Electricity system defence plan of the Grand Duchy of Luxembourg

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Version 1.5.

creos Electris
Gestionnaire de réseau.

Sotel Réseau

SUD STROUM

VILLE DE DIEKIRCH

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Glossary

- *Critical Infrastructure:*

  Site, system or part of a system which is demeed essential for safeguarding the vital interests or the essential services of the territory or part of the territory of Luxembourg or its population or which might be subject to a specific threat in accordance with national law (loi du 23 juillet 2016 portant création d'un Haut-Commissariat à la Protection National).

- *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.

  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 on a local level to supply end consumers, using fixed infrastructure.

- *ERP:*

  Emergency **R**esponse **P**lan (in French "Plan d'intervention d'urgence (PIU) – énergie") 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.

- *High Priority SGU:*

  Significant **G**rid **U**ser for which special conditions apply for demand disconnection.

- *HV / MV / LV:*

  High **V**oltage / **M**edium **V**oltage / Low Voltage

- *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.

- *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).

- *NC E&R*

  Network code on electricity emergency and restoration established by Commission regulation (UE) 2017/2196.

- *PST:*

  Phase **S**hifting **T**ransformer

- *RCC:*

  Regional **C**oordination **C**entre as established by Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity

- *RPP:*

Luxembourg **R**isk **P**reparedness **P**lan for the electricity sector in accordance with article 10 of the Regulation (EU) 2019/941 of the European Parliament and of the Council of 5 June 2019 on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC

- *SEVESO:*

  Establishement classified as « Seveso » in accordance with national law (loi du 28 avril 2017 concernant la maîtrise des dangers liés aux accidents majeurs impliquant des substances dangereuses).

- *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 obliges grid operators to establish preventive measures necessary to "limit the deterioration of safety, reliability, grids efficiency and electricity quality, including possible cuts of connection points". 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 (NC E&R).

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 should be noted that other complementary plans and procedures exist with references to the present system defence plan. Luxembourg's risk preparedness plan for the electricity sector in accordance with article 10 of the Regulation (EU) 2019/941 (RPP), established by the Minister of Energy as competent authority, lists the system defence plan as one of the important measures that may need to be applied in case of an electricity crisis. The system defence plan also appears as one of the relevant measures in the "Plan d'intervention d'urgence (PIU) – rupture énergie" established by the HCPN.

1.2 Objectives of the system defence plan

In line with Article 11 of NC E&R, the system defense plan establishes preventive measures by grid operators to limit the deterioration of safety, reliability, grids efficiency and electricity quality, including possible cuts of connection points.

Due to the fact that potentials for active management of the grid are very limited within the electrical grid of the Grand Duchy of Luxembourg, demand disconnection is the most relevant last resort measure that can be used by the electricity system operators in Luxembourg to prevent the emergence of major incidents and to limit their consequences when they occur.

The focus of this document is therefore 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.

It should be noted that further complementary measures are available to grid operators and other entities involved in crisis prevention and management to avoid demand disconnection as far as possible. They are described in detail in the RPP. A special case relates to Special Protection Scheme setup to prevent a complete blackout in case of a sudden supply interruption from Germany. This scheme should enable a seamless switch of the southern part of Luxembourg to the grid of ELIA via the PST of Schifflange.

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 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 300 000 connected clients), Electris (4 400 connected clients), Sudstroum (21 000 connected clients), the City of Diekirch (4100 connected clients) and the City of Ettelbruck (5300 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.

