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Responsibility of the commission
Swissgrid is responsible for maintaining this document and developing it further.

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It is considered a guideline within the meaning of Art. 27 Para. 4 of the Electricity Supply Ordinance.

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Foreword

This document is an electrical industry document that falls within the sphere of responsibility of the national grid company (Swissgrid). It is part of a comprehensive policy for electricity supply in the open power market. Electrical industry documents contain guidelines recognised throughout the industry, as well as recommendations for using the power markets and for organising the energy business. As such, they fulfil the requirements of the Electricity Supply Act (StromVG) and the Electricity Supply Ordinance (StromVV) for the power supply companies (PSC).

Electrical industry documents are prepared, periodically updated and extended by industry experts within the meaning of the subsidiarity principle. The provisions that apply as guidelines within the meaning of the StromVV are self-regulation standards.

The documents are hierarchically divided into four different stages.

– Basic document: Market model for electrical energy (MMEE)
– Key documents
– Implementation documents
– Tools/software

This Transmission Code (TC) document is a key document. Together, the TC, Distribution Code (DC) and «Grid connection recommendations for energy generation systems (NA/EEA)» comprise the grid code for Switzerland.

The transmission system (TS) is an electricity grid that carries electricity at extra high voltage over long distances within Switzerland and within the interconnected grid with foreign grids. It is the link to the system operators connected to the TS. To ensure stable grid operations and effective disturbance management, it is essential that all the players adhere to uniform minimum standards.

Due to the large number of players, it is necessary to precisely define what information must be sent at the interfaces. By the same token, information required for modelling steady-state and dynamic grid models has to be exchanged and coordinated transparently.

International and national coordination is becoming increasingly important due to the integration of national markets into the EU internal market and the increasing decentralisation of power generation.

The TC is the main document that describes how the players cooperate. The players are the national grid company, system operators and owners that are connected directly to the TS, market players and also certain system operators that are connected to the distribution system (DS). In addition, the national grid company coordinates with the foreign transmission system operators (FTSO) and the regional security coordinators (RSC). The TC puts the regulatory requirements in concrete terms and specifies which issues the players must regulate contractually. Existing contracts and agreements are taken into account in that process.

The behaviour of the increasing number of new players, such as prosumers and operators of decentralised power plants or energy storage facilities, etc., is gaining importance for the TS and DS. Different requirements apply depending on the system type and voltage level. These requirements are laid down in the key documents TC/DC and in the implementation document NA/EEA. The national grid company and the distribution system operator (DSO) ensure that these players follow the standards and requirements that are relevant to them.

Within the scope of grid connection and grid operations, the national grid company and the DSOs check to ensure that both single systems and their sum that is connected to their grids poses no threat to the secure operation of their grids. The protection of persons and systems is a top priority here.

Because the activities of the players at the various voltage levels mutually influence each other, TC, DC and NA/EEA are considered as a whole.

1. Introduction

1.1. General

(1) The TC is based on currently applicable legal provisions, in particular the Electricity Supply Act (StromVG), Electricity Supply Ordinance (StromVV), Electricity Act (EleG), Energy Act (EnG) and Energy Ordinance (EnV).

(2) The TC is in line with international requirements and obligations, such as contracts between the European transmission system operators (TSOs) and the rules and regulations of the European Network of Transmission System Operators for Electricity (ENTSO-E) that apply to the interconnected grid. The TC also takes into account (where applicable) relevant network codes and guidelines that apply to the interconnected European grid.

