Electricity system defence plan of the Grand Duchy of Luxembourg

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Glossary

- *Demand disconnection:*

  An organised approach to significantly reduce electricity consumption, which may be undertaken by a TSO, a DSO or an industrial system operator, to manage an exceptional situation, observed, announced or foreseeable, which endangers the security of electricity supply, the integrity of the grids, the physical security or the safety of persons.

  It consists in restricting or temporarily suspending the supply of electricity to all or part of the consumers of the electricity grids, provided that the nation's essential needs are met.

  The notion of demand disconnection differs from that of contractual cut-off, which consists, for a consumer connected to an electricity grid, in voluntarily reducing his electricity consumption, in return for a possible remuneration. The demand disconnection does not give rise to any form of financial or other type of compensation, and does not require the prior agreement of the electricity consumers concerned.

- *DSO:*

  Distribution **S**ystem **O**perator is an entity entrusted with transporting electrical power (in this case) on a local level to supply end consumers, using fixed infrastructure.

- *ERP:*

  Emergency **R**esponse **P**lan defines the government's action in the event of an electricity supply crisis in the Grand Duchy of Luxembourg by establishing alert procedures, crisis management bodies and measures for the prevention, protection and rescue of the population.

- *ILR:*

  Institut **L**uxembourgeois de **R**égulation is the official government regulatory body for the energy in the Grand Duchy of Luxembourg. Its mission is therefore to ensure that competition is real and fair and that all consumers have access to services on reasonable terms.

- *High Priority SGU:*

  means the **S**ignificant **G**rid **U**ser for which special conditions apply for demand disconnection.

- *HV / MV:*

  High **V**oltage / **M**edium **V**oltage

- *Load-Frequency Control (LFC) Area:*

  Load-**F**requency **C**ontrol Area (LFC Area) is a part of a synchronous area or an entire synchronous area, physically demarcated by points of measurement of interconnectors to other LFC Areas, operated by one or more Transmission System Operators (TSOs) fulfilling the obligations of load-frequency control (Article 3(2)(12) od the Network Code on System Operation).

- *SGU:*

  Significant **G**rid **U**ser in the terminology used in the European Union Internal Electricity Market is the existing and new power generating facility and demand facility deemed by the TSO as significant because of their impact on the transmission system in terms of the security of supply including provision of ancillary services.

- *TSO:*

  Transmission **S**ystem **O**perator is an entity entrusted with transporting electrical power (in this case) on a national or regional level, using fixed infrastructure. Creos is the only TSO in the Grand Duchy of Luxembourg.

1 Preamble

The electricity system defence plan of the Grand Duchy of Luxembourg is an operational document collaboratively drawn up by the electricity grid operators of the Grand Duchy of Luxembourg, and communicated to the Government Commissioner for Energy and the Luxembourgish regulator (ILR).

It shall be applicable by the grid operators from its date of approval.

1.1 Regulatory and contractual basis

The defence plan is established in accordance with Articles 12 and 13 of the amended law of 1 August 2007 on the organisation of the electricity market, which authorises the "cut of connection points" as one of the preventive measures necessary to "limit the deterioration of safety, reliability, grids efficiency and electricity quality". The defence plan is also in conformity with Articles 11 to 22 of the network code on electricity emergency and restoration established by Commission regulation (UE) 2017/2196.

The defence plan is likely to affect all customers connected to the electricity networks of the Grand Duchy of Luxembourg, in compliance with the regulatory and contractual provisions in force relating to access to these networks.

It is also established in accordance with the requirements of the ENTSO-E “Operation Handbook"[a].

1.2 Objectives of the system defence plan

The system defence plan of the Grand Duchy of Luxembourg is limited to a demand disconnection plan.

Indeed active management of the grid is not available within the electrical grid of the Grand Duchy of Luxembourg, thus demand disconnection is the unique tool that can be used as a last resort by the electricity system operators of the Grand Duchy of Luxembourg to prevent the emergence of major incidents and to limit their consequences when they occur.

The purpose of this document is to define the circumstances and conditions under which this tool may be used by electricity system operators, the responsibilities and decision-making procedures associated with the practice of demand disconnection, its operational modalities, as well as the priority rules for demand disconnection of customers with the least damage.

It is designed to apply to the current structure of Luxembourg's electricity grids, but also to be easily adaptable to potential changes in them, in particular possible developments in interconnections with neighbouring grids or investments in control-command systems that facilitate the implementation of demand disconnection.

1.3 Panorama of electricity grids in the Grand Duchy of Luxembourg

It is essential to place this plan in the Luxembourgish electricity context, and to underlign, among its specific features, the country's strong dependence on imports from Germany and to a lesser extent from France and Belgium.

Any action on the balance between electricity supply and demand in the Grand Duchy of Luxembourg, in particular the demand disconnection, must be established in accordance with the actions undertaken by Amprion, and if necessary by RTE or ELIA.

1.3.1 Industrial, transport and distribution electricity grids

The electric system of the Grand Duchy of Luxembourg includes 7 grids :

[a] Policy P5 – Emergency Operations – V 3.1, available on the l’ENTSO-E website, at the following address : https://www.entsoe.eu/Documents/Publications/SOC/Continental_Europe/oh/170926_Policy_5_ver3_1_43_RGCE_Plenary_approved.pdf

- A national transmission grid, operated by Creos, which includes 2 double 220 kV interconnection lines with Germany (Amprion grid), with a unit capacity of approximately 500 MW, from the Flebour, Roost, Heisdorf and Blooren substations, and 6 transformer/distribution substations 220 kV / 65 kV distribution;
- 5 distribution grids operated by Creos (around 250 000 connected clients), Electris (4 100 connected clients), Sudstroum (16 000 connected clients), the City of Diekirch (3 500 connected clients) and the City of Ettelbruck (4 000 connected clients);
- 1 high-voltage industrial grid, operated by SOTEL, which can be connected to the Creos transmission grid via 220 kV substations in Schifflange and Oxylux. This grid supplies only industrial consumers and part of the national railway company. It is connected to ELIA's Belgian transmission grid by two 220 kV lines, and belongs to ELIA's control area; it is also connected to RTE's transmission grid via a 220 kV cable.

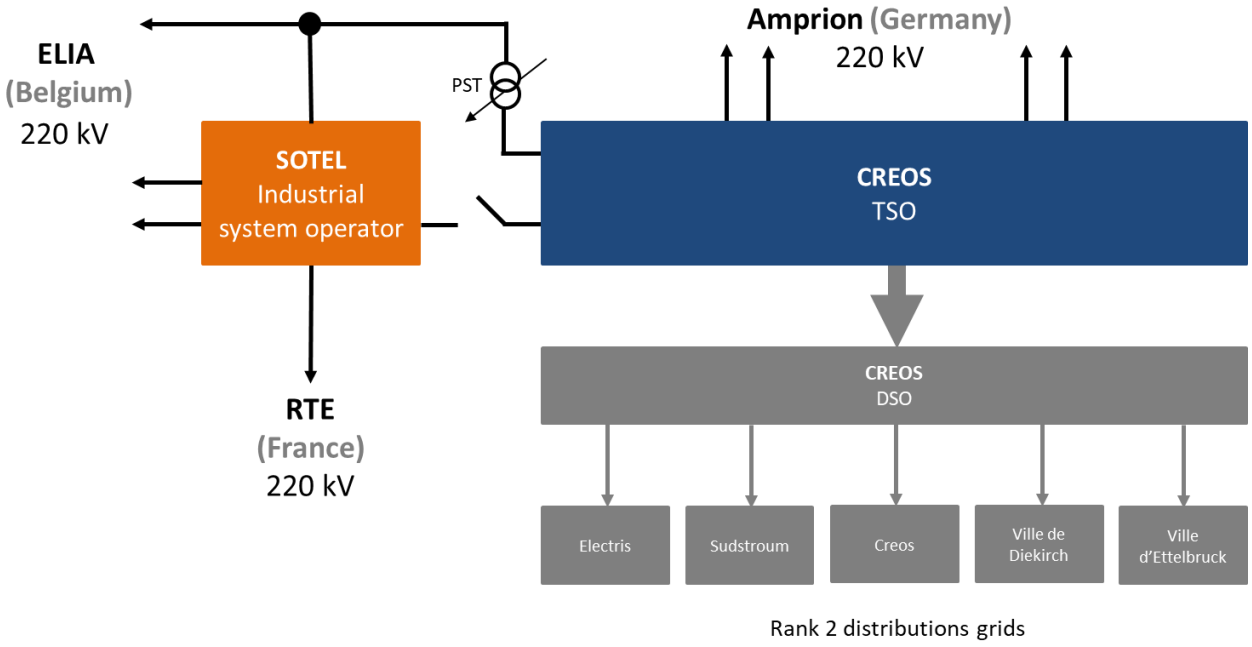


Diagram 1. Electricity grids in the Grand Duchy of Luxembourg and interconnections with neighbouring grids

There are therefore two electrical zones in the Grand Duchy of Luxembourg: the Creos zone and the SOTEL zone.

Creos' network is connected to Elia's grid via a phase-shifting transformer (PST). The maximum capacity of this interconnection is limited to 400 MW.

1.3.2 Overview of the supply / demand on the Creos zone

Under normal circumstances, the Creos zone has a production deficit; its electricity supply depends largely on the interconnection lines with the German grids. Thus, on average 83% of the national consumption is covered by imports.

