



**Evaluation of the probability of
interruption for the Interconnection
Point, as established in the Commission
Regulation (EU) 2017/460, 16th March
VIP Ibérico
Gas Year 2020 / 2021**

Version2

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1 Framework

The publication of Commission Regulation (EU) 2017/460 of 16th March 2017 establishing a network code on harmonised transmission tariffs structures for gas (Tariff Network Code) has defined the rules for the calculation of reserve prices for standard capacity products for interruptible capacity. In particular, Article 16 (1) specifies that reserve prices for interruptible capacity products should be calculated by applying a discount to the reserve prices of their respective firm standard capacity products.

As established in Article 146 (17) of the Portuguese Tariff Regulation for the natural gas sector¹ it is foreseen that, for the establishment of prices for standard capacity products for the use of the network infrastructure, the respective transmission system operator shall annually evaluate the probability of interruption according to the above-mentioned Commission Regulation. This evaluation shall include:

- 1) a list of all types of standard capacity products for interruptible capacity offered, including the respective probability of interruption and level of the discount to be applied;
- 2) an explanation on how the probability of interruption is calculated for each type of product;
- 3) the data used to calculate the probability of interruption.

According to Article 130 of the portuguese Regulation, on the methodology of calculation of tariffs of use of the high pressure network to be applied by the operator, it is foreseen in point 6 that, if in the previous gas year no interruption of capacity has occurred due to physical congestion at the international interconnection points, the reserve prices of standard capacity products for interruptible capacity are equal to the prices of firm standard products on the same horizon, with a subsequent discount applied in case an interruption occurs. This discount consists of a compensation paid for each day an interruption occurred and equals to three times the reserve price for firm standard daily products.

Alternatively, point 8 of the same Article defines that if an interruption of capacity in the interconnection points occurred due to a physical congestion, reserve prices of standard capacity products for interruptible capacity shall be a result from the application of a previous discount, as mentioned in tariff regulation for the natural gas sector.

Taking into consideration the gap between this analysis and the application of such prices, with a 12-month dilation period, the transmission system operator performed an update to the extent of the data to be considered thus achieving a more reliable and updated analysis. The present document includes that result as well as the comments received from the National Regulatory Agency to the proposal presented in March.

¹ The National Tariff Regulation for the natural gas sector in force was approved by Regulamento n.º 361/2019 published in Diário da República, 23rd April 2019, and reviewed by Regulamento n.º 455/2020, 8th May.

2 Types of standard capacity products for interruptible capacity

Regulation (EU) 2017/459 establishing a network code on capacity allocation mechanisms in gas transmission systems, foresees that high pressure system operators shall offer standard capacity products for interruptible capacity at least for the daily and within-day horizon.

Accordingly, standard capacity products for interruptible capacity to be offered in VIP Ibérico, the virtual point which aggregates the capacities of both physical interconnections points at Badajoz / Campo Maior and Valença do Minho / Tuy, are as follows:

- daily capacity product, in both directions of the international interconnection point, where the respective standard capacity product for firm capacity was sold out day-ahead or was not offered. It shall be allocated via an auction process;
- within-day capacity product, in both directions of the international interconnection point, when all firm capacity, whether technical capacity or additional capacity, is sold out. It shall be allocated by means of an over-nomination procedure.

The offer of these products shall be made by the application of Regulation (EU) 2017/459, regarding capacity allocation mechanisms in high pressure gas networks.

3 Probability of interruption for the gas year 2020 / 2021

The probability of interruption shall be calculated for each type of standard capacity product for interruptible capacity to be offered, according to the expression in Article 16 of the Tariff Network Code:

$$Pro = \frac{N \times D_{int}}{D} \times \frac{CAP_{av. int}}{CAP}$$

- (N) expected number of interruptions;
- (D_{int}) average duration of expected interruptions;
- (D) Total duration of the respective type of standard capacity product for interruptible capacity;
- (CAP_{av.int}) expected average amount of interrupted capacity for each interruption, where this amount is related to the respective type of standard capacity product for interruptible capacity;
- (CAP) total amount of interruptible capacity for the respective standard interruptible capacity product type.

3.1 Historical data on the use of capacity

For the international interconnection point of the high pressure network, and for the period in analysis there was no interruption of capacity due to a physical congestion. The following graphic shows booking and usage levels in each direction of the international interconnection point from October 2016 to February 2020.

As the graphic in figure 1 shows, last year presents a different trend as compared to the previous years, with a reduction on the entry point, a growth in the exit point, with a temporary inversion of the physical flow. During this period, there were no conditions in the use of capacity conducive to the occurrence of capacity interruption due to physical congestion.