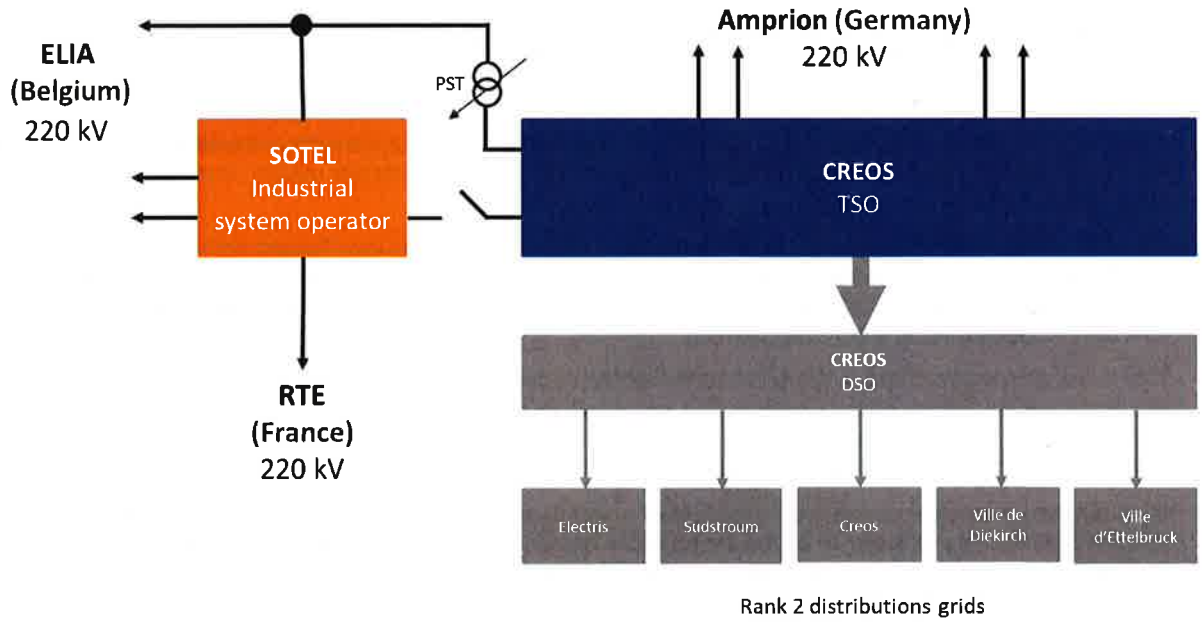

Diagram 1. Electricity grids in the Grand Duchy of Luxembourg and interconnections with neighbouring grids

There are therefore two separate electricity grids in the Grand Duchy of Luxembourg: the Creos grid and the Sotel grid. They are covered by the control areas of Creos, Elia and RTE.

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 balance on the Creos grid

Under normal circumstances, the Creos grid has a production deficit; its electricity supply depends largely on the interconnection lines with the German grid. Thus, on average more than 3/4 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 units, small hydroelectric power plants, wind powered generators, PV installations, biogas installations and one waste incineration unit). None of these plants is dispatched by the national control center of Creos.

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 1, single-line diagram of the Luxembourgish grids) and is not controlled by the national control center of Creos.

2 Conditions of activation of the system defence plan

2.1 Overview

The system defence 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, i.e. in the following three cases:

1) Schemes are activated automatically (cf Section 3.1), or
2) The system is in emergency state in accordance with the criteria set out in Article 18(3) of Regulation (EU) 2017/1485 and there are no remedial actions available to restore the system to the normal state, or
3) Based on the operational security analysis, the operational security of the transmission system requires the activation of a measure of the system defence plan pursuant to Article 11(5) in addition to the available remedial actions.

As such, the plan is 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 Activation scenarios

The activation of the system defence plan is triggered by 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 TSO in order to stabilise the interconnected European power grid.

2.3 Position of the demand disconnection in the hierarchy of available measures

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.

According to Luxembourg's Risk Preparedness Plan, these measures include:

- Saving appeals to the public, e.g. by means of signals submitted through the "StroumMonitor"
- Reduction respectively stop of maintenance and infrastructure works
- Modification of the grid topology and congestion management
- Load frequency control and system protection schemes (further details in Section 3.1)

- Temporary violation of the (n-1) security

The above list may be complemented by measures taken by the Government and public authorities, e.g. obligations to make use of emergency generators on a temporary basis, or targeted and temporary obligation to reduce demand for state and municipal entities. In any case, the feasibility of measures will depend on the specific situation, such as predictability of events, expected impact, etc.

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.

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 article 15 of Regulation (EU) 2017/2196 establishing a network code on electricity emergency and restoration.

Creos has divided the frequency between 49,0 Hz and 48,0 Hz into 8 different batches representing each a load between 30 and 40 MW. Each batch represents several 65/20 kV transformers. A frequencemetric relay is implemented on each of these transformers.disconnection. Appendix 2 shows the different frequency stages and the load that can be removed for each stage.