There is no large power plant connected to the Creos grid. Power generation is mainly based on distributed generation (cogeneration plants, small hydroelectric power plants, wind powered generators, PV installations, biogas installations and one waste incineration plant). None of these plants is programmed by the grid operators.

It should also be noticed that the Vianden pumped storage power plant, with a nominal capacity of 1,300 MW, located in the Grand Duchy of Luxembourg, is directly connected to the German grid (see appendix 6, single-line diagram of the Luxembourgish grids)

2 Conditions of activation of the system defence plan

2.1 Overview

The demand disconnection plan shall be activated in accordance with Article 13 of the network code on electricity emergency and restoration set by Commission regulation (EU) 2017/2196.

It may be triggered to control crisis situations of an exceptional nature due to their scale and leading to a risk of collapse of the whole or part of the electricity system of the Grand Duchy of Luxembourg, or of the European interconnected system.

2.2 Situations and feared events

The activation of the demand disconnection is due to sudden phenomena or situations of electricity shortage, effectively observed or anticipated by the system operators, particulary:

- An imbalance between electricity supply and demand in the Amprion control area, or more generally in the interconnected European grids;
- The limitation of import capacity from neighbouring countries to an insufficient level to guarantee Luxembourg's supply (as a result, for instance, of the unavailability of interconnection lines);
- Any failure occurring on one of the electricity grids of Luxembourg and causing congestion on one or more of these grids.

The events that the demand disconnection plan aims to prevent in such situations are the following:

- A cascade of overloads on high voltage lines, by successive transfer of loads;
- A collapse of the frequency;
- A collapse of the voltage.

Each of these events is likely to lead, in the absence of appropriate corrective or preventive measures, to the total collapse of the grids of the Grand Duchy of Luxembourg.

N.B. The TSO may trigger demand disconnection at the request of a neighbouring TSOs.

2.3 Position of the demand disconnection in the hierarchy of action levers

System operators shall use their best efforts to activate the demand disconnection only after the other measures at their disposal have been deployed, subject to their availability, and that these have not made it possible to restore the technical safety criteria used by the system operators.

These means include :

- The launching of the electricity production facilities available in the Grand Duchy of Luxembourg;
- The remote interruption of residential consumers's electrical heating systems;
- The possible electricity contractual cut-off of consumers, which could be negotiated with electricity suppliers or directly with the customers concerned (without any guarantee of effectiveness);
- The use of back-up contracts with neighbouring TSOs;
- In only certain situations, the drop in the setpoint voltage on 20 kV grids, whose efficiency is limited in time.

Therefore, demand disconnection ranks last in the hierarchy of action levers available to electricity system operators: its application is strictly limited to situations where standard means of managing supply/demand balance and electricity flows are ineffective or insufficient to contain the risks.

3 Technical and organisational measures

3.1 System protection schemes

3.1.1 Automatic under-frequency control scheme

The scheme for the automatic control of under-frequency of the system defence plan includes a scheme for the automatic low frequency demand disconnection and the settings of the limited frequency sensitive mode-under-frequency in the TSO load frequency control (LFC) area.

3.1.1.1 Situations involving automatic demand disconnection

Automatic demand disconnection is implemented in reaction to unexpected events, whose fast onset and evolution do not allow human intervention.

This method of disconnection is less selective and likely to cause more significant disruptions to the electricity market than anticipated disconnection.

3.1.1.2 Communication of demand disconnection orders

Automatic demand disconnection is implemented exclusively by systems configured by the TSO, in order to act as a last resort to preserve the electricity system of the Grand Duchy of Luxembourg or to contribute to the protection of the European interconnected system.

These automatisms are triggered by frequencemetric relays when the frequency measured on the transmission grid falls below critical levels defined by the TSO, in accordance with the requirements of ENTSO-E.

No segmentation and priority order as described below in the defence plan applies to the case of automatic demand disconnection. Appendix 7 shows the different frequency stages and the load that can be removed for each stage.

3.1.2 Automatic over-frequency control scheme

No automatic over frequency management mechanism can be activated by the TSO or DSO in Luxembourg. It is an activity delegated to Amprion.

3.1.3 Automatic scheme against voltage collapse

The automatic scheme used by the TSO Creos against voltage collapse of the system defence plan includes a blocking scheme for on load tap changer.

The conditions under which the on load tap changer shall block are as follows:

- In case of absence of voltage on the Amprion-Creos tie-lines, the automatic voltage stepping on the high voltage transformers is automatically blocked by the SCADA system of Creos (i.e. remote from control room);
- The voltage level threshold at the connection point is 0;
- The flow direction of reactive power will always be in the direction of Creos (Germany to Luxembourg);
- The maximum time lapse between the detection of voltage absence and the tap changer blocking is less than 1 second.

3.2 System defence plan procedures

In addition to the automatically activated schemes described in section 3.1, the following procedures, which are limited in Luxembourg to a manual demand disconnection procedure, shall be activated, in accordance with Article 13 paragraph 2 of the network code on electricity emergency and restoration set by Commission Regulation (EU) 2017/2196 when:

- The operational safety analysis indicates that the activation of a demand disconnection of the electricity grid is required, in addition to the available corrective actions, to ensure the operational safety of the transmission system; or
- The grid is in a state of emergency and no corrective measures are available to restore the grid to its normal state.

A transmission system in a state of emergency is considered when at least one of the following conditions is met:

- At least one operational safety limit of the TSO has been crossed;
- The frequency does not meet the criteria of normal state:
    - The frequency deviation on the grid in steady mode does not fit within the standard frequency range.
    - Where the absolute value of the frequency deviation on the steady mode system is greater than the maximum frequency deviation in the steady mode and the system frequency limits established for the alert state are not reached.
- The frequence does not meet to the criteria of the alert state:
    - The absolute value of the frequency deviation on the grid in steady mode is not greater than the maximum frequency deviation in steady mode; and
    - The absolute value of the frequency deviation on the steady mode system has continuously exceeded 50% of the maximum steady mode frequency deviation for a period longer than the time for activating the alert state, or has exceeded the standard frequency range for a period longer than the time for restoring the frequency.
- There is a defect in the functioning of tools, equipments and installations such as:
    - Transmission system condition monitoring facilities, including condition estimation applications and frequency-power control devices;
    - The control and command of circuit-breakers, coupling circuit-breakers, transformer load changers and other equipment used to adjust transmission system components;
    - The means of communication with the control centres of other TSOs and CSRs;

Tools for operational safety analysis; and the tools and means of communication necessary for TSOs to facilitate cross-border operations on the electricity market), which results in the unavailability of these tools, means and installations for more than 30 minutes.

3.2.1 Frequency deviation management procedure

Creos has no Load Frequency Controller implemented due to the fact that there is no significant power plant connected to Creos' network, hence Creos cannot implement a frequency deviation management procedure.

3.2.2 Voltage deviation management procedure

Due to the fact that there are no large power plants connected to Creos grid, Creos cannot actively regulate the voltage on its grid, hence Creos cannot implement a voltage deviation management procedure.

3.2.3 Power flow management procedure

Due to the fact that there is no large power plant connected to Creos' grid, Creos cannot actively regulate the power flow on its grid, hence Creos cannot implement a power flow management procedure.

3.2.4 Assistance for active power procedure

Creos is part of the German bidding zone and the adequacy in the Creos control area is always negative, as own power production in Luxembourg only accounts for 27% of the total consumption, thus, Article 21 of the network code on electricity emergency and restoration set by Commission Regulation (EU) 2017/2196 is not applicable.

3.2.5 Manual demand disconnection procedure

3.2.5.1 Responsibility and decision making

3.2.5.1.1 Coordination between system operators

In all cases, one and only one system operator shall be empowered to make the decision to initiate manual demand disconnection :

- The system operator concerned, when the event triggering the crisis is located on a distribution or industrial grid, and the potential consequences of the crisis are limited to that grid alone (no risk of propagation);
- The TSO, in all other cases.

This system operator, called coordinator, assesses whether the criteria for triggering the demand disconnection are verified and coordinates its implementation.

In the first case, the term used is "localised" demand disconnection; in the second case, the term used is "national"[a] demand disconnection.

Each system operator has established criteria for activating the demand disconnection, which are set in an internal procedure that is communicated to the Government Commissioner for Energy. In particular, the frequency criteria shall be defined in line with the requirements of ENTSO-E[b].

In accordance with the article 14 of the code on electricity emergency and restoration of the COMMISSION REGULATION (EU) 2017/2196, upon request from a TSO in emergency state (Amprion or Elia), Creos shall provide through interconnectors any possible assistance to the requesting TSO, provided this does not cause its transmission system or the interconnected transmission systems to enter into emergency or blackout situations.

Creos may proceed to a manual disconnection of any transmission system element having a significant cross-border impact (including an interconnector), in coordination with the related TSOs, and without danger of emergency or blackout situations for the related TSOs.

Moreover, Creos may manually disconnect any transmission system element having a significant cross-border impact, including an interconnector, without coordination, in exceptional circumstances implying a violation of the operational security limits, to prevent endangering personnel safety or damaging equipment.

Within 30 days of the incident, Creos shall prepare a report in English containing a detailed explanation of the reasons, implementation and impact of this action and submit it to the relevant regulatory authority, to the neighbouring TSOs and all concerned DSOs. Creos has also to make it available to the significantly affected system users.

The decision-making procedure and the method of coordination between the actors concerned depends on the type of demand disconnection (localised/national demand disconnection).

