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PRINCIPLES FOR THE RESTORATION PLAN

Article 4(5) of Commission Regulation (EU) 2017/2196 of 24 November 2018 establishing a network code on electricity emergency and restoration (NC ER) requires each TSO to notify the regulatory authority of the restoration plan prepared pursuant to Article 23 or at least the central elements of the restoration plan.

This document constitutes Energinet's notification of the central elements, as set out in points (a) to (d) of Article 4(5).

1. Objective, cf. point (a) of Article 4(5)

The objective of the restoration plan is to ensure full restoration and stabilisation of the transmission grid following a blackout, power shortage, or other critical situation affecting the quality of supply in the transmission grid.

Specifically, the system restoration plan must address:

- Blackout, i.e. situations in which at least 50% of the supply is missing in an area
- Re-energisation
- Frequency management
- Resynchronisation.

2. Criteria triggering the activation of the restoration plan, cf. point (b) of Article 4(5)

The restoration plan is activated according to the following two criteria:

- Blackout state; the state is defined in Article 18(4) of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SO GL)
- Emergency mode; the state is defined in SO GL Article 18(3).

In both cases, system restoration will not be initiated until the system has been stabilised and actual restoration can be effectively initiated.

3. Measures, cf. point (c) of Article 4(5)

3.1 Blackout

Blackout situations in which at least 50% of a transmission company's area is unsupplied or the transmission company's grid has no voltage for at least three minutes, cf. Article 18(4) of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation (SO GL).

3.1.1 Rationale

In a blackout situation, it is critical to restore electricity supply in the transmission grid as quickly as possible so that energy can distributed to consumers in the distribution grid.

In order for consumers to be supplied, the voltage in the transmission grid must be stable and within the normal range defined in Article 18(1) of SO GL. This is to ensure that consumers are not unnecessarily inconvenienced by repeated outages during the restoration process.

Energinet's analyses indicate a need for 300 MW of active power in steps of ±10 MW and ±100 MVAr. It is thus a requirement that the unit used to start from is able to maintain normal operating conditions for voltage and frequency (as defined in Technical regulation 3.2.3 for thermal units above 11 kW), also in the event of momentary connection and disconnection of 10 MW and/or 100 MVAr.

3.1.2 Explanation

Energisation of the transmission grid can be done according to two principles: top-down or bottom-up.

Top-down means that the surrounding grid can provide energy to supply the area affected by the blackout. This energy can come from intact parts of the transmission grid or from interconnectors. Both domestic and international connections are used.

Bottom-up supply is used in situations where top-down supply is not possible. For this purpose, Energinet Elsystemansvar has signed agreements with two facilities in each synchronous area.

During transmission grid energisation, initial account is taken of the grid's own physical needs, active and reactive power, in order to be able to establish an electrical connection. As the transmission grid is energised, it will be necessary to stabilise the voltage. This is achieved by connecting demand in specific nodes in the transmission grid.

3.1.3 Responsibility

Energinet Elsystemansvar A/S is responsible for this restoration, and the task lies with Energinet's Control Centre Electricity.

Control Centre Electricity gather information about the situation to create an overview, and ensure that any faults are under control or isolated so that the transmission grid can be energised.

Energisation then begins, and as more power is available and the energised transmission grid thereby expands, Control Centre Electricity will contact the grid companies that can create demand from substations with a backup auxiliary supply. These critical substations are part of the restoration plan, cf. NC ER Article 23(4).

3.2 Re-energisation

In restoration situations, automatic re-energisation is not allowed. This means that if a demand facility, power-generating facility, or distribution grid is disconnected from the transmission grid, re-energisation is only allowed with the agreement of Energinet's Control Centre Electricity to ensure that inappropriate load does not worsen the condition of the transmission grid.

3.2.1 Rationale

During energisation, it is critical that the ratio of available active to reactive power is constantly monitored. This is to ensure that voltage and current do not become unstable, thereby making the situation worse.

3.2.2 Explanation

Ensuring that generation as well as demand are connected under controlled conditions prevents the occurrence of power excesses or deficits. Control Centre Electricity contact the relevant grid company and state the amount of power that can be connected, specified by active and reactive power and also by generation.

3.2.3 Responsibility

Through Control Centre Electricity, Energinet Elsystemansvar A/S ensures that the required capacity is reconnected as more power becomes available in the transmission grid.

3.3 Frequency management

Bringing frequency back into the normal range after a deviation is done by activating bids for active power (low frequency) or adjustable demand (high frequency).

3.3.1 Rationale

The frequency in Denmark depends to a large extent on the frequency of the surrounding transmission grid, including the frequency in Germany for DK1 and the frequency in Sweden for DK2. However, frequency is also dependent on power being able to flow freely to and from an area. Thus, high frequency in Denmark could be reduced by reducing generation in the affected area. Similarly, low frequency could be remedied by increasing generation.

In some cases, specifying a different frequency setpoint for power-generating facilities may be able to eliminate both high and low frequencies.

3.3.2 Explanation

Activation of bids from generating facilities or downward regulation of their output will have a beneficial effect on the frequency, and this is the primary approach.

In case of prolonged frequency deviations, it may be necessary to adjust the frequency setpoint.

3.3.3 Responsibility

Through Control Centre Electricity, Energinet Elsystemansvar A/S constantly monitors the frequency in Denmark for both synchronous areas and ensures that deviations are addressed.

3.4 Resynchronisation

Transmission-connected generation and demand facilities may only resynchronise with the agreement of Energinet's Control Centre Electricity.

3.4.1 Rationale

To ensure that voltage and frequency are kept stable during restoration of the transmission grid, it is necessary to control the amount of power generated and consumed in the transmission grid. This means that facilities that are capable of island operation must not automatically synchronise with the transmission grid, as this could potentially harm the restoration process.

3.4.2 Explanation

Once the transmission grid has stabilised, Energinet authorises Elsystemansvar A/S, through Control Centre Electricity, to allow the transmission-connected generation and demand facilities, as well as any grid companies in island operation, to resynchronise in sections to avoid instability in the transmission grid.

The criteria for the actual resynchronisation are stated in the connection agreement with Energinet Elsystemansvar A/S.

If the facility/system does not have the necessary synchronisation functionality, the facility/system is shut down and connected to the transmission grid, after which it can be restarted.

3.4.3 Responsibility

Through Control Centre Electricity, Energinet Elsystemansvar A/S ensures that resynchronisation is done in a controlled way until the transmission grid is stable again and the restoration procedure has been completed.

4. Deadlines, cf. point (d) of Article 4(5)

The requirements specified in the restoration plan, cf. point (g) of Article 23(4), must be implemented by 18 December 2019, with the exception of the backup power supply requirements.

The backup power supply requirements, cf. NC ER Article 42(2) and (5), must be implemented by 18 December 2022, cf. Article 55.