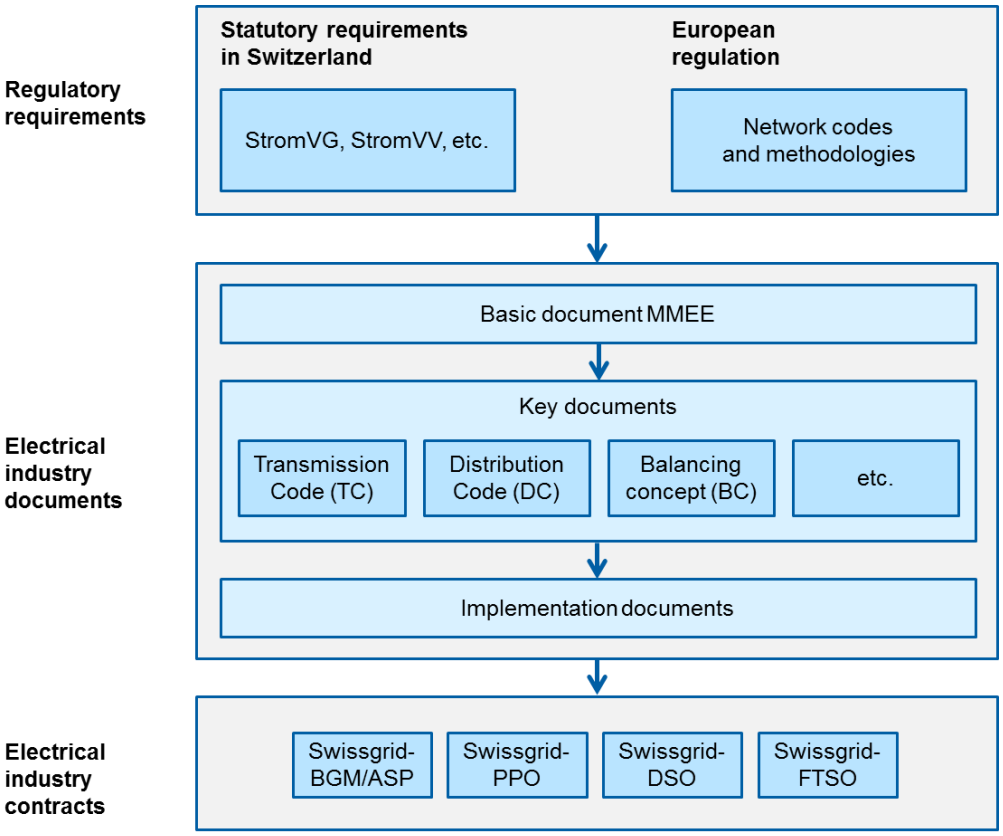


Figure 1: Position of the TC in the document hierarchy

Figure 1 provides an overview of the regulatory requirements and electrical industry documents and contracts.

The Annex in section 9 provides an overview of which regulatory bases are relevant to which chapter of the TC, as well as which VSE implementation documents and electrical industry contracts implement individual requirements from the TC.

In addition, the system and power plant operators have to consider the national and international standards.

(3) The TC defines the technical principles and requirements for grid connection to the TS, operation and use of the TS and the roles of the various players.

(4) The provisions of the TC concern the relation between the national grid company and the operators and owners of systems that are significant for the TS.

(5) Furthermore, the TC defines principles for data exchange between the players who reach concrete agreements on this basis.

(6) Compliance with the principles and requirements of the TC is essential in order to ensure a secure and reliable supply of electricity. The provisions of the TC thus serve as a basis for determining mutual rights and obligations in the contracts and agreements that the national grid company concludes with the respective players.

(7) The players are free to expand upon the requirements set out in this TC or to define them in greater detail.

(8) The national grid company, the operators of systems connected to the TS and other players must take steps to guarantee secure grid operation. In the process, they pay particular attention to the protection of persons and systems. At the same time, these players must further develop their interfaces and processes in a coordinated manner to ensure effective and efficient grid operation.

(9) The following points are not part of the TC:

a) The commercial handling of the mutual rights and obligations; these are contractually regulated.

b) The rules for determining and billing grid utilisation costs are outlined in the electrical industry document Grid Usage Model for the Swiss Transmission System (NNMÜ-CH), and the grid usage tariffs for the TS are published by the national grid company.

c) Measurement and metering data management for billing purposes; these are regulated in the electrical industry document Metering Code (MC-CH).

d) Balance responsible parties and schedule management; these are regulated in the electrical industry document Balancing Concept (BC-CH).

(10) In the event of a severe power shortage, the «Organisation for Supply of Electricity in Extraordinary Situations» (OSTRAL) shall apply, on a situational basis, measures that were determined by the Federal Council based on the State Supply Law (LVG), and these measures shall take precedence over the rules of the TC.

(11) If the TC is amended, existing contracts and agreements must be considered accordingly. If required for reasons of system security, the affected parties must strive for an amicable agreement regarding contract amendment in accordance with the TC.

(12) The VSE glossary[1] defines abbreviations and technical terms that are used in the TC.

1.2. Contents of the Transmission Code

(1) ***Section 1 Introduction***

contains an introduction to the purpose, form, content and bases of the TC, a description of the observability area of the national grid company and a brief overview of the various players and roles that are affected by the regulations of this TC. It defines the scope of application of the TC.

(2) ***Section 2 Introduction to the operation of the transmission system***

deals with the essential provisions concerning outage planning and grid operations management for the TS, including the applicable criteria. This section describes the grid states, the grid situations and the national grid company's right to issue directives depending on the grid state. It also describes the coordination of outage planning and switching actions. Section 2 also deals with operational congestion management and the provision of information necessary for grid operations, and it provides guidelines for the instruction, training and certification of operating staff.

(3) ***Section 3 Energy exchange and capacity allocation***

addresses issues concerning setting up balance responsible parties and their tasks, as well as general requirements for allocating available cross-border grid capacities.

(4) ***Section 4 Ancillary services***

[1] Until the update of the entire VSE glossary is completed, the national grid company will publish a glossary and list of abbreviations for the TC.

defines the different ancillary services (frequency maintenance, voltage maintenance, black start and island operation capability) and regulates their procurement and deployment by the national grid company.