3.2.5.1.2 Localised demand disconnection

In this case, the system operator defines the power to be disconnected and implements the demand disconnection itself.

[a] According to this definition, a crisis affecting a rank 1 distribution grid supplying one or more rank 2 distribution grids can only be resolved by a national demand disconnection procedure.

[b] Policy P5 available on the l'ENTSO-E website at the following address : https://docstore.entsoe.eu/Documents/Publications/SOC/Continental_Europe/oh/170926_Policy_5_ver3_1_43_RGCE_Plenary_approved.pdf

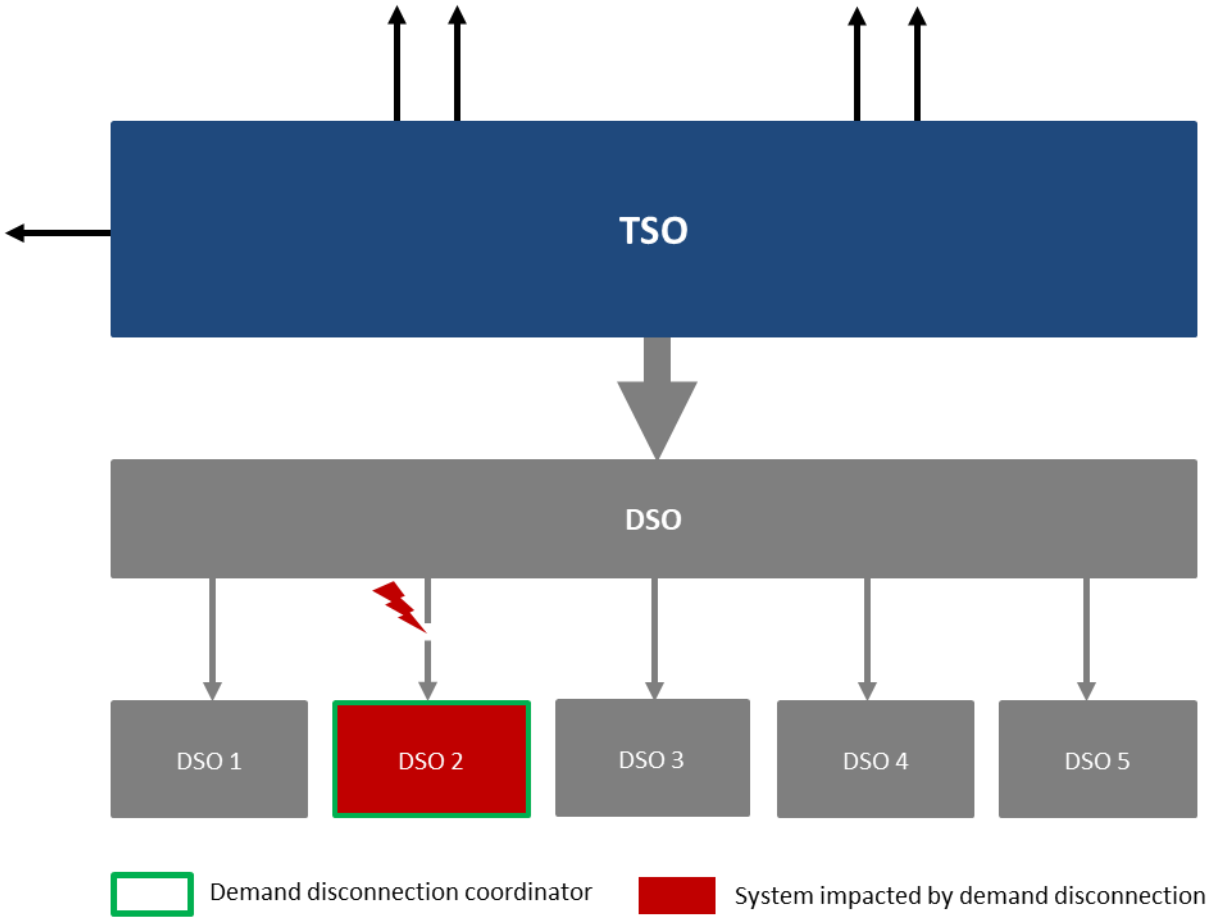


Diagram 2. Illustration – Localised demand disconnection

3.2.5.1.3 National demand disconnection

As far as the situation makes it possible, the TSO shall consult with the other Luxembourgish system operators to agree on the implementation of demand disconnection, as well as with neighbouring TSOs.

The TSO determines the power to be disconnected on all Luxembourgish grids.

It also determines the distribution of the power to be unloaded between the different networks, and between the different categories of consumers, in accordance with the principles of priority and equity detailed further in this document.

The TSO shall itself implement demand disconnection for consumers directly connected to the transmission grid, and shall delegate demand disconnection to the various industrial or distribution grid operators for consumers connected to their grids.

However, the DSO may authorise another system operator to undertake the necessary operations on its behalf, by signing a specific agreement. In this case, the DSO concerned shall remain fully responsible for preparing demand disconnection; only the execution of the demand disconnection may be entrusted to another system operator.

The TSO shall inform the DSOs' on-duty-teams of the actions and measures taken.

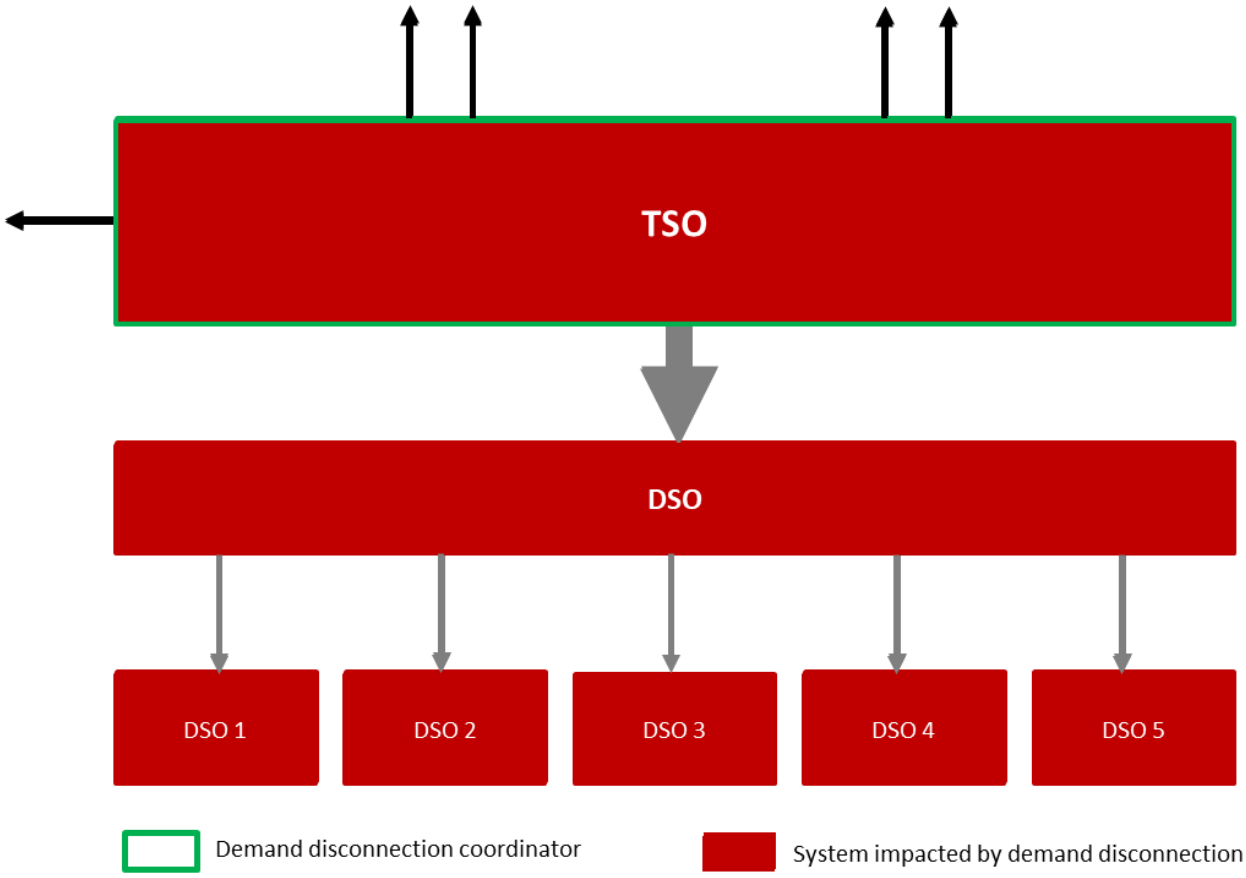


Diagram 3. Illustration – National demand disconnection

The disconnection of the demand in the Grand Duchy of Luxembourg has no negative cross-border impact ("no cascading outside my border"). However, Creos will maintain Amprion informed of the activation of its procedure of manual demand disconnection.

3.2.5.1.4 Skills maintenance and experience feedback

3.2.5.1.4.1 Training

Demand disconnection is only implemented in exceptional cases. It is therefore essential that operators of the various grids in the Grand Duchy of Luxembourg maintain their knowledge of the demand disconnection plan and associated procedures through appropriate training, in particular in order to guarantee the implementation timeframe.

Each system operator is responsible for maintaining these skills for each of its operators who may be involved in a demand disconnection procedure.

