the facilities of the National and Zonal Transmission System, which are paid in full by the final customers. In the case of the National Transmission System, the payment is made by all customers, while the payment of the facilities of the Zonal Transmission System is made by the customers who use them, recognizing a differentiation by voltage level. The full recognition of all zonal transmission facilities and the payment by their users explains that their planning is now done centrally. Finally, the new regulation established a single four-year process in which the facilities of all transmission systems must be categorized, unlike the previous regulation, which contemplated only the categorization of the STT and STx facilities, and in different processes. On this point, it should be noted that, given the change in the definitions of the transmission systems with respect to those contained in the previous regulation, in particular, of the Zonal and Dedicated Transmission System, the categorization methodology developed by the Commission, sought to collect these differences, in order to duly reflect in the result of the process the changes introduced by Law No. 20.936, which is detailed in the following sections.

II. DEFINITION OF THE NEW TRANSMISSION SEGMENTS

The General Electric Services Law establishes the definitions of: (a) transmission system, (b) national transmission system, (c) transmission system for development poles, (d) dedicated transmission system, (e) zonal transmission system, and (f) international interconnection systems.

For the purposes of this work, a resume of definitions contained in the "Transmission System" "National Transmission System", "Transmission System for Development Poles", "Dedicated Transmission System" and "Zonal Transmission System" Laws will be presented below, since, according to the GLES, the facilities of these 4 systems are the ones that should be subject to the categorization process.

Transmission System: the "electricity transmission or transmission system" is the set of electrical lines and substations that are part of an electrical system and are not intended to provide the public distribution service, whose operation must be coordinated as provides article 72 ° -1 of this law.

In each transmission system, electrical lines and substations are distinguished from the following segments: "national transmission system", "transmission system for development poles", "zone transmission system" and "dedicated transmission system". Once the limits of each of these transmission systems have been determined, all the facilities that are necessary to ensure the continuity of such system will be included.

National Transmission System: the national transmission system is that system that allows the formation of a common electricity market, interconnecting the other segments of transmission, and will be constituted by the electrical lines and substations that allow the development of this market and enable the supply of the entire consumption of the electrical system, in front of different scenarios of availability of the generation facilities, including contingency and failure situations, considering the quality and safety of the service requirements established in this law, regulations and standards techniques.

Dedicated Transmission System: dedicated transmission systems will consist of radial electrical lines and substations, that being interconnected to the electrical system, are essentially arranged for the supply of electricity to users not subject to price regulation or to inject the production of the power plants to the electrical system.

Likewise, those entangled facilities that are arranged for what is indicated in the previous paragraph will belong to the dedicated transmission systems, and in addition it is verified that their operation does not produce significant impacts or modifications in the operation of the rest of the system, according to what regulation determines.

The payment for use made by regulated customers of this type of facilities will be governed in accordance with the rules established in articles 102 and following.

Zonal Transmission System: each zonal transmission system will consist of the electrical lines and substations arranged essentially for the current or future supply of regulated, territorially identifiable customers, without prejudice to the use by not regulated customers or generation means connected directly or through of transmission systems dedicated to said transmission systems.

Transmission System for Development Poles are not relevant for this paper purpose.

IV. DESCRIPTION OF THE CHILEAN ELECTRICAL SYSTEM

The characteristics of the transmission system whose assets were categorized in the last process are presented in Table 1.

Table 1: Characterization of transmission assets of the National Electric System

Item type	Number of sections	Topology section		Topology section [%]	
		Radial	Mesh	Radial	Mesh
Transmission Lines	1039	672	367	64,7%	35,3%
Transformers HV/HV	148	83	65	56,1%	43,9%
Transformers HV/MV	292	290	2	99,3%	0,7%
Transformers MV/MV	4	4	0	100,0%	0,0%

In addition, regarding the radial transport sections, the detail is presented in Table 2.