3.1.2 Automatic over-frequency control scheme

As there are no major loads (like pumps) connected to the grid of Creos, no automatic over frequency management mechanism can be activated by the TSO or DSOs in Luxembourg. It is a task delegated to Amprion (with the exception of over-frequency protection present on different equipment (e.g. generators)).

3.1.3 Automatic scheme against voltage collapse

The automatic scheme used by the TSO Creos against voltage collapse 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.

3.1.4 Special Protection Scheme

Creos has set up a special protection scheme in order to allow for an automatic load transfer to Elia, via the PST in Schifflange, in case of a supply failure on the Amprion grid. Note, however, that this load transfer is limited to 400 MW and can thus only be partial. Taking into account the given topology of the 220 kV and 65 kV network, this special protection scheme has been set up to split the Creos grid in such a way that the southern part of Luxembourg and the city of Luxembourg continuous to be supplied via the PST by Elia.

3.2 System defence plan procedures

In addition to the automatically activated protection 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 is considered in a state of emergency when at least one of the following conditions is met:

- At least one operational safety limit of the TSO has been trespassed;
- 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 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 non- availabilityof 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 RCCs;
- There is a structural deficit of production capacity to meet predicted consumption levels
    - In application of article 22 of Regulation (EU) 2017/2196 the upstream TSO (Amprion) may notify Creos of the amount of netted demand necessary to disconnect in order to prevent the propagation or worsening of an emergency state at the upstream TSO to Creos.

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.

However, it should be noted that the unavailability of tools, equipments and installations does not necessarily mean that a load shedding procedure will be triggered.

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. This task is delegated to Amprion as Creos belongs to the same LFC block as Amprion.

3.2.2 Voltage deviation management procedure

Due to the fact that there are no large power plants connected to the 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 less than a quarter 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 Voluntary demand reduction

To trigger voluntary demand reduction, an electricity monitor (StroumMonitor) is being developed by TSO Creos to alert and launch saving appeals to final customers. These saving appeals can be activated to address different levels of severity by means of a traffic light system. Specifically, a call for reduction of demand can be communicated during specific hours where a shortfall in electricity is expected with the objective to avoid as far as possible the activation of more severe options such as manual load shedding. The saving appeal is communicated through a website widget, which is easily accessible for the general public.

In the widget, the green signal is the default signal of the StroumMonitor. It means that the level of electricity consumption is lower than the available production for the day with sufficient margins based on ENTSO-E's Short-Term Adequacy Forecasts (STA). The orange signal is activated when the available electricity reserves are low, i.e. when the available production is very close to the expected consumption level. The red signal is activated when there is not enough electricity to cover all needs.

In addition, the widget also indicates peak hours according to production and consumption forecasts on a daily basis to incentivize enhanced flexibility and peak load shaving.

To support the saving appeals, a dedicated website was created, which describes easy-to-apply saving measures for both individuals and companies. The general advice is to avoid high power applications during times of tension and shift them to less stressed times. The message may be echoed and reinforced through dedicated communication channels (communiqué de presse, etc.) to achieve a reduction of electricity consumption in anticipation of the expected shortfall and to avoid the activation of manual load shedding

To reinforce the message, the TSO/DSO may also contact certain industries directly to inform them of the situation and to inquire if a reduction in demand can be arranged for the predicted day of the shortfall.

3.2.6 Modification of the grid topology and congestion management

Modification of the grid topology, e.g. by changing the interconnection of lines in substations and/or coupling or decoupling of busbars, is a measure that can be taken rapidly and mostly remotely with the aim to avoid unacceptable loadings of assets that may cause further outages.

Topological measures may be supplemented by applying congestion management in a grid convenient way, such as redispatch of power production from one location to another. Due to the small size and the properties of the national energy supply system, congestion management potential in Luxembourg is very limited.

3.2.7 Temporary violation of the (n-1) security

The system operator may also accept a temporary violation of the (n-1) security criterion provided that this allows to avoid the activation of load shedding measures and to regain (n-1) security after short time. Such temporary non-compliance with the (n-1) security criterion is compatible with the article 35 of the System Operation Guideline as long as there are only local consequences within the system operator's control area.