3.2.5.1.4.2 Experience feedback

Any effective demand disconnection shall be the object of a formalised feedback of experience, led by the system operator coordinator, in which the others system operators involved, shall participate.

The purpose of this feedback is to identify possible dysfunctions in the procedure and to improve it.

3.2.5.1.5 Communication to the authorities and the public

In accordance with the amended law of 1 August 2007, the system operator in charge of the coordination shall inform the Government Commissioner for Energy and the ILR as soon as possible, by phone or e-mail, of the actions and measures taken. In accordance with the ERP, the system operator coordinator shall also inform the High Commissioner for National Protection. The list of corresponding contacts is in Appendix 1.

In the case of a prolonged situation, the affected system operators shall inform their customers as soon as possible of the decisions made, and in particular of the expected duration of the crisis situation, in accordance with Article 27 of the amended law of 1 August 2007.

In case of national demand disconnection, the TSO will inform the public through appropriate communition channels.

3.2.5.2 Operational implementation of manual demand disconnection

3.2.5.2.1 Manual demand disconnection

3.2.5.2.1.1 Situations making manual demand disconnection possible

Manual demand disconnection is implemented in reaction to events whose quick onset and evolution make human intervention possible.

3.2.5.2.1.2 System defence plan instructions

When the crisis situation affects several grids (for instance, in the case of national demand disconnection), for the disconnection of consumers who do not belong to the smart groups defined in paragraph 3.2.5.6, the TSO shall notify the impacted DSO and industrial system operator by phone of the demand disconnection instructions, specifying in particular:

- The date and time when the demand disconnection took effect;
- The expected duration of the demand disconnection;
- The power to be disconnected.

For this purpose, a list of contacts in the various DSOs and Industrial system operator shall be retained by the TSO. This list shall be communicated annually to the DSOs and Industrial system operator for validation or amendment. In addition, they shall inform the TSO as soon as possible of any changes concerning these contacts.

For the disconnection of consumers belonging to the smart groups defined in paragraph 3.2.5.6, the TSO will directly notify Luxmetering of the demand disconnection instructions, and keep the concerned DSOs informed.

The system operators concerned and Luxmetering shall respect the TSO’s instructions.

All orally communicated instructions will need to confirmed in written form, preferably by e-mail.

3.2.5.2.1.3 Opening of the connection points

The targeted consumers are disconnected from the grids by remote opening, via the remote controls of the dispatch stations, appropriate circuit-breakers at the HV and MV transformer substations, or directly at the customers' connection substations.

They can be selectively disconnect or by groups of consumers connected to the same substation, depending on the technical possibilities of each system operator.

Some customers fitted with an electricity smart meters, and public charging stations can also be selectively and remotely disconnected for part of their load (see paragraphs 3.2.5.6 and 3.2.5.7).

3.2.5.2.1.4 Execution delays

System operators must be able to execute demand disconnection orders within 20 minutes after the TSO phone confirmation.

3.2.5.2.2 Rotational demand disconnection

When the crisis situation is likely to continue, each system operator affected by the demand disconnection may, after consultation with the coordinator, organise, on its own initiative and in an appropriate way (regarding the duration and expected extent of the shortage), a rotational demand disconnection, with the objective to limit the consequences for each consumer affected by demand disconnection.

This rotational demand disconnection consists in alternately disconnecting different groups of consumers for a limited period of time.

In such cases, the system operator concerned shall ensure that the security of its grid is not compromised. In particular, by checking that switching from one consumer group to another does not generate overloads.

The reconnection of the disconnected consumers is only made after the group of consumers substituting them has been disconnected.

3.2.5.2.3 *Determination of the load to be disconnect and the estimated duration of the disconnection*

According to the amended law of 1 August 2007, the emergency measures taken must "cause the least possible disturbance to the functioning of the internal [electric] market and must not exceed the scope strictly necessary to resolve the sudden difficulties that have emerged".

Thus, the coordinator determines the size of the demand disconnection action to be carried out, taking into account any portfolio effects (diversity factor), in order to minimise the energy not distributed to Luxembourgish consumers.

The power to be disconnected can be evaluated in terms of MW or in terms of number of steps, i.e. as a percentage of national consumption (in accordance with the provisions of paragraph 3.2.5.3.1).

3.2.5.2.4 Demand reconnection

Demand reconnection is organised by the coordinator.

It occurs when the coordinator considers that the risks of collapse of the electrical system have been eliminated and that all the technical safety criteria have been restored.

Demand reconnection shall be carried out gradually, taking into consideration the evolution of risks, and in accordance with the priority rules set out in paragraph 3.2.5.5 (first disconnected, first reconnected).

3.2.5.2.5 Demand disconnection failure

In case of failure of the preventive or corrective demand disconnection actions undertaken, i.e. when the system operators are unable to restore the safety criteria and all or a part of the electricity grids in the Grand Duchy of Luxembourg are powered down ("blackout"), the system operators shall execute the grid restoration plan provided for in the amended law of 1 August 2007 (which does not fall within the scope of this document) and in Commission regulation (EU) 2017/2196.

3.2.5.3 Segmentation and priority rules

The objective of this section is to specify the methods according to which the system operators target the consumers to be disconnected, by preparing lists of groups of consumers organized on a hierarchical basis according to the priority nature of the supply of power to the various categories of consumers, and by distributing these groups in “batches” corresponding to a given percentage of national consumption.

3.2.5.3.1 Demand disconnection targeting

3.2.5.3.1.1 National demand disconnection

In the case of national demand disconnection, when the objective is to reduce the load on the grids in the Grand Duchy of Luxembourg in a global manner, the TSO organizes demand disconnection according to a pre-established plan, respecting the principles of priority described in paragraph 3.2.5.5.

The TSO has two options :

- *Option 1 – Demand disconnection by batches* : the load on the grids in the Grand Duchy of Luxembourg is divided into 5 batches, each representing approximately 20% of the maximum power demand at the national level. The TSO may decide to successively disconnect batch 1, then batch 2

and so forth. This option, which is not very selective, is applicable in emergency situations. The principles of elaboration of these batches are described in paragraph 3.2.5.4.6

- *Option 2 – Demand disconnection on power basis* : when there is more time to organise the demand disconnection, the TSO has the possibility to be more selective, and to determine exactly the load to be disconnected in MW. It then uses a hierarchical list of consumer groups (cf. paragraph 3.2.5.4.5), and instruct each of the system operators to disconnect all consumer groups linked to their grids and located above a certain position in that list. In the case where the effectiveness of the demand disconnection action would require to target it on a grid, the TSO has the possibility to derogate from the principle of equity and to request disconnections only to the system operators of its choice.

3.2.5.3.1.2 Localised demand disconnection

In the case of localised demand disconnection, the system operator concerned shall organise the demand disconnection according to a pre-established plan, respecting the priority principles described below in the document, using for this purpose a hierarchical list of consumers, unless technical reasons require a derogation from these principles (particularly in the case of a very localized problem).

Only power demand disconnection is possible in this case (the notion of batch is not defined for each of the grids but only at the national level).

3.2.5.4 Hierarchical list of disconnectable consumer groups

In order to allow a very fast implementation of demand disconnection, system operators must have at any time a predefined segmentation of the grids load as a list of selectively disconnectable customer groups, hierarchised according to the priority nature of their power supply.

3.2.5.4.1 Overview of the process

Segmentation process of the consumption includes 5 steps, which are each detailed in the following sections of this document:

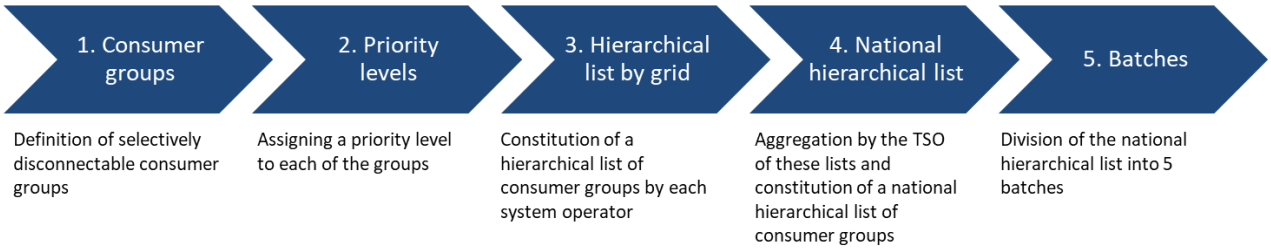


Diagram 4. Overview of the national consumption segmentation process

3.2.5.4.2 Step 1 : identification of selectively disconnectable consumer groups

Each of the system operators of the Grand Duchy of Luxembourg establishes a list of consumer groups connected to its grid(s) and disconnectable on a selective basis (i.e. in such a way that each of these groups can be remotely disconnected independently of the other groups).

Depending on the technical possibilities of these operators, these groups may be composed of a single consumer (example: industrial site connected to the transmission network), several consumers supplied through the same source substation, or an entire distribution area.

These consumer groups are defined so that each consumer belongs to one and only one group.