(5) ***Section 5* Measures during operation of the transmission system and disturbance management**

determines responsibilities and regulates measures that are required to maintain or restore a normal grid state. In addition, it describes measures for frequency maintenance, voltage maintenance, congestion management, limitation of major disturbances and grid restoration. This section also contains requirements for instructing and training the players with regard to disturbance management.

(6) **Section 6 Connecting to the transmission system**

covers the construction, modification and termination of grid connections and therefore provides a basis for concluding grid access contracts. This section defines, in particular, the technical requirements for connecting technical systems to the TS.

(7) ***Section 7 Grid development of the transmission system***

documents the grid planning criteria that must be observed and regulates the provision of information by third parties, necessary for expansion planning.

(8) ***Section 8 Final provisions***

contains general regulations for compliance with and further development of the TC.

(9) ***Section 9 Annex***

contains a list of regulatory specifications for the TC and a list of the downstream electrical industry documents and contracts with which the TC requirements are implemented.

1.3. Scope of application of the Transmission Code

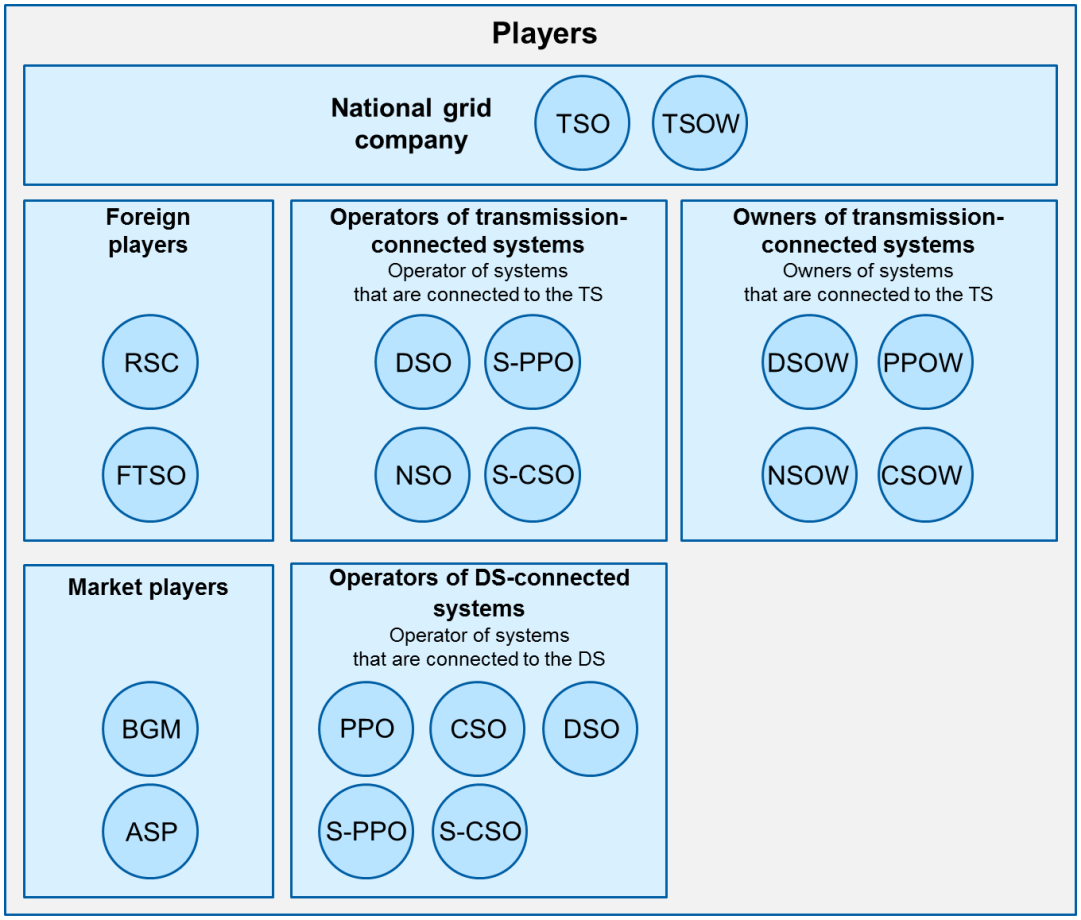
(1) The requirements of the TC apply to the players relevant to the TS, as presented in section 1.4, for both their new and existing systems.

(2) The requirements in section 6 regarding grid connections to the TS are subject to special regulations that are defined in section 6.1.

(3) The TC forms the basis for concluding contracts between the national grid company and other players, e.g., for connection to the TS, operation of the TS, grid utilisation of the TS, the establishment of balance responsible parties and the provision of ancillary services.

1.4. Definition of players and their roles

(1) The TC draws distinctions between the groups of players presented in Figure 2. These are presented in detail after the figure:



FTSO = Foreign transmission system operator
BGM = Balance group manager
NSO = Neighbouring system operator
NSOW = Neighbouring system owner
CSO = Customer system operator
CSOW = Customer system owner
PPO = Power plant operator
PPOW = Power plant owner
RSC = Regional security coordinator

S-CSO = Significant CSO
S-PPO = Significant PPO
ASP = Ancillary service provider
TSO = Transmission system operator
TSOW = Transmission system owner
DSO = Distribution system operator
DSOW = Distribution system owner

Figure 2: Players in the TC

(2) **The national grid company** performs the roles of the TSO and TSOW.

