H. RELIABILITY STANDARD AND LOLE CRITERIA

Power systems need to have the ability to always meet demand. This vital characteristic is referred to as the Adequacy of the power system. A system is considered 'adequate' if it meets a reliability standard criterion. Following EU Regulation, the metric used to express the reliability standard is the Loss Of Load Expectation (LOLE). This appendix defines this metric and puts it into perspective.

H.1. DEFINITION

The LOLE metric defines, for a given geographic area and time period, the statistically expected number of hours during which the generation will not meet demand, taking into account interconnectors and generation, and for a statistically normal year.

The EU Regulation 2019/943 required that a new harmonised methodology for calculating the reliability standard needs to be defined. This methodology is the one adopted by ACER (Decision 23-2020) on 2nd October 2020 and now serves as a basis for determining the reliability standards of European countries.

ACER has defined a full methodology to assess the reliability criteria. A given LOLE target can be established. This metric is an upper bound which if exceeded would result in a loss of welfare. This target is defined by two other metrics:

- The Value of Lost Load (VOLL) $[\frac{€}{MWh}]$:
  the monetary losses arising from the non-supply of energy.
- The Cost of New Entry (CONE) $[\frac{€}{MW}]$:
  the total annual net revenue per unit of de-rated capacity, that a new generation resource or demand-side response would need to receive over its economic life in order to recover its capital investment and fixed costs.

$$LOLE_{target}[h] = \frac{CONE\ [€/MW]}{VOLL\ [€/MWh]}$$

The full definition and way to compute the CONE and VOLL are described in the EU Regulation 2019/943.

H.2. LOLE STANDARDS ACROSS THE EU

As stated above, in Europe the LOLE criteria is defined for each Member State. Hence, depending on the region the LOLE criteria can vary significantly. In the Table H- 1 are displayed some LOLE criteria across the EU:

TABLE H-1 — NATIONAL RELIABILITY STANDARDS APPLIED BY EU MEMBER STATES AS OF JUNE 2023 (SOURCE: ADAPTED FROM ACER'S SECURITY OF EU ELECTRICITY SUPPLY, OCTOBRE 2023)

MEMBER STATE	TYPE OF RELIABILITY STANDARD	VALUE (HOURS/YEAR)	CAPACITY MECHANISM
BE*	LOLE	3.00	Yes, market-based
CZ*	LOLE	15.00	No
DE*	LOLE	2.77	Yes, out of market (strategic reserves)
EE*	LOLE	9.00	No
FI*	LOLE	2.10	Yes, out of market (strategic reserves)
FR*	LOLE	3.00†	Yes, market-based († LOLE=2.00 after non-market measures applied)
GB***	LOLE	3.00	Yes, market-based
GR*	LOLE	3.00	No
IE**	LOLE	8.00	Yes, market-based
IT*	LOLE	3.00	Yes, market-based
LT	LOLE	8.00	No
NL	LOLE	4.00	No
LU*	LOLE	2.77	No
PT	LOLE	5.00	No
PL	LOLE	3.00	Yes, market-based and out of market
SE*	LOLE	0.99	Yes, out of market (strategic reserves)

* Based on the **EU-wide methodology for calculating the value of lost load (VOLL), the cost of new entry (CONE) and the reliability standard**. Implementation of the VOLL/CONE/RS methodology based on NRA declarations; the actual degree of compliance is not examined.
** The RS for the Integrated Single Electricity Market (ISEM) for the island of Ireland is set to 8h. Northern Ireland has a reliability standard of 4.9 h
*** Taken from the 'Statutory Security of Supply Report 2022' report

Setting the Belgian reliability standard remains the responsibility of the Belgian authorities. As of 4th September 2022, the official Belgian reliability standard has been defined to 3 hours [LAW-2].

The update of the Belgian reliability standard followed the commitment taken by the Belgian authorities in the framework of the decision (UE) 2022/639 of the European Commission on the 27th of August 2021 concerning the introduction of a capacity remuneration mechanism in Belgium. Therefore, the competent Belgian authorities have updated all metrics needed to compute the reliability standard, under to the methodology published by ACER (ACER (Decision 23-2020, of 2nd October 2020).

In summary, the CONE [FPS-7], VOLL [FPS-8] have thus been updated, after the introduction of a capacity remuneration mechanism in Belgium, and according to the required legal process.

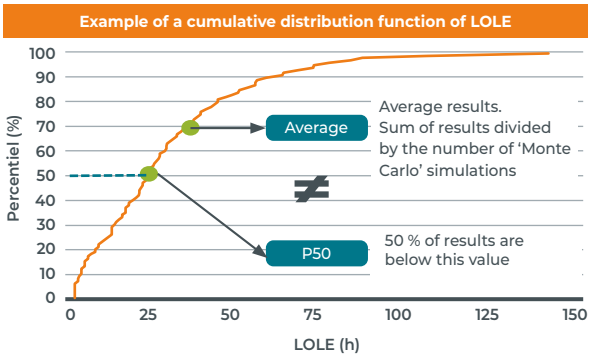
H.3. HOW TO INTERPRET THE LOLE CRITERIA

The LOLE metric cannot be computed over one single given year. This is because it can be highly sensitive to conditions of a particular year, such as: how cold the winter is; whether or not an unusually large number of power plants fail to work on a given occasion; the power output from wind generation at peak demand; and, all the other factors which affect the balance of electricity supply and demand. Hence the computation of the LOLE metric needs a probabilistic approach taking into account a large amount of climate years and outage patterns.

For this, one must run several 'Monte Carlo' simulations to compute future states of the system. For each future state, the model calculates the LOLE for the year. The distribution of the LOLE among all studied future states can be extracted. The following indicative Figure H-1 shows how to interpret the adequacy criteria through several metrics: Average LOLE and P50. Indeed, the average and the P50 are not the same in very skewed distributions (which is the case for the loss of load). In the past, another criteria was also used in Belgium, namely the P95 criteria. This is not anymore used, only the average LOLE is defined.

The LOLE criterion is the yearly average calculated from all the Loss Of Load (LOL) results obtained for each future state.

FIGURE H-1 — GRAPHICAL REPRESENTATION OF AVERAGE AND PERCENTILE (P50) BASED ON SEVERAL SIMULATIONS



Depending on the values of these indicators, four situations can be derived from the results as represented in Table H-2.

TABLE H-2 — WAYS TO INTERPRET THE DIFFERENT LOLE METRICS

LOLE AVERAGE	LOLE P50	Situation
0	0	No LOLE observed in any of the future states
>0	0	LOLE in less than 50% of all future states
>0	>0	LOLE in more than 50% of all future states

Note that the LOL results used to calculate these indicators are not an exact prediction of expected outages, or black-outs. They provide a measure of the probability of scarcity (in terms of the number of hours in which supply is not meeting demand), for a given future state of the system.