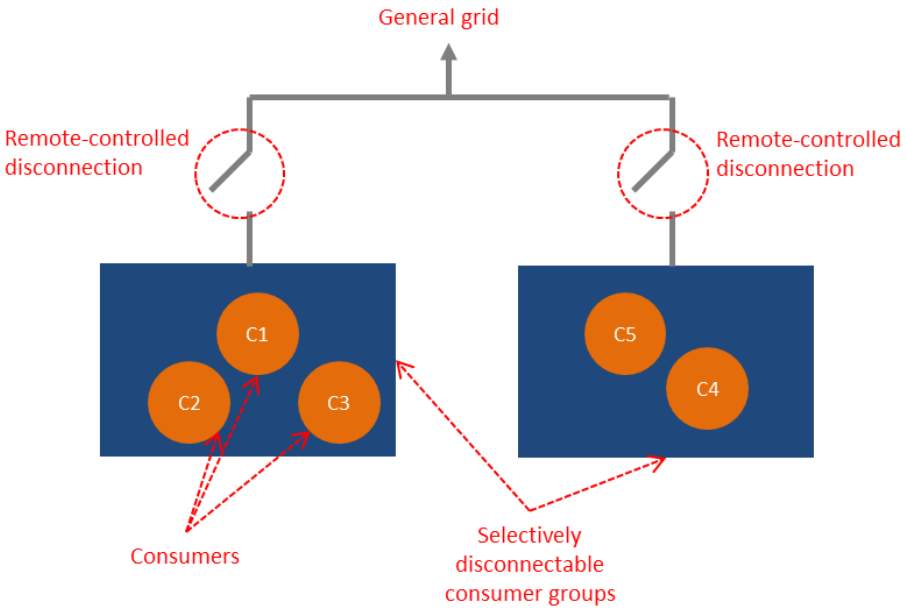


Diagram 5. Illustration - Distribution of consumers into selectively disconnectable groups

3.2.5.4.3 Step 2 : ranking of consumer groups by level of priority

To each consumer is assigned a priority level (from level 1, the highest priority, to be disconnected last, to level 3, the lowest priority, to be disconnected first), determined according to the priority rules.

The system operator defines the priority level of each consumer group as that of the "highest priority" consumer belonging to that group.

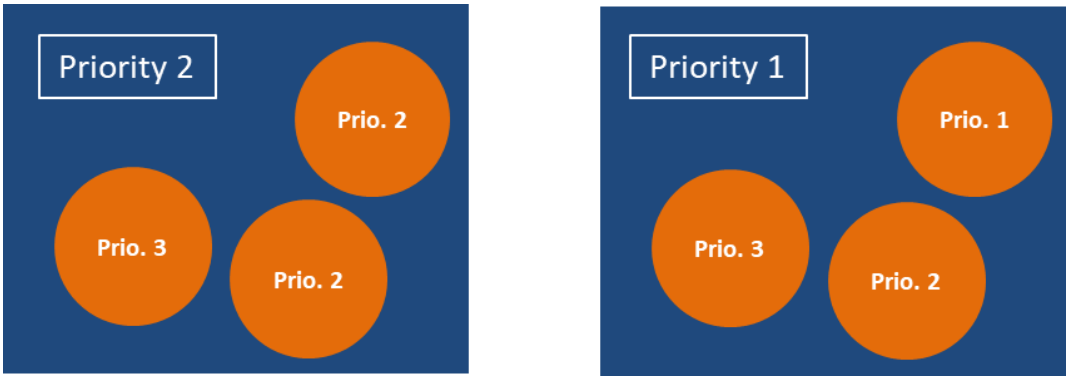


Diagram 6. Illustration - Assigning a priority level to a group of consumers

3.2.5.4.4 Step 3 : elaboration of a hierarchical list of consumer groups by each sytem operator

Each system operator shall evaluate as precisely as possible the maximum power consumed by the disconnectable consumer groups through a survey among the concerned consumers, complemented where appropriate by measures at its disposal.

On the basis of this information, it elaborates a hierarchical list of these consumer groups, based on the following two criteria:

- *Priority level* : the lowest priority groups are placed at the top of the list (main criteria);

- *Maximum power*: the largest groups are placed before the smallest, with the same priority level (secondary criteria).

A rank is thus assigned to each group of consumers in this list.

Then, the system operators communicate this list to the TSO. This list is updated on a yearly basis.

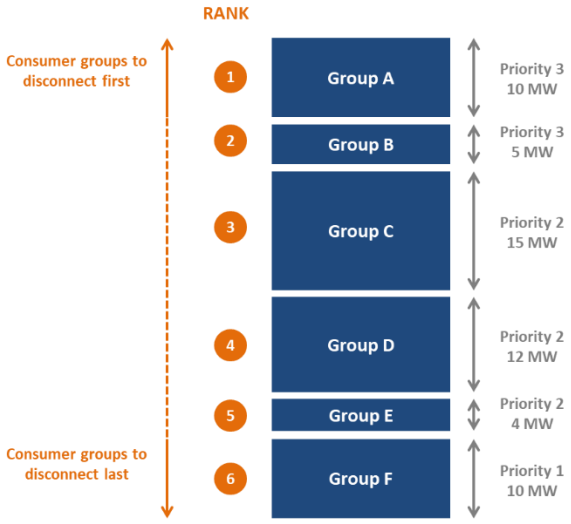


Diagram 7. Illustration – Elaboration of the hierarchical list of consumer groups by each of the system operators

3.2.5.4.5 Step 4 : conception of a hierarchical list of consumer groups by the TSO

The TSO consolidates the lists communicated by the Luxembourgish DSOs.

On that basis, the TSO establishes a national list of consumer groups, ranked in accordance with the principles mentioned in step 3 (3.2.5.4.4), while also trying to respect a principle of equity between system operators.

The hierarchy criteria for this national list are therefore as follows:

- *Priority level* (main criteria);
- *Equity between system operators* (secondary criteria): as far as possible, consumer groups should be combined in the list on a pro rata basis according to each system operator's share of national consumption;
- *Maximum power* (tertiary criteria).

A rank is thus assigned to each group of consumers in this national list.

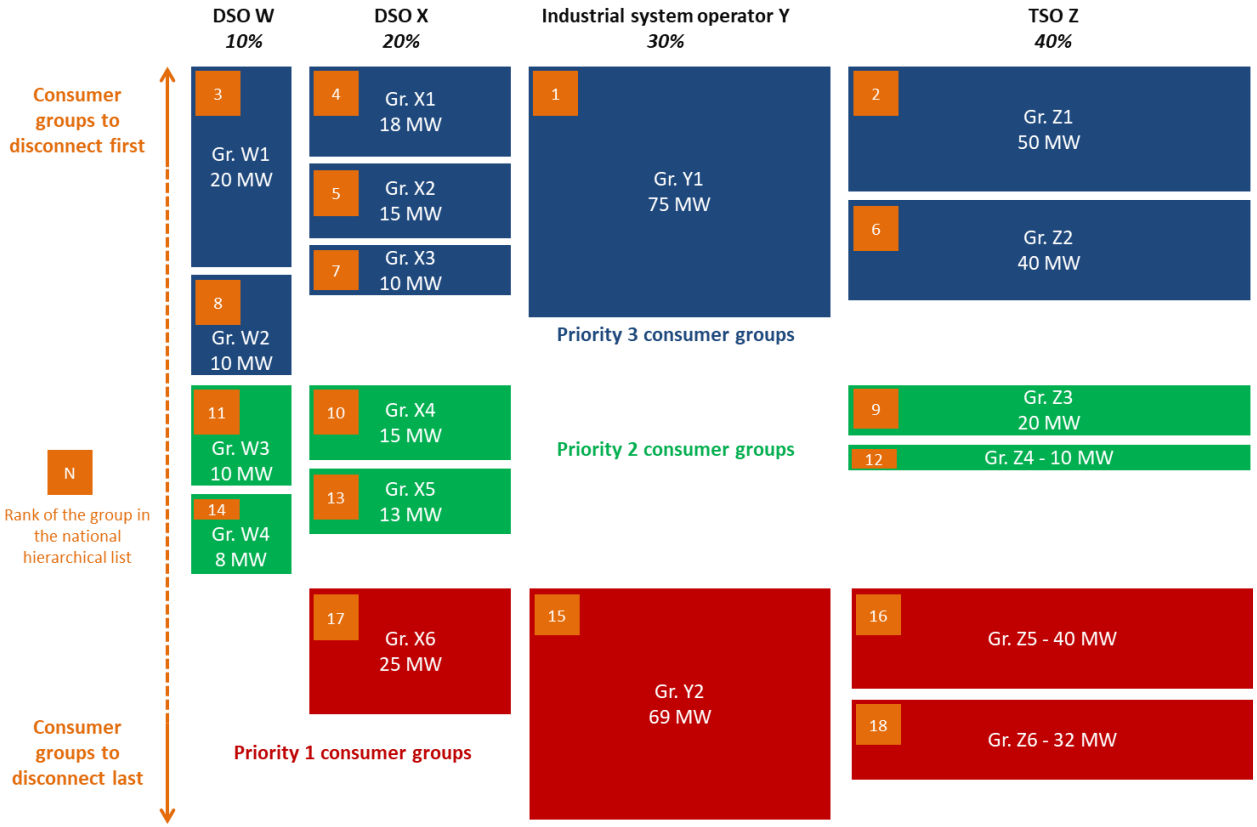


Diagram 8. Illustration – Elaboration of the national hierarchical list

This hierarchical list shall also be updated annually by the TSO and shall be communicated back to DSOs and Industrial system operator.

3.2.5.4.6 Step 5 : definition of the batches

All consumer groups in the national hierarchical list are divided by the TSO into 5 batches, each representing approximately 20% of the total load.

Batch 1 is composed of consumer groups at the beginning of this list, batch 5 consists of consumer groups at the end of it.