The national grid company operates the Swiss TS in accordance with the legal regulations and the provisions of this TC and in compliance with applicable national and international standards and agreements. It performs these tasks in collaboration with the involved national players and with the FTSO and RSC in its capacity as the responsible contact.

TSO: In this role, the national grid company is responsible for the following, among other things:

a) secure, efficient, reliable, high-performance and non-discriminatory grid operations of the TS during grid operational planning and grid operations management in compliance with the operational safety limits and the applicable technical and regulatory requirements;

b) coordination of grid operational planning and grid operations management with operators of transmission-connected systems and market players and is authorised to give instructions regarding operation of the transmission system;

c) coordination of grid operational planning and grid operations management for the TS with FTSO and RSC;

d) the procurement and deployment of ancillary services, congestion management and schedule management;

e) the operational regulations that apply when connecting to the TS.

TSOW: In this role, the national grid company is responsible for the following, among other things:

f) planning, construction and maintenance of the operating facilities in its possession;

g) connection of DSOW, NSOW, PPOW, CSOW or end consumers to the TS.

(3) **Foreign players:** Within the scope of European grid operations, the national grid company must coordinate with foreign players. This involves foreign transmission system operators (FTSO) and regional security coordinators (RSC).

(4) **Operators of transmission-connected systems:** This is a collective term for DSOs, NSOs, S-PPOs and S-CSOs whose systems are connected directly to the TS. All operators of systems connected to the TS are responsible for planning and managing the secure, efficient, reliable and high-performance operation of their systems in compliance with operational safety limits and applicable technical and regulatory requirements.

(5) **Owners of transmission-connected systems:** This is a collective term for DSOWs, NSOWs, PPOWs and CSOWs whose systems are connected directly to the TS. Owners of systems connected to the TS are also referred to in other documents as grid connected parties.

(6) **Market players:** The market players in the context of the TC are ASPs and BGMs.

a) A BGM represents a balance group (BG) vis-à-vis the national grid company and other players. The BGM is responsible in particular for the timely submission of schedules and for ensuring that the balance responsible parties under its supervision have a even energy balance.

b) An ASP performs ancillary services for the national grid company.

(7) **Operators of distribution-connected systems:** This is a collective term for all players whose systems are connected to the DS. This may be PPOs, S-PPOs, CSOs and S-CSOs, as well as other DSOs with no direct connection to the TS.

(8) S-PPO and S-CSO are collective terms for PPOs and CSOs whose systems are significant for the operation of the TS. These are:

a) PPOs and CSOs whose systems are directly connected to the TS, or

b) PPOs and CSOs whose systems are connected to the DS and are significant for outage planning and operation of the transmission system. They are therefore part of the «external observability list» (cf. section 1.5) of the national grid company.

Figure 3 depicts the interfaces between the grid operators and the S-PPO and S-CSO. The TS in Switzerland is directly connected to the TS of the FTSO, the grid of the SBB (NSO) and the directly connected DSO, S-PPO and S-CSO.

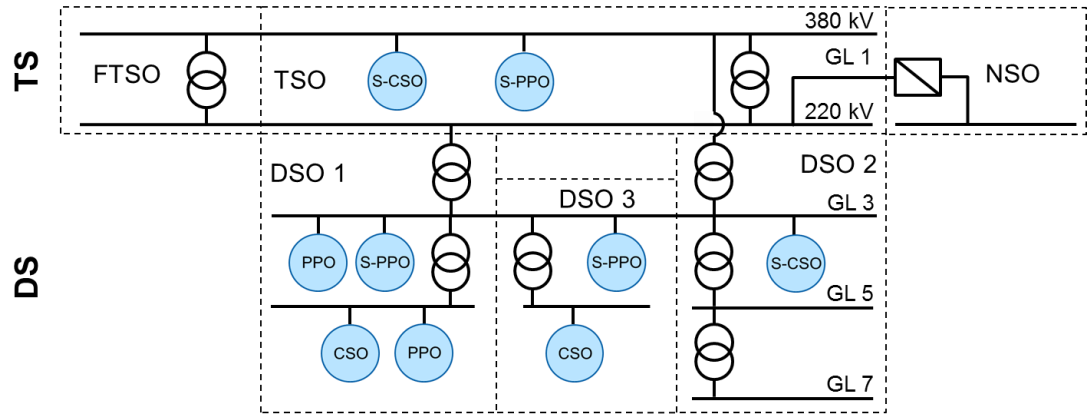


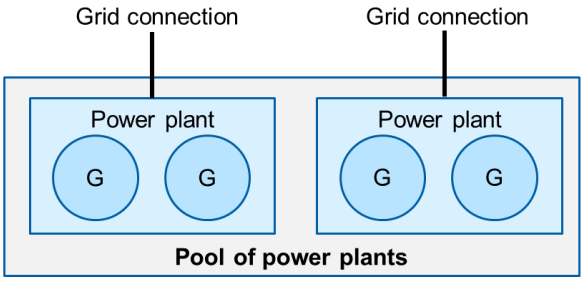
Figure 3: Interfaces between grid operators and S-PPO and S-CSO (illustrative)