Table 2: Characterization of radial sections

Item type	Number of radial sections
Transmission Lines	672
Transformers HV/HV	83
Transformers HV/MV	290
Transformers MV/MV	4

Respect for zonal transmission assets, in accordance with the provisions of the technical regulations, these correspond to installations with a voltage greater than 23 kV, and depending of the geographical area of the Chilean system, there is zonal transmission at voltage levels of 33 kV, 44 kV, 66 kV, 110 kV, 154 kV and 220 kV.

IV. STAGES OF THE CATEGORIZATION PROCESS

- According to the established on the GLES, the process begins by sending the transmission system information to the NEC by the National Electrical Coordinator². Then, within ninety calendar days following the receipt of the information indicated above, the NEC must issue a Preliminary Technical Report with the categorization of all lines and substations of the transmission system. Interested participants and users and institutions have a period of fifteen business days to submit their comments to that report.
- Within fifteen business days following the expiration of the deadline for submitting observations, the Commission must issue and communicate the Final Technical Report on the Categorization of facilities, accepting or rejecting the observations raised.
- Within ten business days following the communication of the Final Technical Report, interested participants and users and institutions may submit their discrepancies to the Panel of Experts³ [5], which has a maximum legal deadline to define a hearing, in which both the Commission and those who have submitted discrepancies They have the possibility to develop their arguments. Subsequently, the Panel of Experts must issue an opinion regarding all discrepancies, which must be collected and implemented in a Final Technical Report by the NEC.
- Within the following ten bussines days of the communication of the Final Technical Report, interested participants and users and institutions may submit their discrepancies to the Panel of Experts³, which has a maximum legal deadline to define a hearing, in which both the Commission and those who have submitted discrepancies have the possibility to develop their arguments. Subsequently, the Panel of Experts must issue an decision regarding all discrepancies, which must be collected and implemented in a Definitive Technical Report by the NEC.

V. METHODOLOGICAL DISCUSSION

The methodological discussion on the categorization of facilities of transmission systems was carried out in the following instances: (i) internal discussion at the NEC, (ii) discussion between NEC and a small group of specialists through work tables; and (iii) reception and analysis of proposals made by stakeholders. The above served as input for the NEC in the development of the regulation that would contain the methodology of categorization of transmission facilities.

Due the Law mandates the categorization of infrastructure of lines and substations, but does not establish general guidelines on how and under what criteria develop the categorization of facilities, except those present in the definitions of each of the transmission systems, is that the first difficulties arose⁴. Thus, from the legal definitions it was necessary to detach certain criteria according to which to make the categorization of facilities, those that were based on their characteristics (voltage, mesh level, among others), their functionality, their location within the system, among other aspects.

² The Independent Coordinator of the National Electric System is the technical and independent body responsible for coordinating the operation of all the installations of the national electric system that operate interconnected with each other (article 212-1 GLES).

³ Autonomous Collegiate Body, whose function is to pronounce, by means of binding opinions, on those discrepancies and conflicts that, according to the law, arise on the occasion of the application of the electricity and gas services legislation that the electric companies, gas services and other authorized entities submit to their knowledge. Definition obtained from the website of the Panel of Experts <https://www.panelexpertos.cl/>.

⁴ In contrast, the GLES, before the changes introduced by Law N° 20.936, established the following five characteristics that the STT had to meet, based on which it proceeded to its categorization: (i) relevant variability in magnitude and direction of the flows; (ii) have a nominal voltage equal to or greater than 220 kV; (iii) that the magnitude of the flows was not determined by the consumption of a small number of consumers or a small group of generating plants. These characteristics were not compatible with the new definitions of the transmission systems, so it made no sense to replicate the criteria previously used to perform the rating.