The composition of each batch shall be communicated to all system operators of the Grand Duchy of Luxembourg.

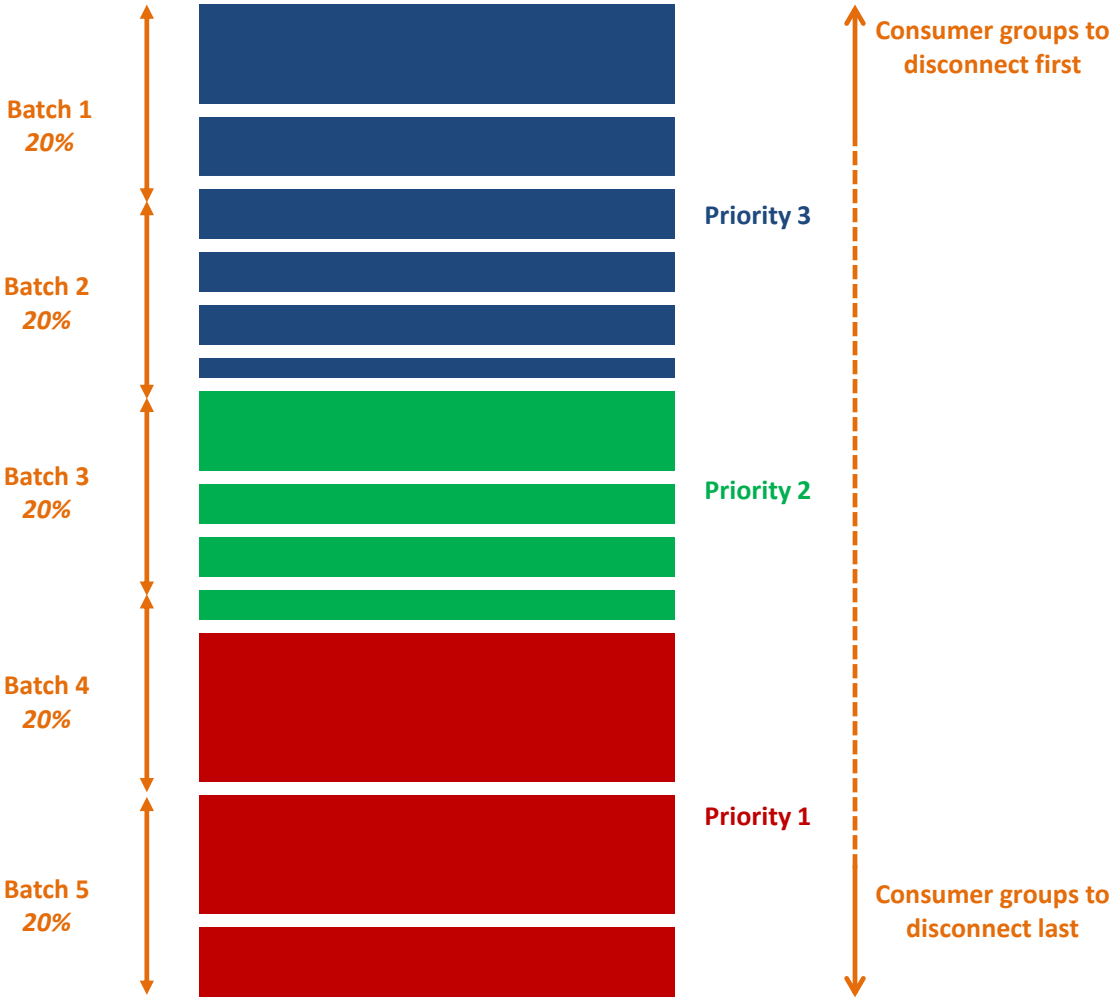


Diagram 9. Illustration – Composition of the demand disconnection batches from the national hierarchical list

3.2.5.5 Priority rules

A priority service is set up in order to meet the nation's essential needs and to limit the consequences of demand disconnnection as much as possible.

Electricity consumers in the Grand Duchy of Luxembourg are thus divided into 3 levels of priority :

- *Level 1* : strategic national defence facilities and vital communication centres, hospitals, railways, airports, residential consumers, and non-industrial professional consumers with a maximum power demand of 1MW or less.
- *Level 2* : industrial sites classified in accordance with the European SEVESO directive.
- *Level 3* : consumption sites in the service and public sectors with a maximum power demand greater than 1 MW, other industrial sites, and certain previously defined consumer groups.

3.2.5.6 Arrangements regarding smart meters

Electricity smart meters are currently being deployed in the Grand Duchy of Luxembourg. This mass deployment is planned to be completed by end 2020. These smart meters are fitted with load control relays that are connected to loads in homes, apartments or buildings where they are installed. Such relays can be remotely switched on and off by the 5 DSOs through the national central system operated by Luxmetering.

These relays are primarily connected to electric storage heating systems, to electric boilers and to private charging stations for electric vehicles.

The deactivation of such relays allows the DSOs to disconnect demand which could be significant in the future, with non-critical impact on the corresponding consumers.

As a consequence, 2 new consumer groups are created and included in the process of elaboration of the hierarchical list of disconnectable consumer groups. Each of these groups corresponds to the aggregation of a certain type of loads connected to the relays of an electricity smart meter. These groups are:

- *Smart group 1*: heating systems (electric storage heating, boilers, heat pumps etc);
- *Smart group 2*: private charging stations.

Priority 3 is assigned to these 2 groups.

Each DSO includes these 2 groups in its hierarchical list of consumer groups communicated to the TSO at the end of step 3 of the process previously described, and takes the appropriate procedural and technical measures in cooperation with Luxmetering to be able to remotely disconnect the corresponding loads within the delay specified in paragraph 3.2.5.2.1.4.

3.2.5.7 Arrangements regarding electric vehicles public charging stations

The 5 DSOs in Luxembourg operate a nationwide network of public charging stations for electric vehicles, named Chargy. This network is fitted with smart charging capabilities allowing the DSOs to remotely modulate the maximum charging power of each charging point and of groups of charging points.

As a consequence a new consumer group is created, named "public charging stations", gathering the public charging stations of the Chargy network[a]. This group is included in the process of elaboration of the hierarchical list of disconnectable consumer groups. The disconnectable power of this group will be computed considering that demand can be remotely reduced down to a minimum of 1 kW per charging point.

[a] The Chargy network also includes charging stations installed by third parties which requested their integration into the Chargy network. Such third party charging stations are excluded from the « Public charging stations » consumer group.

4 SGUs

In Luxembourg, at this moment there is no SGU responsible for implementing on its installations the measures resulting from the mandatory requirements set out in Regulations (EU) 2016/631, (EU) 2016/1388 and (EU) 2016/1447 or from national legislation. The corresponding list, required by the network code on electricity emergency and restoration is thus currently empty but might evolve in the future. It will be updated as required, on an ad-hoc basis.

In Luxembourg, at this moment there is no high priority SGU either. The corresponding list, required by the network code on electricity emergency and restoration is thus currently empty but might evolve in the future. It will be updated as required on an ad-hoc basis.

Signatory Page Creos

Carlo Bartocci	Marc Reiffers
Head of Grid Operations	CEO

Place:

Date:

Signatory Page Ville de Diekirch

Place :

Date :

Signatory Page Electris

Place :

Date :

Signatory Page Ville d’Ettelbruck

Place :

Date :

Signatory Page Südstroum

Place :

Date :

Signatory Page Sotel Réseau

Place :

Date :

Appendices

Appendix 1. List of contacts at the Ministry of Economy and the ILR as well as at the High Commission for National Protection

Ministry of Energy

Name	Position	Phone number	E-mail
Olaf Munichsdorfer	Premier Conseiller de Gouvernement	(+352) 247-86833	olaf.munichsdorfer@energie.etat.lu
Marco Hoffmann	Conseiller de direction 1ère classe	(+352) 247-84324	marco.hoffmann@energie.etat.lu
Simeon Hagspiel	Commissaire du Gouvernement à l'Energie	(1352) 247-741141	simeon.hagspiel@energie.etat.lu

