

Joint operation between the Western Danish and Swedish subsystems on the Konti-Skan 1 and 2 DC links

Appendix 5 to SOA Annex OS (DK1 and SE)

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1 Background

The subsystems of Norway, Sweden, Finland and Eastern Denmark are synchronously interconnected. The subsystem of Western Denmark is connected to Norway, Sweden and Eastern Denmark using DC links. This Appendix describes the DC links between Sweden and Western Denmark.

2 Transmission facilities linking the subsystems of Sweden – Western Denmark

Facility	Voltage kV
KS1 Lindome - Vester Hassing	285 kV DC
KS2 Lindome - Vester Hassing	285 kV DC

Together, KS1 and KS2 make up the Konti-Skan link.

Settlement presently takes place on the AC side at Vester Hassing.

3 Electrical safety for facilities

3.1 General

The common ground for the electrical safety work of the system operator companies within the Nordic countries is constituted by the European standard for managing electrical high-voltage facilities EN 50 110 - which governs the organisation and working methods. In addition to the standard, there are national regulations and special instructions which entail certain mutual differences between the system operators as regards dealing with operational issues from an electrical safety point of view.

3.2 Responsibility for electrical operation/Operational management

The responsibility for electrical operation of the transmission facilities is held in Western Denmark by Energinet and in Sweden by Svenska kraftnät. The responsibility for electrical operation is regulated by facility agreements between Energinet and Svenska kraftnät.

The power operation responsibility boundary between Svenska kraftnät and Energinet lies at Læsø Øst, at the transition between the submarine and shore-end cables.

3.3 Switching responsible operator

Facility	Swedish side	Danish side
Konti-Skan 1	Svenska kraftnät's Operations Centre in Sundbyberg (DCSY)	Energinets control room at Vester Hassing
Konti-Skan 2	Svenska kraftnät's Operations Centre in Sundbyberg (DCSY)	Energinets control room at Vester Hassing

During work between Lindome and XL1-F at Læsø Øst or Lindome and XL2-F at Læsø Øst, the Operations Centre at Sundbyberg (DCSY) shall be the power operation manager for the entire link up to Vester Hassing.

During work on the Danish parts of the link, Energinets control room at Vester Hassing is the power operation manager for the entire link up to Lindome.

3.4 Operation monitoring and control in respect of electrical safety

Operation monitoring and control is carried out from Energinets Control Centre at Erritsø or Vester Hassing and the Operations Centre at Sundbyberg (DCSY).

- Normally, bipolar operation is applied to Konti-Skan 1 and 2 but each of them can also be operated in monopolar mode.

3.5 Switching schedule

Switching concerning Konti-Skan takes place as follows:

- Switching which concerns Vester Hassing alone takes place in accordance with a switching schedule drawn up by Energinet.
- Switching on the Danish part of the cable takes place in accordance with a switching plan drawn up by Energinet. Before the work begins, the Operations Centres shall confirm that the link is grounded and secured against switching on by exchanging switching confirmations.
- Switching in Lindome alone takes place in accordance with a switching plan drawn up by Svenska kraftnät.
- Switching on the Swedish part of the cable takes place in accordance with a switching schedule drawn up by Svenska kraftnät. Before the work begins, the Operations Centres shall confirm that the link is grounded and secured against switching on by exchanging switching confirmations.

3.6 Disturbance management

3.6.1 Cross-border link trips – management

During operational disturbances, measures in accordance with issued instructions shall, as soon as possible, restore the link to normal state.

3.6.2 Switching schedule

In the event of faults requiring switchings impacting upon the cross-border link, Energinets Control Centre at Erritsø and Svenska kraftnät are informed prior to any switchings being made. In the event of switchings on the Swedish grid, a switching schedule will be drawn up by Svenska kraftnät.

3.6.3 Fault finding

Initial fault finding will be carried out differently from case to case. Generally speaking, the respective facility owner will be responsible for fault finding. For fault finding, a special preparedness plan for submarine cables has been drawn up.

3.6.4 Fault clearance, remaining faults

Once the fault has been localized, the respective facility owner will attend to clearing the fault as agreed in Anläggningsavtal gällande överföringsanläggningarna Konti-Skan i och 2 mellan Danmark och Sverige. For fault clearance, a special preparedness plan for submarine cables has been drawn up.

4 System operation for facilities

Executed in relation to capacity calculations based on flow-based advanced hybrid coupling. The business process is detailed in the RCC document *High Level Business Description – CCC FB Day Ahead*.

4.1 Transmission Capacity on the Links

The transmission capacity of the links depends on the temperature of the air, cable runway, and ground. The nominal capacity at the receiving end:

- In bipolar operation, the nominal capacity is 715 MW,
- In monopolar operation (KS1 or KS2), the capacity is 345 MW.
- Technical minimum transfer capacity of KS1: 12 MW; KS2: 9 MW.