On the other hand, because Law No. 20.936 establishes the full recognition of the facilities of the Zonal Transmission System, from the point of view of their remuneration, there was a great incentive for the methodological proposals that were submitted would set aside the larger number of facilities from being classified as part of the National or Zonal Transmission System, assigning the Dedicated Transmission System to those radial facilities for exclusive use by generating plants or customers not subject to price regulation, which was not consistent with the definition of zonal and dedicated transmission systems. In this sense, the GLES contemplates that both systems can be used by both customers subject to price regulation and by not regulated, determining whether an installation belongs to one or the other of these systems depends on what is the purpose for which it is essentially arranged, which was defined based on a Factor. Thus, the proposals aimed at establishing a similar Factor to the one used to categorize the STx⁵ which was relevant, especially for the categorization of radio installations, because additional criteria were used in the meshed installations in accordance with what was explained in section VI.

Similarly, there were also visions found as to how to apply the principle of continuity established in the GLES. The proposals tended to result in the methodology ended up in the majority of the facilities being categorized as part of the National or zonal system. However, the criteria according to which the principle of continuity was applied sought, on the one hand, to collect the real functionality of the facilities, and on the other, to reflect that GLES admits the existence of a plurality of zonal and dedicated systems (what it follows from the definitions of these systems).

Also related to the new remuneration structure, in which all final customers attend to the payment of the facilities of the National Transmission System, those national substations, which physically contained power transformers arranged essentially to supply customers subjected to price regulation, corresponded that they were paid by all final customers, a hypothesis that did not happen in the previous regulation, and that could mean that all customers not subjected to price regulation experienced a significant increase in their transmission charges.

Another relevant aspect when establishing the methodology for qualifying facilities for the Chilean electrical system was the consideration of the topological and siting characteristics of the system. The current Chilean electrical system is the interconnection of two systems, SING and SIC, which functioned independently and whose topological characteristics were different. The old SING, or Interconnected System of the Great North, presented a rather meshed topology with few radial installations, which were located in the first three regions of the country, instead, the former SIC, or Central Interconnected System, presented a rather radial characteristic, with a main corridor that went from north to south covering ten regions.

By joining these two systems, the current Chilean electrical system turns out to be heterogeneous in its topology, so general or simple rules did not include the behavior or functionality of the networks, so the qualification of the facilities became a more complex problem.

Finally, there was also an additional difficulty related to the size of the problem - and the consequent amount of information of the facilities - since the categorization process according to the new regulation covers a much greater amount of facilities than the previous ones, in which the categorization of the STT and STx facilities was disengaged, and the facilities of the additional transmission systems were rated in shape. In this way, the application of a simple methodology was able to solve the problem in limited time with consistent results.

To solve the problem indicated above, the criteria described below were discussed and adopted:

⁵ Under the previous regulation it was clear that, from an expected operation, consider a Factor of at least 10% of regulated customers so that it was categorized as subtransmission.

From the categorization by voltage level: due to the size of the problem and the need to incorporate restrictions that allow its convergence, the National Transmission Systems could be composed of installations with voltage greater than 200 kV and, in particular, all the transmission meshed facilities, with voltage level equal to 500 kV (higher voltage level in Chile), will be part of said system.

From the conceptualization of the facilities to be categorized: the definitions of “transport section” and “substation section” were incorporated into the regulation. In these definitions, it was considered that the “substation section” would not necessarily contain all the elements that are physically in a substation, but that it is constituted by a set of common facilities, economically identifiable, located inside a substation, whose use is not attributable to a particular transport segment and that serves all transport segments that connect to it, regardless of their categorization. At the same time, “transport segment” was defined as that consisting of the minimum set of economically identifiable facilities to form a transmission line, and which may include all those facilities that are not contained in the definition of substation section. Under this logic, those power transformers, for example 220 kV to 110 kV, which are physically located in a substation, are considered as transport sections, since they are economically identifiable, and it could have a different categorization than the substation that belong.

This resulted in the existence of about 1483 transport sections, consisting of transmission lines and power transformers, and 876 substation sections, consisting of all the elements that are part of a substation and are not identified as transport sections.

The size of the problem: various methodologies were discussed to categorize based on maximum consumptions, installed generation capacity, line capacity and substations. However, it was concluded from the discussion that it was not possible to perform a categorization of facilities without at least having simulations of the economic operation of the system, due to the impossibility of associating maximum consumptions and generation and transmission capabilities to mesh systems. The discussion at this point served to define a categorization methodology for radio installations, which is presented in the next section.