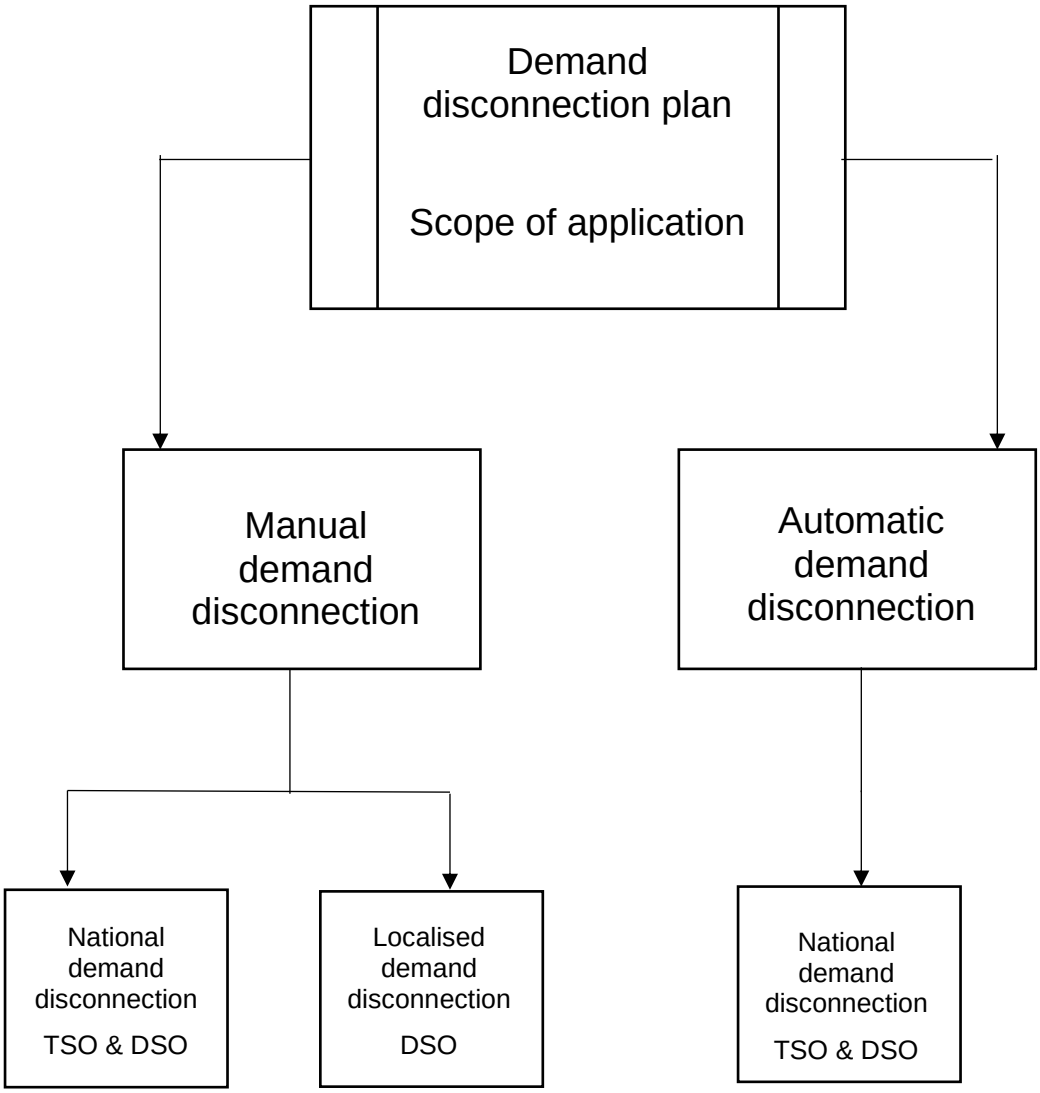
ILR (Institut Luxembourgeois de Régulation)

Name	Position	Phone number	E-mail
Camille Hierzig	Directeur adjoint	(+352) 28228 203	camille.hierzig@ilr.lu
Claude Hornick	Service Energie	(+352) 28228 341	claude.hornick@ilr.lu

High Commission for National Protection

Name	Position	Phone number	E-mail
Luc Feller	Haut-Commissaire	(+352) 247-88900 +352 621541408	Luc.feller@hcpn.etat.lu
Permanence HCPN		(+352) 621150073	cc@hcpn.etat.lu

Appendix 2. Type of demand disconnection



Appendix 3. Table of operators values

	Match Code	Client	Ancien dénomination	Poste HT	Transfo(s)	Pmax 22.01.2019 (MW)
Niveau 3	77001	Circuit Foil	Yates	Wiltz/Usines 65/20kV	Circuit Foiles 1 et 2	15,7
	77002	Kronospan Luxembourg	-	Paafewee 65/10kV	Kronospan 1 et 2	7,3
	77003	Carlex Glas Luxembourg	Luxguard, Guardian	Potaschbierg 65/20kV	Carlex 1 et 2	12,3
	77004	Faurecia AST Luxembourg	Sommer, Tarkett	Lentzweiler 65/20kV	Tarkett	10,0
	77005	Eurofoil Luxembourg	Novelis, Granges, Luxalum	Riedgen 65/20kV	Industries 1	8,8
	77006	Hyosung Luxembourg	Fabric Plant	Fabric Plant 65/2,4kV	Fabric Plant 1 et 2	4,0
	77007	ArcelorMittal Dudelange	Galvalange	Galvalange 65kV	Galvalange 1	2,8
	77008	Cimalux	Ciments Luxembourgeois	Schifflange 220/65/20kV	Ciments	8,0
	77009	Ceratizit	Cerametal	Cerametal 65/20kV	Cerametal 1	8,0
	77010	ArcelorMittal Dudelange	Ewald Giebel S.A.	Galvalange 65kV	Giebel 1 et 2	3,0
	77011	ArcelorMittal Bissen	Trefilarbed	Bissen Trefilarbed 65kV	Trefilarbed 1 et 2	5,7
	77012			→ *Client 20kV*		-
	77013	Glanzstoff Textilcord	Uniroyal	Steinfort 65/20kV	Uniroyal 1	0,0
	77014	Avery Dennison Luxembourg	Fasson	Lamadelaine 65/20kV	Fasson	3,5
	77015			→ *Client 20kV*		-
	77016			→ *Client 20kV*		-
	77017	Ceratungsten	-	Biff 65/20kV	Ceratungsten	2,6
	77018	Goodyear	Mold Plant	Mold Plant 65/2,4kV	Mold Plant 1	1,6
	77019	Goodyear	ADM	ADM 65/2,4kV	ADM 1	1,5
	77020	WSA	-	Sanem WSA 65/20kV	WSA 1	0,4
Niveau 2	77021	DuPont de Nemours	-	Dupont 65/20kV	Dupont 1 et 2	21,3
	77022	Goodyear	Tire Plant	Tire Plant 65/2,4kV	Tire Plant 1, 2 et 3	16,6
	77023	Guardian Luxguard II	Guardian Dudelange	Galvalange 65kV	Luxguard 1 et 2	3,0
	77024	Guardian Luxguard I	Guardian Bascharage	Bascharage 65/20kV	Luxguard 1 et 2	6,2
	77025			→ *Client 20kV*		-
	77026			→ *Mold Plant*		-
Niveau 1	77027	CFL I	-	Oxylux 220/2x25/20 kV	CFL 1 et 2	11,6
	77028	CFL II	-	Berchem 220/2X25 KV	CFL 3 et 4	32,3
	77029	RTL	-	Beidweiler RTL 65kV	RTL 1	1,1
	77030	Sebes	-	Esch/Sûre Sebes 65/6kV	Sebes 1 et 2	3,0

Creos: Plan de délestage manuel

Creos (DSO)

Priority levels	Consumer group	Pmax 2019 (kW)	Pmax 2020 (kW)
Level 3	Smart group 1		40.000
	Smart group 2		0
	Public charging stations		8.800
Level 2			
Level 1			

Electris (DSO)

Priority levels	Consumer group	Pmax 2019 (kW)	Pmax 2020 (kW)
Level 3	Smart group 1		
	Smart group 2		
	Public charging stations	18	20
Level 2			
Level 1			

Sudstroum (DSO)

Priority levels	Consumer group	Pmax 2019(kW)	Pmax 2020 (kW)
Level 3	Smart group 1		
	Smart group 2		
	Public charging stations		
Level 2			
Level 1			

Ville de Diekirch (DSO)

Priority levels	Consumer group	Pmax 2019 (kW)	Pmax 2020 (kW)
Level 3	Smart group 1		
	Smart group 2		
	Public charging stations		
Level 2			
Level 1			

Ville d'Ettelbruck (DSO)

Priority levels	Consumer group	Pmax 2019 (kW)	Pmax 2020 (kW)
Level 3	Smart group 1		
	Smart group 2		
	Public charging stations		
Level 2			
Level 1			