VIP Ibérico - October 2016 to February 2020

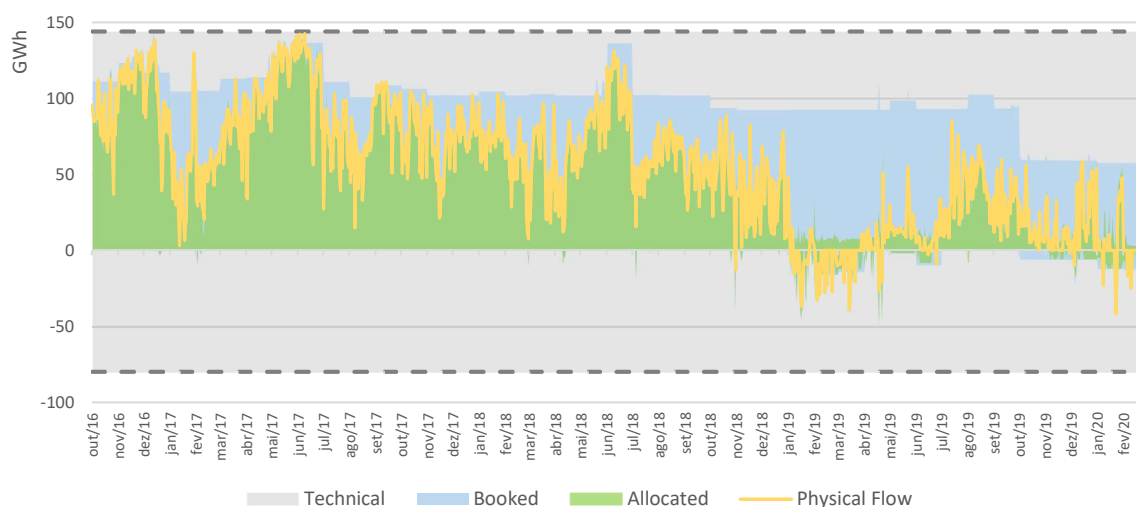


Figure 1

For the above mentioned reason, due to the lack of incidents for the calculation of probabilities with some adherence to practical scenarios, it is not possible to compute this probability on the basis of historical interruption with the direct application of the expression referred in the Tariff Network Code, for any of the standard capacity products of interruptible capacity.

Hence, an alternative approach is suggested for the calculation of the probability of interruption that will respect equivalent requirements regarding the expected occurrence of interruptions, their dimension and average duration.

Considering that all requirements to offer such capacities are fulfilled, any eventual standard capacity for interruptible capacity products in the international interconnection points can only derive from the firm capacities that although previously booked have not been used. In this case, both the offer and its respective interruptibility will be driven by the way the market will use their rights in nominations and renominations for each gas day.

The following paragraphs present the suggested methodology, valid for both directions of the International Interconnection point.

3.2 Alternative Methodology for the calculation of the probability of interruption

In practice, when all firm capacity (technical capacity and additional capacity) for a gas day is booked, its under use, either by nomination or renomination at any time, will result in an available interruptible capacity, as presented in figure 2.

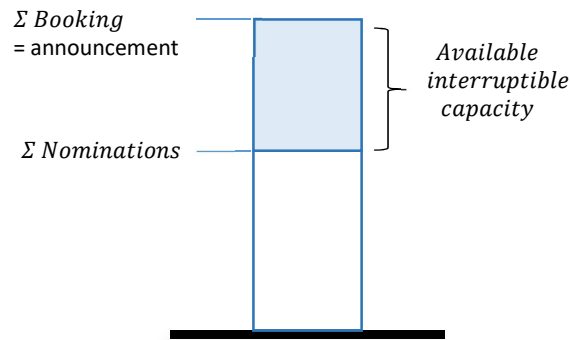


Figure 2

This interruptible capacity is available for booking as defined in Regulation (EU) 2017/459.

In this case, further renominations for higher levels of usage within the respective firm capacity booked, within the limits of booked capacities will shorten the interruptible capacity previously offered, and affect the confirmation of interruptible capacity previously assigned, creating an interruption of capacity. This case is illustrated in figure 3.