(9) The Swiss Federal Railway (SBB) assumes various roles depending on the situation (PPO, PPOW, ASP, BGM, DSO, DSOW, CSO). The existing interfaces between the TS and the grid of the SBB are regulated in separate contracts. Furthermore, according to the StromVV, the SBB is considered an end consumer vis-à-vis the TS. From an operational standpoint, the SBB is considered to be an owner (NSOW) and operator (NSO) of a neighbouring system.

(10) Energy Storage Devices (e.g., battery storage devices or hydro pumped storage power plants) and prosumers are not defined as players in the TC. The roles of PPO and CSO are sufficient for the TC because prosumers and energy storage devices always assume one of these roles at any given time.

(11) In the TC, various terms are used in connection with a power plant. They are defined in accordance with Figure 4. Synonymous terms used in other electrical industry documents are also stated there.

A power plant can consist of multiple generators or modules that feed in electricity via inverters. A power plant has a grid connection. A PPO/CSO or ASP can consolidate multiple power plants/end consumers into a pool and perform collective tasks for it, e.g. offer ancillary services products or send schedules.



TC terms	Synonymous terms in other electrical industry documents
Generator G (can also refer to modules that feed in electricity via inverters)	Power generating unit
Power plant	Power generating module
Pool of power plants	Generating unit

Figure 4: Definition of synonymous terms of power plant

1.5. Significant grid elements and systems for the operation of the transmission system

1.5.1. Introduction and purpose of the observability area

(1) The synchronously operated continental European grid, which connects regions and countries (horizontal view) on the one hand and voltage levels (vertical view) on the other, is operated by several thousand grid operators. In a time when power generation and storage is becoming increasingly decentralised and grid infrastructure is becoming more and more difficult to upgrade, this requires increased cooperation based on transparent and non-discriminatory methods. To this end, the national grid company and every FTSO establishes for itself an «Observability Area,» an «External Observability List» and an «External List of Contingency.» The information and coordination processes planned for these areas will continue to contribute to security of supply in the future.

(2) To ensure secure grid operation in grid operational planning and grid operation management, the national grid company must take account not only of the grid elements within its responsibility area, but also of grid elements from other transmission system operators (TSOs), distribution system operators (DSOs) and significant systems (S-PPOs, S-CSOs) that substantially influence their grid.

(3) The grid representation from Figure 5 is an ENTSO-E diagram[2] and depicts the observability area of the national grid company. The diagram is supposed to show that, in addition to the company's own grid elements, foreign grid elements and systems are also significant for the company's own grid operations. As the distance increases, foreign grid elements and significant systems tend to decrease in relevance (with regard to both distance and voltage level). The diagram is illustrative and does not provide an adequate picture of the quantity structure. It also does not depict the large number of grid elements in low voltage levels or elements from the European grid that are of no significance for the national grid company.

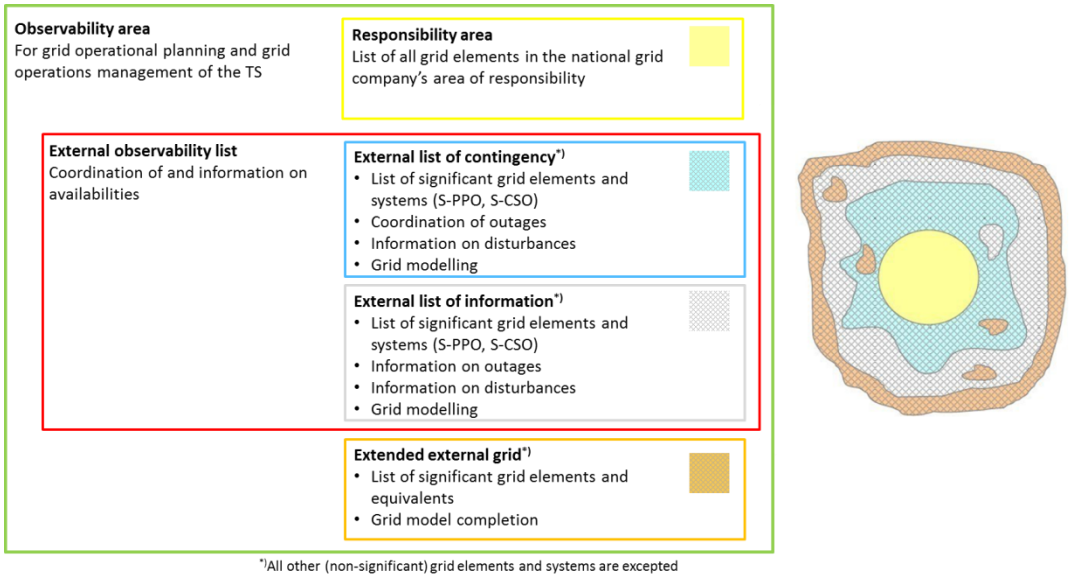


Figure 5: Different groups of significant grid elements and systems in the observability area