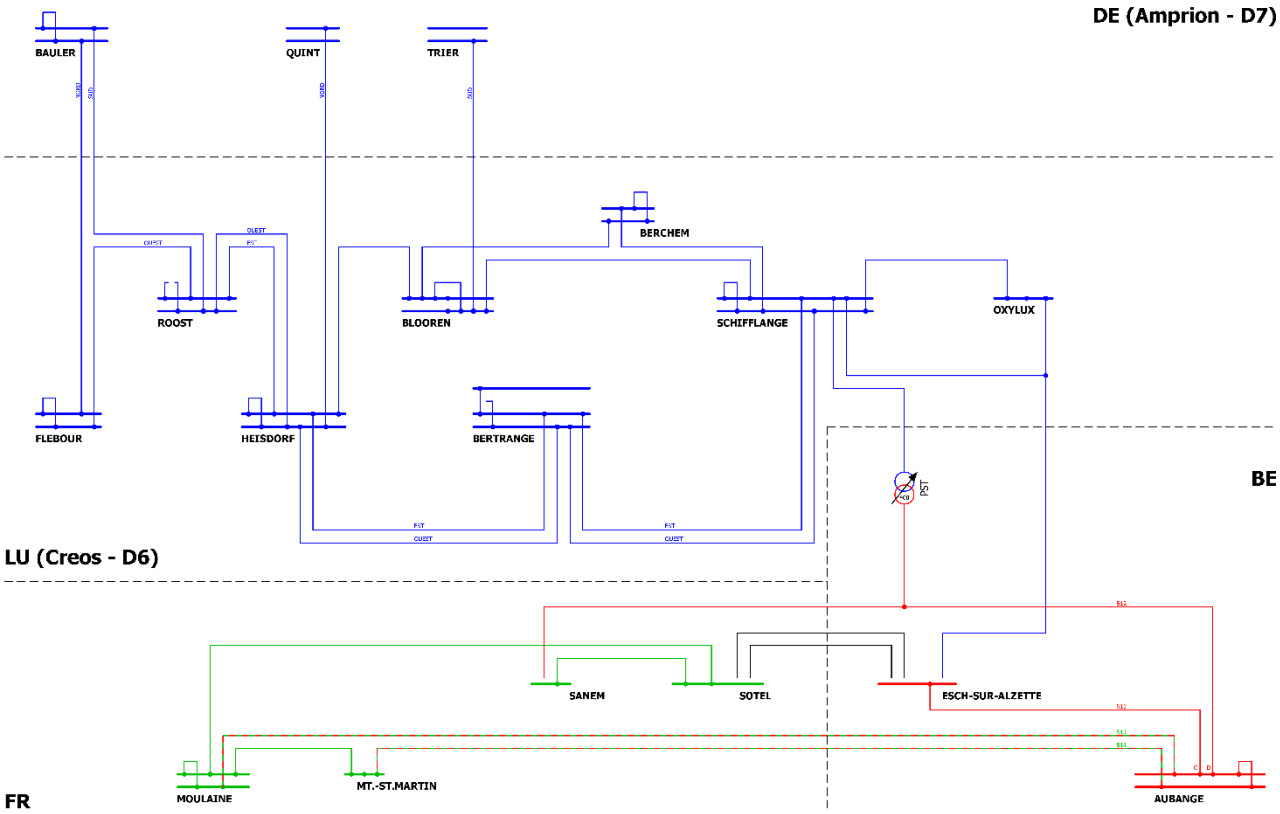
Appendix 4. List of system operators

Transmission system operator	Distribution system operator	Industrial system operator
Creos Luxembourg S.A.	Creos Luxembourg S.A. Ville de Diekirch Electris par Hoffmann Frères S.à.r.l. et Cie s.e.c.s. Ville d'Ettelbruck Sudstroum S.à.r.l. & Co s.e.c.s.	Sotel Réseau & Cie s.e.c.s.

Appendix 5. List of suppliers

Please refer to the list published by ILR on their website (web.ilr.lu)

Appendix 6. Single-line diagram of the Luxembourg grids



Appendix 7. Underfrequency demand disconnection scheme

creos

UFLS Scheme LU v4.xlsx
ABR
21/01/2020

Under-Frequency Load Shedding (UFLS) Scheme of Luxembourg

Measured values of 22.01.2019 (high demand)

Step 1 < 49,0 Hz

No.	Station	MV Client	MW	
CL1	Galvalange	Galvalange 1 (HDG)	3,1	
CL2	Galvalange	Giebel 1	1,6	
CL3	Galvalange	Giebel 2		
CL4	Potaschbierg	Carlex (Guardian 1)	11,8	
CL5	Potaschbierg	Carlex (Guardian 2)		
CL6	Schifflange	Ciments	7,9	
CL7	Wiltz/Usines	Circuit Foil 1	14,9	
CL8	Wiltz/Usines	Circuit Foil 2		
		Load disconnected	*39,3*	*5,71%*

Step 2 < 48,86 Hz

No.	Station	MV Client & Transfo	MW	
CL9	Bascharage	Luxguard I 1	6,9	
CL10	Bascharage	Luxguard I 2		
CL11	Galvalange	Luxguard II 1	2,1	
CL12	Galvalange	Luxguard II 2		
1	Bascharage	65/20kV 1	11,6	
2	Galvalange	65/20kV 1	2,8	
3	Ingeldorf	65/20kV 1	9,0	
4	Junglinster	65/20kV 1	7,6	
		Load disconnected	*40,0*	*5,81%*

Step 3 < 48,71 Hz

No.	Station	MV Transfo	MW	
5	Bertrange	65/20kV 1	9,5	
6	Biff	65/20kV 1	1,7	
7	Ehlerange	65/20kV 1	1,7	
8	Lamadelaine	65/20kV 1	5,5	
9	Lentzweiler	65/20kV 1	4,4	
10	Schifflange	65/20kV 1	11,6	
11	Welergewan	65/20kV 2	2,2	
		Load disconnected	*36,6*	*5,32%*

Step 4 < 48,57 Hz

No.	Station	MV Transfo	MW	
12	Bertrange	65/20kV 2	0,0	
13	Findel	65/20kV 2	9,6	
14	Freckelsen	65/20kV 2	7,2	
15	Helfent	65/20kV 2	10,5	
16	Junglinster	65/20kV 2	3,1	
17	Riedgen	65/20kV 2	2,8	
		Load disconnected	*33,2*	*4,82%*

Step 5 < 48,43 Hz

No.	Station	MV Transfo	MW	
18	Blooren	65/20kV 1	5,2	
19	Freckelsen	65/20kV 1	1,5	
20	Kayl	65/20kV 1	4,8	
21	Riedgen	65/20kV 1	7,8	
22	Wolwer	65/20kV 1	4,3	
23	Erpeldange	65/20kV 2	6,4	
		Load disconnected	*30,0*	*4,36%*

Step 6 < 48,29 Hz

No.	Station	MV Transfo	MW	
24	Potaschbierg	65/20kV 1	13,9	
25	Redange	65/20kV 1	3,7	
26	Lamadelaine	65/20kV 2	7,1	
27	Roost	65/20kV 2	4,2	
28	Windhof	65/20kV 2	3,4	
29	Wolwer	65/20kV 2	5,1	
		Load disconnected	*37,4*	*5,43%*

Step 7 < 48,14 Hz

No.	Station	MV Transfo	MW	
30	Aspelt	65/20kV 1	9,9	
31	Betzdorf	65/20kV 1	3,2	
32	Findel	65/20kV 1	11,6	
33	Schifflange	65/20kV 2	13,2	
		Load disconnected	*37,9*	*5,51%*

Step 8 < 48,00 Hz

No.	Station	MV Transfo	MW	
34	Koerich	65/20kV 1	9,9	
35	Roost	65/20kV 1	14,6	
36	Windhof	65/20kV 1	7,5	
37	Blooren	65/20kV 2	3,8	
38	Bascharage	65/20kV 2	7,5	
		Load disconnected	*43,3*	*6,29%*

Available

No.	Station	MV Transfo	MW	
39	Bascharage	65/20kV 3	4,5	
40	Bel'Air	65/20kV 2	0,0	
41	Bel'Air	65/20kV 3	18,1	
42	Betzdorf	65/20kV 2	0,1	
43	Bonnevoie	65/20kV 1	7,1	
44	Bonnevoie	65/20kV 2	4,3	
45	Bonnevoie	65/20kV 3	0,0	
46	Dudelange	65/20kV 1	9,3	
47	Echternach	65/20kV 1	6,2	
48	Echternach	65/20kV 2	3,9	
49	Ehlerange	65/20kV 2	1,6	
50	Helsdorf	65/20kV 1	10,0	
51	Helsdorf	65/20kV 2	6,5	
52	Helfent	65/20kV 1	7,3	
53	Howald	65/20kV 1	2,8	
54	Howald	65/20kV 2	5,8	
55	Kirchberg A	65/20kV Luxtram	0	
56	Oxylux	220/20kV A	14,9	
57	Riedgen	65/20kV 3	0,0	
58	Roullingen	65/20kV 1	6,8	
59	Welergewan	65/20kV 1	1,5	
		Total load	*110,7*	*16,09%*

Not available

No.	Station	MV Transfo	MW	
60	Biff	65/20kV 2	7,3	*(H)**
61	Ingeldorf	65/20kV 2	8,4	*(H)**
62	Kayl	65/20kV 2	6,5	*(H)**
63	Koerich	65/20kV 2	5,3	*(H)**
64	Bel'Air	65/20kV 1	15,9	*(CHP)**
65	Cloche d'Or	65/20kV 1	4,7	*(CHP)**
66	Cloche d'Or	65/20kV 2	0,0	*(CHP)**
67	Ecco	65/20kV 1	16,3	*(CHP)**
68	Ecco	65/20kV 2	16,6	*(CHP)**
69	Kirchberg A	65/20kV 1	12,3	*(CHP)**
70	Kirchberg A	65/20kV 2	12,3	*(CHP)**
71	Kirchberg B	65/20kV 1	18,5	*(CHP)**
72	Kirchberg B	65/20kV 2	1,4	*(CHP)**
73	Bocksbierg	65/20kV 1	5,6	*(WPP)**
74	Bocksbierg	65/20kV 2	5,0	*(WPP)**
75	Erpeldange	65/20kV 1	4,3	*(WPP)**
76	Flebour	65/20kV 1	1,2	*(WPP)**
77	Flebour	65/20kV 2	5,5	*(WPP)**
78	Lentzweiler	65/20kV 2	2,6	*(WPP)**
79	Mamach	65/20kV 1	1,1	*(WPP)**
80	Mamach	65/20kV 2	0,8	*(WPP)**
81	Redange	65/20kV 2	6,8	*(WPP)**
82	Roullingen	65/20kV 2	6,7	*(WPP)**
83	Troisvierges	65/20kV 1	6,1	*(WPP)**
84	Troisvierges	65/20kV 2	3,0	*(WPP)**
		Total load	*174,2*	*25,31%*

* *(H) = Medical Facilities*
(CHP) = Cogeneration unit
(WPP) = Wind turbines

Disconnected load 65/20kV	**297,7**	**43%**
Total available load 65/20kV	**408,4**	**59%**
Total load 65/20kV	**582,6**	**85%**
Total Import of Luxembourg	**688,2**	**100%**