From the tendency to categorize the facilities as national or zonal: it was early identified that this could steeply increase the transmission charges of regulated customers - and not regulated in some cases -, without having a direct benefit. The above was always in sight in the discussion.

Of the Factor: in this case, when there are new definitions of the transmission systems, based fundamentally on the functionality of the facilities and in the concept of essentiality⁶, in addition to trying to find a simple methodology to categorize, it arrived at a Factor, which It establishes, from a theoretical exercise, that at the end of five tariff periods, that is, twenty years, there would be an expected use of regulated clients with respect to the free ones equal to a proportion of 51% - 49%, respectively. In this way, achieving stability was aimed in the categorization, being the premise that it did not suffer modifications, at least, because of the change in the growth rate of consumption. Additionally, in the first instance, it was discussed in the Commission to compare the maximum consumption of regulated customers with respect to the sum of maximum consumption of not regulated customers and generating plants. However, when receiving observations regarding that methodology, the directionality resulting from the flow was also considered when comparing consumptions with respect to generation and, in the event that the installation is essentially arranged for the supply of final customers, determine whether for customers free or regulated.

⁶ The concept of "essentiality" contained in the definitions of Dedicated Transmission System and Zonal Transmission System established in the GLES, refers to the purpose for which the facilities are essentially arranged, and not to whether a particular installation is essential or Not for a certain purpose.

On the categorization of facilities from expansion plans: initially, the discussion aimed at categorizing all the facilities of the transmission system, regardless of their origin. Then, it was noted that there were facilities established in expansion plans that had a secured payment for 20 years from the date of commissioning (those of the STT) that, applying the methodology developed, would be attached to the Dedicated Transmission System. This generated an incongruity, since, on the one hand, the installation would be paid during the next 20 years by the final users, but it would not have to comply with the technical requirements established in the technical regulations for this segment. Due to the aforementioned, an “administrative restriction” was incorporated at the end of the categorization process, which consisted of maintaining the categorization of those facilities from expansion plans, regardless of the categorization obtained as a result of the application of the methodology.

On the application of the continuity criterion: because the GLES establishes that “once the limits of each of these transmission systems have been determined (national, zonal, dedicated, and others), it will be included in it all the transmission assets that are necessary to ensure the continuity of such system”. In many cases, once any methodological test was conceptualized, there would undoubtedly be isolated zonal transmission facilities that, interconnected through several dedicated facilities, were interconnected to other zonal or national facilities. Taking into account the principle of continuity, the dichotomy was presented as to whether all the facilities of the dedicated transmission system indicated in the example were to be assigned to the zonal transmission system, or if the zonal transmission system that was isolated should be assigned to the dedicated transmission system. The answer to the previous question was of great relevance, given that the categorization of these facilities would impact on who will pay those assets.

VI. METHODOLOGY AND ITS IMPLEMENTATION

The methodology that was defined based on the criteria set exposed in the previous section was embodied in Exempt Resolution No. 380, 2017, of the National Energy Commission [6], and in the Technical Categorization Report [7]. The methodology can be separated into the following sequential stages: categorization of radial installations; categorization of mesh installations with less than 200 kV voltages; categorization of meshed installations with more than 200 kV voltages; and continuity analysis of the transmission segments. Each of these stages is described below.

Categorization of radial installations: The categorization of facilities starts from the extremes of the entire transmission system, and from these, it is analyzed, regarding each transport section, for which use it is essentially arranged, according to the following:

Categorization of transport and substation sections for exclusive use: those radial installations that are exclusively for use by a generator or customer not subject to price regulation are categorized as dedicated system. On the other hand, are categorized as zonal system.