(4) The groups of significant grid elements or systems[3] introduced in Figure 5 are summarised in various constellations. The following definitions apply to the national grid company (in the TC these terms are always capitalised and enclosed in «»):

a) **«Responsibility area» (yellow):** comprises the grid elements in the operational responsibility of the national grid company (including the cross-border lines).

b) **«External list of contingency» (blue) :** comprises significant foreign and domestic DSO, TSO, S-PPO and S-CSO grid elements and systems whose outages, swithing actions and special switching states are coordinated with the national grid company and which are included in their contingency lists for calculating grid security.

c) **«External list of information» (grey):** comprises significant foreign and domestic DSO, TSO, S-PPO and S-CSO grid elements or systems for which information is exchanged concerning outages, switching actions, system tests and disturbances and which are included in their contingency lists for calculating grid security.

d) **«Extended external grid» (orange):** comprises the grid elements or equivalents that are necessary to create an extended grid model for grid operational planning and grid operations management.

The following collective terms are also used:

e) **«External observability list» (red):** is a collective term that covers all grid elements and systems that belong to the «external list of contingency» or the «external list of information.»

f) **«Observability area» (green):** is a collective term that refers to all grid elements and systems that belong to the «responsibility area,» the «external list of contingen-

[2] Supporting document for the entire TSs' proposal for the methodology for coordinating operational security analysis in accordance with Article 75 of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation and for the methodology for assessing the relevance of assets for outage coordination in accordance with Article 84 of the same Regulation.

[3] The national grid company does not operate foreign grid elements or systems. If a foreign grid element or system is relevant to the operation of the TS, it is assigned to the external list of contingency, the external list of information or the external extended list.

cy/information» or the «external extended list». Structural and real-time data (switching states, measured values of current and voltage, etc.) is exchanged for all grid elements that belong to the «observability area» so that the grid elements can be modelled in the grid models.

(5) Figure 6 illustrates the observability area of the national grid company as an example.

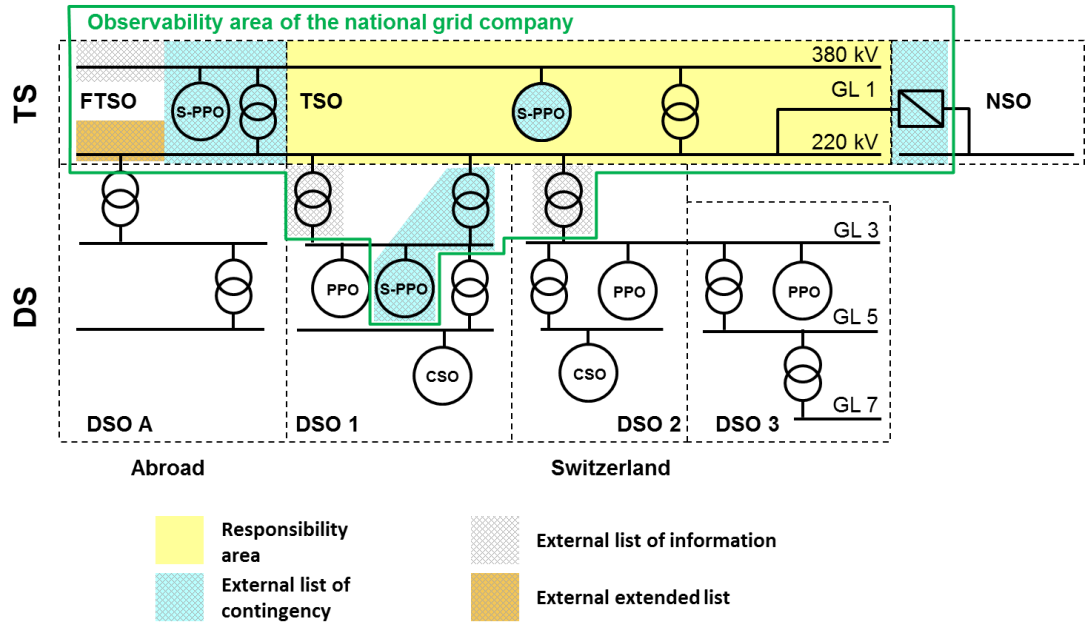


Figure 6: Observability area of the national grid company (illustrative)

(6) The national grid company and all DSOs connected to the TS are solely responsible for the operation of their own grid elements. However, the information from their «observability area»[4] enables them to fulfil this responsibility better. Challenges and congestions are detected early on and can ideally be resolved during grid operational planning.