3.2.8 Manual demand disconnection procedure

3.2.8.1 Responsibility and decision making

3.2.8.1.1 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" demand disconnection.

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).

3.2.8.1.2 Localised demand disconnection

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

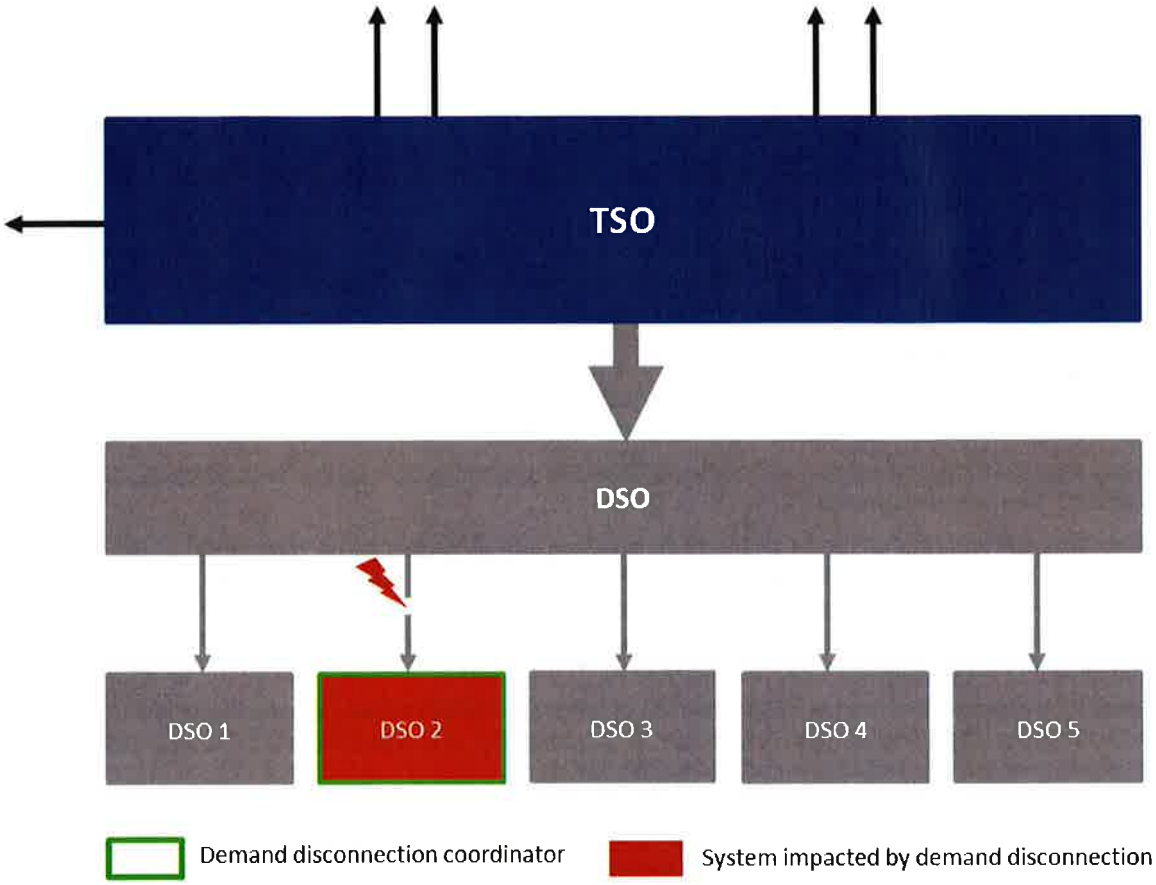

Diagram 2. Illustration – Localised demand disconnection

3.2.8.1.3 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, based on the effective grid topology and the load on the different grid elements, respectively based on the demand of Amprion.

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 detailed further in this document.

The TSO shall implement on its own 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.