4.2 Routines for determining the transmission capacity

The transmission capacity between Jutland and Sweden shall be set on a routine basis by the Parties. In the case of intact connecting networks, the transmission capacity is determined by the thermal capacity of the facilities' components. The thermal overload capability allowed by monitoring equipment shall be capable of being used as and when required in accordance with special instructions. Technical data for the facilities' transmission capacities is reported in the current facility agreement between Energinet and Svenska kraftnät.

For any limitations in the connecting AC networks, Energinets Control Centre at Erritsø is responsible for supportive data on the Western Danish side and Svenska kraftnät for the same on the Swedish side.

4.3 Trading capacity (Regional Coordinated capacity calculation)

The trading capacity is calculated in the coordinated capacity calculation process as defined in the Nordic Capacity calculation methodology. The full capacity calculation process is specified in the Nordic RCC – TSO procedures (High Level Business Description – CCC FB Day ahead).

The following calendar day's trading capacity is set every day. The trading capacity can be limited by line work, production in the connection area, overhauls etc.

Both Parties inform the other Party in good time prior to the relevant calendar day regarding the transmission capacity seen from the respective sides. The values that are the lowest will be the trading capacity.

4.3.1 Allocation constrains

- Implicit losses is applied on the border and the loss factor is defined according to the Nordic Capacity Calculation Methodology.
- Ramping restrictions are applied in accordance with the Nordic Ramping methodology (Nordic LFC block methodology for ramping restrictions for active power output in accordance with Article 137(3) and (4) of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation).

4.4 Operation monitoring and control in respect of system operation

Operation monitoring and control is carried out from Energinet's Control Centre at Erritsø and Svenska kraftnät's Operations Centre in Sundbyberg.

4.4.1 The power flow and distribution between the poles

Konti-Skan 1 and 2 are normally operated in bipolar mode.

During disturbances and maintenance on one pole, monopolar operation is applied.

4.4.2 Regulating the link

Regulation of the Konti-Skan links in accordance with agreed exchange plans will be carried out, until further notice, from the Danish side. Energinets Control Centre at Erritsø is responsible for its own balance regulation towards Sweden.

Regulation takes place, in principle, in accordance with a power plan using ramping transitions between different power levels. The plans are issued as power plans in whole MW for each 5 min of plan value. The links are regulated in accordance with this power linearly from power value to power value.

The power plan is determined in accordance with the exchange plan for Konti-Skan.

4.5 Outage planning

The Parties shall, in consultation, plan outages on the link itself and on their own networks when these outages impact upon the transmission capacity of the link.

Operational planning and maintenance are co-ordinated between Svenska kraftnät's Operational Department and Energinet's Control Centre at Erritsø.

Overhaul planning is co-ordinated with the other HVDC links in the Nordic area.

4.6 System protection - emergency power

4.6.1 General

The Konti-Skan link is of major importance to Sweden and Denmark and outages due to disturbances thus generally entail major economic losses. In the event of operational disturbances, measures in accordance with issued instructions shall, as soon as possible, restore the link to normal state.

Automated operational disturbance systems are installed at Lindömen and Vester Hassing which can begin to function during operational disturbances on the Swedish or Jutland networks.

4.6.2 Delta power control, DPC1-4

Delta Power control is regulating measures which are initiated manually (manual DPC)

On the Western Danish side, Energinet's Control Centre at Erritsø has the right to initiate Delta power controls in the event of disturbances to the power balance or transmission network.

On the Swedish side, Svenska kraftnät has the right to initiate Delta Power Controls in the event of disturbances to the power balance or transmission network.

Delta Power controls of less than 100 MW and 100 MWh/calendar day may be activated without previous notification. Prior to activation over and above this, notification and approval shall take place between the staff of Energinet's Control Centre at Erritsø and SvK-VHI at Network Control at Sundbyberg.

4.6.3 Emergency power (EPC) and System protection

At the DC facilities, system protection is installed in the form of an emergency power function. Activation criteria for emergency power can be locally-measured frequency and voltage or via telecommunications on the basis of a supplied signal. In the event of activation, any ongoing normal regulation will be interrupted. Activation over and above the agreed limits and regulation back to plan may not occur until the counterparty has approved this. (See further in Appendix 9 – System protection schemes).

5 Miscellaneous

5.1 System services

5.1.1 Transmission scope for operation reserves

Available transmission capacity can be used for the automatic or manual activation of operational reserves.

Both Svenska kraftnät and Energinet have the right to utilize idle transmission capacity after Elspot trading and XBID trading for the transmission of system services. Configuration values, power limits etc. are agreed upon bilaterally.