1.5.2. Methodology for identifying significant foreign grid elements and systems

(1) To ensure the amount of administrative effort required for:

a) coordination of outages,

b) grid modelling and

c) data maintenance in the IT-systems in question

does not become excessive, the national grid company factors in only the foreign grid elements and systems that are significant for grid operational planning and grid operations management. A proper balance must be struck between expenditure and benefit.

(2) In coordination with the operators of transmission-connected systems, the national grid company develops a methodology for determining the observability area for the TS. The methodology contains a qualitative and a quantitative option. First, the national grid company and the DSOs connected to the TS come to an agreement on the grid area that is presumed to contain the grid elements and systems that are significant for the national grid company. The DSOs connected to the TS also create a list of the systems connected to their DS that are significant for their grid operations. If necessary, this list is expanded to include significant grid elements and systems in the grid of a downstream DSO. This list is incorporated into the joint analysis.

a) **Qualitative method:** On the basis of their many years of experience, the operational experts from the national grid company and the transmission-connected DSOs determine

[4] DSOs are generally free to decide whether and in what form they want to define and implement their «observability area.»

which grid elements (e.g., parallel lines) and systems (large generators and loads) are significant. They jointly analyse the grid plans and hold discussions to determine which grid elements and systems are significant based on operational events. Then they assign them to the groups defined in 1.5.1 (4).

b) **Quantitative method:** For unclear grid areas presumed to contain other significant grid elements and systems, each party makes the necessary data available for the specific purpose on the basis of a data exchange agreement. For each foreign grid element, a contingency calculation determines factors that determine the element's relevance for the TS. These calculations are performed for various scenarios and take outages into account. The level of the factors gives the experts additional information to help them determine whether the foreign grid element or the system is significant for the national grid company and to which groups of the observability area defined in 1.5.1 (4) the element or system must be assigned.

(3) The qualitative method, which involves less effort, is always applied first. Quantitative mathematical methods are used for unclear areas only if the grid operators are unable to locally determine or agree upon which grid elements and systems are significant. This intends that the grid operators identify the foreign grid elements and significant systems with the help of contingency calculations. Because the quantitative method involves additional effort, its necessity must be justified.

(4) The national grid company and the DSO connected to the TS coordinate annually to determine whether there is a need for adaptation in the observability area of the national grid company. The lists of foreign grid elements and significant systems are modified as needed.

1.5.3. Implementation document and data exchange

(1) In an implementation document, the national grid company and the DSOs connected to the TS agree to principles for identifying significant grid elements or systems.

(2) The data exchange for the operational processes includes, among other things, structural, schedule and real-time data[5]. The data is exchanged for a specific purpose.

a) For S-PPOs, S-CSOs and DSOs connected to the TS, the data exchange is governed by agreements concluded directly with the national grid company.

b) For S-PPOs, S-CSOs and DSOs connected to the DS and belonging to the «observability area» of the national grid company, the data exchange takes place via the DSO connected to the TS whose DS the S-PPO/S-CSO/DSO is connected to.

c) If an FTSO or foreign DSO requires data from the national grid company or a Swiss DSO, S-PPO or S-CSO, the FTSO can inform the national grid company of this requirement. The national grid company informs the DSOs, S-PPOs and S-CSOs in question of the foreign request and forwards the data to the FTSO on the basis of a data exchange agreement between the national grid company and the Swiss players.

d) If a domestic DSO requires data from a foreign TSO, DSO, S-PPO or S-CSO, it can report this requirement to the national grid company. The national grid company coordinates the data exchange with the FTSO.

Figure 7 below depicts the exchange of data and information.

[5] The data is described in detail in the implementation document and regulated in depth in contracts.