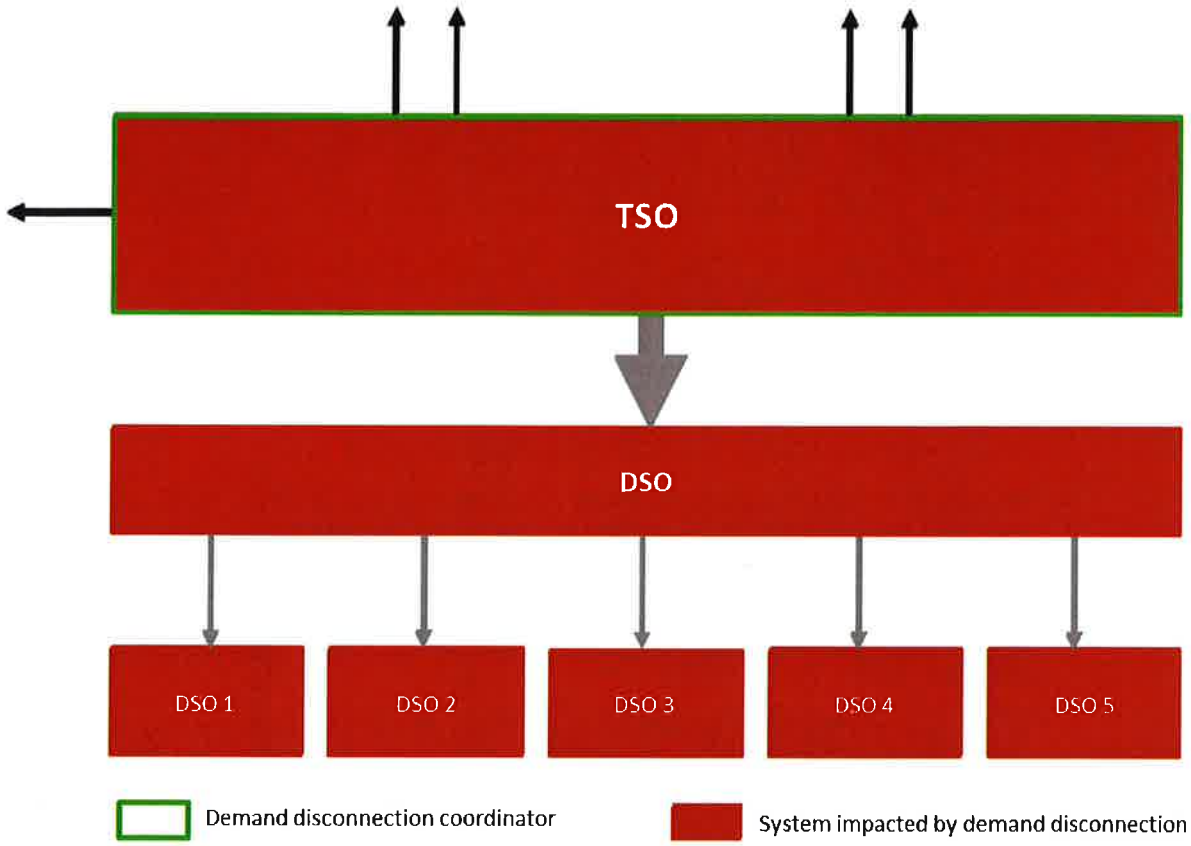

Diagram 3. Illustration – National demand disconnection

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.

3.2.8.1.4 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 of a crisis, 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.

3.2.8.2 Hierarchical list of disconnectable consumer groups

In order to allow a very fast implementation of demand disconnection, a hierchical list composed of three main groups labeled Niveau 1-3 (or N1-N3) is established where the highest ranking number (in this case N3) is disconnected first, in accordance with the corresponding measure described in Luxembourg's Risk Preparedness Plan.