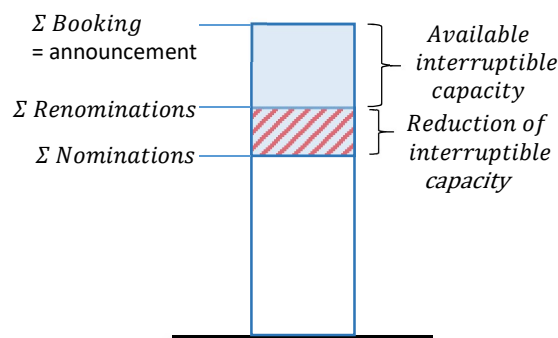


Figure 3

Assuming, as a proxy, that historical market behavior in the use of firm booked capacity may have the same statistical significance in case firm capacity is completely taken, it will be reasonable to accept that the probability of interruption of the interruptible capacity for a gas day will be a result of the product between (i) probability of booking interruptible capacity

available because of the under use of firm booked capacity, figure 2, and the (ii) probability of reducing the available interruptible capacity (renomination to a higher value).

$$PI(d) = PC(d) \times PR(d) \times T \quad (1)$$

PI (d) - Probability of interruption for gas day d

PC(d) - Probability of booking of interruptible capacity for gas day d

PR (d) - Probability of reduction of available interruptible capacity for gas day d, as a function of higher use of firm capacity in renomination processes taking place in an historical relevant period

T - ratio between the number of days for which an increase in the use of firm capacity in a renomination is expected and the number of days of the considered period.

As it is not possible to predict the market behavior when booking interruptible capacity, it is proposed to assume a behavior of the frequency of occurrences in the PC(d) booking interval identical to the frequency distribution calculated for PR(d), presented in figure 4.

The following chapters present the results of the application of this methodology.

3.3 Proposal to calculate the probability of interruption for the gas year 2020 / 2021

It is considered relevant the period between October 2016 and February 2020.

Regarding the entry direction through the international interconnection point, the ratio of increase of use of firm capacity in renomination processes was as follows:

T:	58,77%
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Through this analysis, it was possible to calculate the frequency of reduction of the interruptible capacity, thus determining the distribution of such capacity reduction, PR(d), expected on gas day d, as in figure 4.

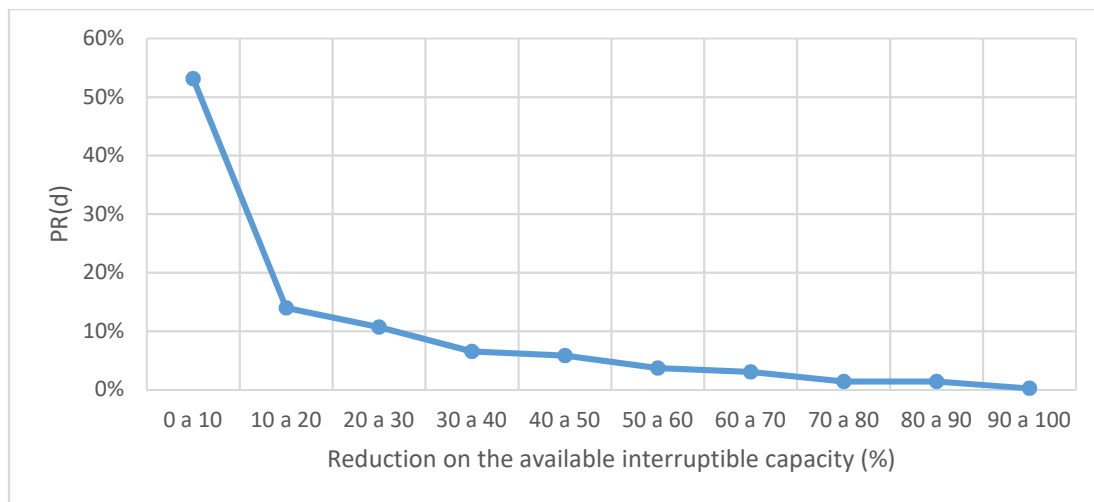


Figure 4

As already referred in 2.2, it is assumed that the probability of booking of interruptible capacity, PC(d), shows the same distribution of reduction of available interruptible capacity, calculated for PR(d), where both compete to the reduction of such capacity, but in opposite directions.

Having all terms of equation (1) characterized, it will be possible to calculate PI (d). The probability of interruption for each set of hypotheses of reduction of booked interruptible capacity, PC(d), and by renomination, PR(d), for each range of available interruptible capacity, is shown in table 1, and is the product between the first and the second term of equality (1). This table show the result of the accumulated probability of interruption for each range of available capacity, in the last column, $\Sigma [PC(d) \times PR(d)]$.