Categorization of transport and mixed use substation sections: three cases are identified:

- 1) if the installation presents a shared use between generators and free clients, the installation is categorized as a dedicated transmission;
- 2) If the installation is used by not regulated customers and regulated customers, the maximum consumptions of these are compared. If, as a result of the comparison between the maximum consumption of the not regulated customers and that of the regulated customers, considering the Factor referred on Section V, the proportion of not regulated customers is higher, then the installation is categorized as dedicated system. Otherwise, it is categorized as zonal system; and,

3) If the installation is shared by a generator, not regulated customers and regulated customers, in the first instance, the net power of the generator is compared with respect to the sum of the consumptions of the customers, free and regulated. If as a result of the comparison, considering the Factor referred in Section V, the generator presents more participation, the installation is categorized as a dedicated transmission. Otherwise, the procedure set out in point (ii) is applied to determine whether the installation is dedicated transmission or zone transmission.

Categorization of mesh installations with less than 200 kV voltage:

1) Categorization of border substation sections: “border substation section” is defined as the one that connects the meshed up system with the radial one. These sections are categorized by the methodology described in the previous point, considering all the generators, consumptions of not regulated customers and regulated customers that are radially connected to this section of substation.

2) Categorization of transport sections between border substations categorized as zonal transmission: in case there are two sections of border substation categorized as belonging to the zonal transmission system, linked through a transport section, the last one is also classified as zonal transmission.

3) Categorization of transport sections by use indicators: GLDF (Generalized Load Distribution Factor) indicators are used to identify the proportion of use between not regulated customers and regulated customers with respect to all transport sections. Once this has been done, the indicators used to qualify the mixed-use radio installations are used as a threshold to categorize zonal installations. Additionally, those transport sections that have a not regulated customers GLDF greater than 90% are categorized as belonging to the dedicated transmission system.

4) Categorization of remaining transport sections through the exercise of expendability⁷: with all the transport sections not categorized according to the above, successive simulation exercises are carried out, in power system analysis software and economic dispatch software, in which it is dispensed a particular transport segment, and that case is compared with respect to a base case, which is one in which all sections are operating normally closed. If, as a result of the exercise of disregard of a particular installation, energy is not supplied to regulated customers, a relevant variation of marginal costs or voltage profiles that do not allowed on the current regulations, said installation is classified as belonging to the zonal transmission system. If none of these effects occur, the installation is categorized as part of the dedicated transmission system.

Categorization of meshed installations with voltage exceeding 200 kV

1) Categorization of transport and substation sections with a constructive standard equal to 500 kV: they are classified as belonging to the National Transmission System.

2) Categorization of transport sections by exercise of expendability⁸: Regarding those installations with a voltage level below 500 kV, it is carried out a sequential exercise of disregard to determine if the transport section belongs to the National Transmission System. If the section under analysis is not categorized as National, it is analyzed whether the section belongs to the zonal transmission segment, and in case none of the hypothesis to be categorized as such are fulfilled, it is assigned to the dedicated transmission segment.

⁷ It is previously analyzed if the installation, to which the exercise of disqualification will be applied, has the necessary maneuvering equipment to perform it. In case it does not have such equipment, this set of facilities is qualified at the end of the stage, depending on the qualification of the facilities that are around it, assigning a primacy for the purposes of qualifying the national, then zonal, and finally dedicated transmission facilities.

⁸ The same is considered with respect to the maneuvering equipment of those installations with a voltage level below 200 kV.

2.1) The analysis to determine if a section of transport belongs to the National Transmission System is to check, as a result of the exercise of disregard, the expected flows, with respect to a base case, on those facilities previously classified as belonging to the National Transmission System (initially as indicated in letter a), they are modified by 10%, or if there is a change in marginal costs or energy is not supplied in two or more regions of the country⁹, or if there is a decrease in the security of the system and a modification in the tension profiles of such an entity, that the system does not comply with the provisions of the technical regulations. If any of these effects occur, the section in question is classified as part of the National Transmission System.