- N3: High voltage customers connected at 65 kV, 110 kV or 220 kV. excluding critical infrastructures. This group is split into:

- N3.2 High voltage customers classified as non-SEVESO. In order to avoid that always the same customers will be selected for a load shedding operation, a monthly changing scheme with 5 equally sized batches is established. See appendix 3

Year	Month	Jan.	Feb.	Mar.	Avr.	Mai	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
	prio 1	A	B	C	D	E	A	B	C	D	E	A	B
	prio 2	B	C	D	E	A	B	C	D	E	A	B	C
	prio 3	C	D	E	A	B	C	D	E	A	B	C	D
	prio 4	D	E	A	B	C	D	E	A	B	C	D	E
	prio 5	E	A	B	C	D	E	A	B	C	D	E	A

- N3.1. High voltage customers classified as SEVESO

- N2: Low and medium voltage customers connected to a grid at voltage levels lower than 65 kV, excluding critical infrastructures. Should the preceeding level N3 not have been sufficient to cover the demand to be disconnected, the TSO will have to disconnect 65/20 kV transformers and connected customers. The total load of these transformers amounts to roughly 110 MW. The disconnection time is as far as possible limited to 2 hours per transformer. Hence, a rotational system may be applied if the total time during which the power has to be disconnected would exceed 2 hours.
- N1: Critical infrastructures as defined by the law of July 23rd 2016 concerning the creation of a "High Commission for the National Protection". Critical infrastructures are to be disconnected as a very last resort measure bearing in mind that with more than half of the total consumption already disconnected, the TSO is already in a "black-out" state according to current ENTSO-E definitions.

All system operators shall prepare their respective lists and procedures for manual demand disconnection according to the aforementioned priority list to allow for the fastest possible implementation. Specifically, lists and groupings shall be prepared to ensure exclusion of critical infrastructures at levels N2-N3, application of batches A-E in N3, as well as suitable groups for the rotational systems in N2. DSOs shall communicate their respective lists to the TSO and keep them duly updated, at least once per year.

Practical implementation of N2 is done via transformers which are fitted with control relays that can be remotely switched on and off by the concerned DSOs. Each DSO takes the appropriate procedural and technical measures in cooperation with TSO Creos to be able to remotely disconnect the corresponding loads within the delay specified in paragraph 3.2.8.3.4.

3.2.8.2.1 Hierarchical list for 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 and there is sufficient time to organise the national demand disconnection, the TSO organizes demand disconnection according to the hierarchical list of disconnectable consumer groups described in paragraph 3.2.8.2, and instructs each of the system operators to disconnect all consumer groups within their grids and within the same level(s) of priority.

3.2.8.2.2 Hierarchical list for localised demand disconnection

In the case of localised demand disconnection, the system operator concerned shall organise the demand disconnection according the same priority principles described in Section 3.2.8.2., using for this purpose a

hierarchical list of its own consumers, unless technical reasons require a derogation from these principles (particularly in the case of a very localized problem).

3.2.8.3 Operational implementation of manual demand disconnection

3.2.8.3.1 Activation scenarios

Manual demand disconnection is implemented in reaction to events whose onset and evolution make human intervention and a manual selective approach possible.

3.2.8.3.2 Instructions

When the crisis situation affects several grids (for instance, in the case of national demand disconnection), , 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 will take 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.

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

3.2.8.3.3 Opening of the connection points

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

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

Customers equiped with electricity smart meters can be selectively and remotely disconnected.

3.2.8.3.4 Execution delays

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

3.2.8.3.5 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, as far as possible for no longer than 2 hours.

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.

3.2.8.3.6 *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".

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 3.2.8.2).

3.2.8.3.7 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 3.2.8.2(first disconnected, first reconnected).

3.2.8.3.8 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 the procedures foreseen in Commission regulation (EU) 2017/2196.

3.2.8.4 Training and field reports

3.2.8.4.1 Training

Demand disconnection is only applied 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.

3.2.8.4.2 Field reports

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.

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

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Mario Grotz
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Place: Luxembourg
Date: 19.12.2022

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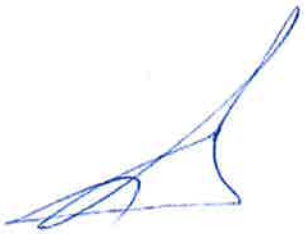

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VU ET APPROUVÉ:

VILLE D'ETTELBRUCK
Le collège échevinal

ADMINISTRATION COMMUNALE ETTELBRUCK

Place : Ettelbruck

Date : 23 DEC. 2022

Signatory Page Sudstroum

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CTO

Place : Esch-sur-Alzette

Date : 22.12.2022

Signatory Page Sotel Réseau

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Date : 16/12/2022