Table 1

	0 to 10	10 to 20	20 to 30	30 to 40	40 to 50	50 to 60	60 to 70	70 to 80	80 to 90	90 to 100		
	PR(d)											
PC(d)	53,15%	13,99%	10,72%	6,53%	5,83%	3,73%	3,03%	1,40%	1,40%	0,23%	$\Sigma [PC(d) \times PR(d)]$	
90 to 100	0,23%	0,124%	0,033%	0,025%	0,015%	0,014%	0,009%	0,007%	0,003%	0,003%	0,001%	0,233%
80 to 90	1,40%		0,196%	0,150%	0,091%	0,082%	0,052%	0,042%	0,020%	0,020%	0,003%	0,655%
70 to 80	1,40%			0,150%	0,091%	0,082%	0,052%	0,042%	0,020%	0,020%	0,003%	0,460%
60 to 70	3,03%				0,198%	0,177%	0,113%	0,092%	0,042%	0,042%	0,007%	0,671%
50 to 60	3,73%					0,217%	0,139%	0,113%	0,052%	0,052%	0,009%	0,582%
40 to 50	5,83%						0,217%	0,177%	0,082%	0,082%	0,014%	0,571%
30 to 40	6,53%							0,198%	0,091%	0,091%	0,015%	0,396%
20 to 30	10,72%								0,150%	0,150%	0,025%	0,325%
10 to 20	13,99%									0,196%	0,033%	0,228%
0 to 10	53,15%										0,124%	0,124%
	$\Sigma [PC(d) \times PR(d)] =$											4,245%
	$\Sigma [PC(d) \times PR(d)] \times T =$											2,495%

Example: If at a time when interruptible capacity is available, there is a level of booking of such capacity in the range of up to 10% (event with probability of occurrence

PC(d) = 53.15%), the reduction up to 90% on the interruptible capacity cannot generate any impact. Only when there is a reduction to a capacity level in the range of 90 to 100% (independent event with probability of occurrence PR(d) = 0.23%) an interruption will occur, in this case with a 0.124% probability. The same reading should be made for each booking range and the accumulation of probabilities over successively reduced capacity ranges should be considered for this purpose

By applying the sum to the calculated cumulative probability distribution set, the interruption probability is obtained by taking as a reference the days where the firm capacity increases in re-nomination processes. Since the probabilities calculated in Table 1 were determined within the ratio of firm capacity increases in renomination processes, T, it is necessary to transpose this reality into the frame of reference for the period considered in the study, applying the last term of equality (1). This computation, $PI(d) = \sum [PC(d) \times PR(d)] \times T = 2,495\%$, and this should be the probability of interruption to use. The value calculated is in some way characteristic of the most recent market behavior.

In the export direction, there is a lack of relevant historical data to enable a similar analysis to be carried out on a sustained basis. For this reason, the same probability of interruption, PI(d), should be considered for both directions.

4 Conclusions

Due to the lack of any record of interruptions of interruptible capacity at the international interconnection points, the ex-post discount methodology as defined in the document has been applied in the national system until now. This methodology is explained in the "Implementation of the Network Code on Harmonised Tariff Structures for the Transmission of Natural Gas - Document justifying the reasoned decision", approved by ERSE Directive No 3/2019. The ex-post discount is calculated according to the following expression²:

$$\underbrace{Ex - post\ discount}_{\text{€}} = 3 * \underbrace{Reserve\ Price\ (Firm\ daily\ product)}_{\text{€/kWh/day}} * \underbrace{Booked\ capacity}_{\text{kWh/day}}$$

Remark: booked capacity is the booked capacity of a standard interruptible capacity product for a user whose capacity was interrupted.

The application of this discount identified the need to mitigate the possibility of significant deviations in revenue from the booking of this type of product in the mentioned booking horizons. It should be noted that, since interruptible capacity products are offered due to the effect of the nomination levels on each gas day and re-nomination verified at each time, there is a possibility of artificial discounts being generated to be supported by the system. To overcome this effect, it would be necessary that in the monthly settlement of the use of each market player's national natural gas transmission network, as regards daily and within-day horizons, that discount would be confined to the aggregate monthly amount of interruptible capacity booked by the respective market agent in these horizons.

As this option has too little approval by the market, reflecting its low implementation at European level, a theoretical approach on the calculation of a probability value reflecting the effects on possible interruptions of this type of capacity has been chosen, seeking to establish a methodology that would allow the implementation of an earlier discount, taken by the market to be more stable and predictable.

Considering the alternative methodology for determining the probability of interruption proposed in this document complies with the requirements set out in the relevant regulations regarding the expected occurrence of interruptions and their average size and duration, a prior discount on the reserve prices for their standard capacity products of firm capacity equal to the value of the probability presented shall be more appropriate.

² Paragraph 73 (capítulo 6 – Descontos e Multiplicadores / subcapítulo 6.2 – Desconto aplicável a produtos de capacidade interruptível normalizados).