2.2) Subsequently, to determine if the sections that were not categorized as indicated in the paragraph belong to the zonal or dedicated transmission system, a similar methodology is applied, but a region is bounded and the variation of expected flows are not analyzed regarding facilities previously categorized as belonging to the zone transmission segment (analysis of radio installations). In case of non-supplied energy from regulated clients increase in marginal costs, or variation in tension profiles, the section under analysis is attached to the zonal transmission system. Otherwise, it is attached to the dedicated transmission system.

3) Categorization of remaining substations: at this stage all of the transport sections are categorized. Therefore, those sections of substation not categorized by means of the aforementioned (dispuesto), the transport capacity of the transport sections corresponding to transmission lines will be compared, being the substation sections rated based on that transmission segment that has the highest proportion.

Continuity analysis of the transmission segments: The GLES establishes that, once the limits of the transmission systems are determined, all the facilities that are necessary to ensure the continuity of such systems must be included in each of them. In particular, in the definition of the National Transmission System, it is pointed out that it must be the one that allows the formation of a common electricity market, emphasizing its uniqueness. That is, there must be a single National Transmission System. Due to the above, the continuity analysis consists in the fact that, if due to the application of the methodology, there were sections whose categorization implies that the National Transmission System is not electrically connected, those installations with a higher than 200 kV voltage level will be assigned to this system, allowing it to be joined from the minimum electrical distance between the unconnected points.

On the other hand, regarding the continuity of zonal and dedicated installations, analyzes were made of each of the sets of electrically interconnected installations, identifying those that presented a different categorization than the electrically connected installations adjacent to them, which changed their categorization to the one presented by the facilities to which the installation in analysis was interconnected, in order to ensure the continuity of the respective set of adjacent facilities. It should be noted that the aforementioned did not affect the continuity of the National Transmission System, that is, the categorization that would ensure the continuity of the National Transmission System was respected, regardless of the fact that, by the application of the continuity analysis another categorization would have corresponded. In addition, those dedicated transport sections that connected a section of national substation with a section of zonal substation also changed their categorization at this stage of analysis, becoming categorized as belonging to the zonal transmission segment.

In the event that a section of transport or substation could be classified indistinctively, by the application of the continuity criteria, as part of the zone transmission system or the dedicated transmission system, it was assigned in such cases to the zone transmission system.

⁹ The regions in Chile correspond to an administrative division of the country.

VIII. CONCLUSIONS

As the first conclusion of this work, we can highlight that, given legal changes of relevance, such as those introduced to GLES under Law No. 20.936, it is important and necessary to have more precise instruments in order to establish the objectives that were set at the time of undertaking such legal modifications. In this sense, when the first categorization process of transmission system installations was carried out, it was revealed that GLES suffers from a certain lack of precision in this matter, being necessary to establish the criteria to carry out said process in a regulatory body ad hoc, which led to a considerable quota of controversies about the relevance of the criteria defined by the regulator for the purpose of categorize the installations.

Related to the above, it was also noted the categorization process carried out, which is very useful for this type of process to be participatory, both for the purposes of developing a methodology, as well as for its implementation. As for the former, since that can be used to determine what those involved in the process expect and to gather visions and information with which the regulator, given its position, does not necessarily count, obtaining as a result a more transversal and legitimate methodology by All the actors. On the other hand, regarding the participation in the process of reviewing results and criteria established in the reports, the participation of the actors involved is useful for the purpose of reviewing the calculations developed by the regulator and the results.

Regarding more specific aspects, it is also important to highlight the difficulties that arose in the development and application of the methodology to categorize mixed-use facilities through the application of a Factor, and on the methodology for applying the principle of continuity of transmission systems. Particularly, in the first categorization process, it was complex to apply the methodology related to the two aspects previously mentioned –functionality of the facilities and continuity–, given that it departed from what had been done based on the regulation prior to the entry into force of Law No. 20.936, since in many cases, the results obtained were not as expected, which generated a high level of challenge to the methodology itself and the results obtained.

In this sense, it can be concluded that it is relevant that all the actors involved in a process, in this case, the categorization one, are able to abandon the concepts and ideas that have been reformed and that have lost their validity, adapting to the new paradigms that arise from the new regulation.

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