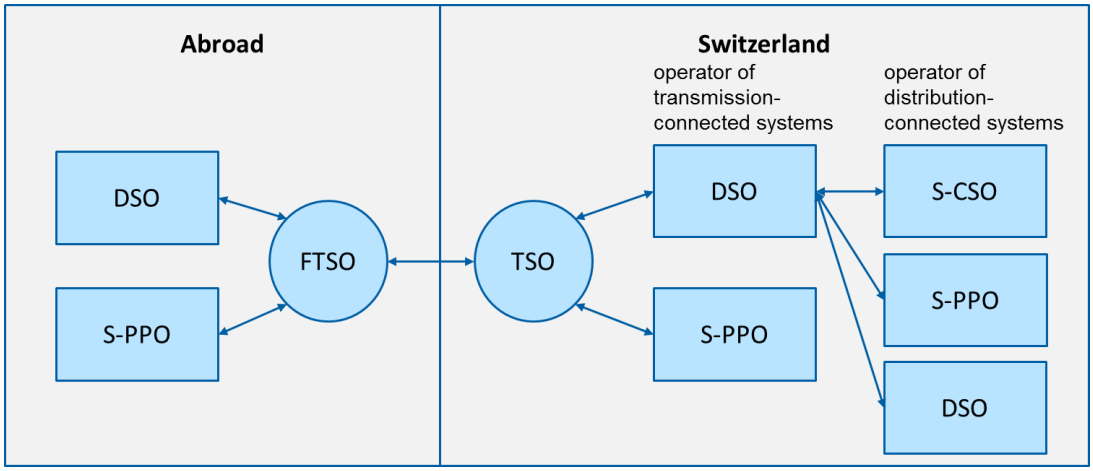


Figure 7: Data exchange relationships

(3) After the observability area for the TS has been fully implemented, the methodology may be developed further based on operational experience. To this end, all the DSOs connected to the TS can submit adjustment requests to the national grid company, which are then coordinated with all the DSOs connected to the TS. As required, the national grid company will review all the adjustment proposals with all the DSOs connected to the TS and coordinate adjustments with them.

2. Introduction to the operation of the transmission system

2.1. General

(1) Distinctions are drawn between different grid states in the course of grid operational planning and grid operations management. The national grid company takes measures in order to maintain the normal grid state or to revert to it after a disturbance (cf. section 5.3). In the event of a critical grid situation (cf. section 2.1.2), the national grid company has additional measures at its disposal (cf. section 5.3). Depending on the grid state, the national grid company has various rights to issue directives (cf. sections 2.1.3).

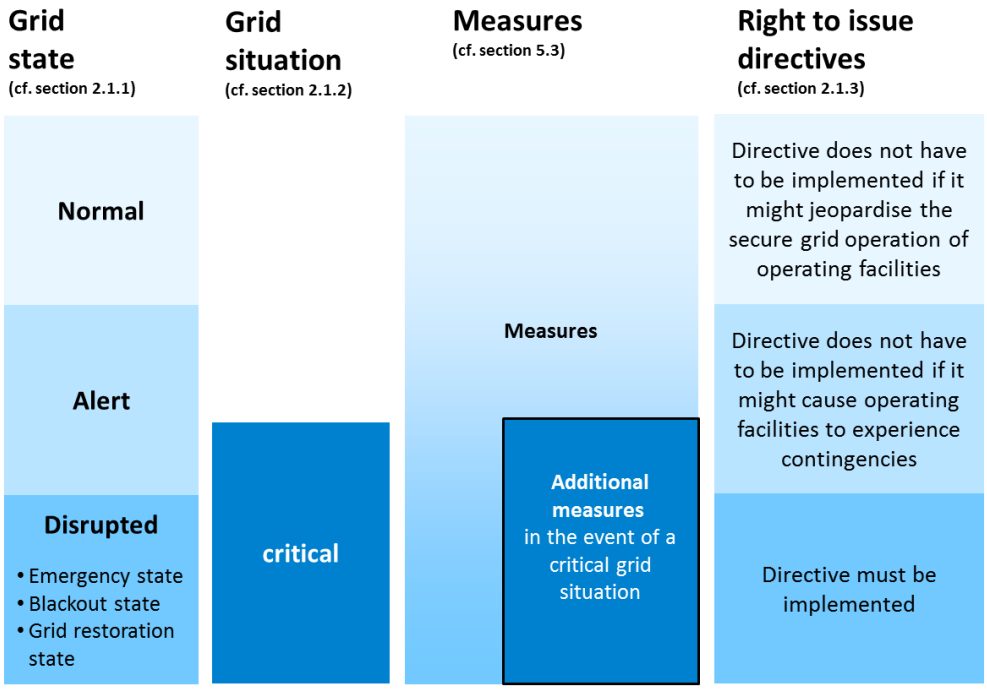


Figure 8: Grid state, grid situation, measures and right to issue directives in the operation of the TS

(2) As a rule, the national grid company can declare the grid state or a critical grid situation for a locally restricted grid area as well.

2.1.1. Classification of grid states

(1) The grid state denotes the operating state of the TS as determined by the national grid company on the basis of criteria. Possible states include normal grid state, alert state and disrupted grid state (subdivided into emergency state, blackout state and restoration state).

(2) **Normal grid state:**

The grid is considered to be in a normal state when all of the following criteria are met:

a) *Voltage values:* fall within the limits specified by the national grid company for the TS.
b) *Frequency deviation:* less than 200 mHz in a steady-state situation.
c) *Ancillary services:* the power and energy reserves for frequency and voltage maintenance are adequate.
d) *Operating facility contingency:* the (n-1) criterion (cf. section 2.2) is fulfilled, and the special grid contingencies arranged with the FTSO do not jeopardise the operation of the TS.

e) *Short-circuit current:* the calculated maximum short-circuit current does not exceed the limits for the operating facility permanently (i.e., more than a few minutes).

f) *Thermal loadability:* current flow values do not exceed the limits permanently (i.e., more than a few minutes).

(3) **Alert grid state:**

The grid is considered to be in an alert state when at least one of the following criteria is met:

a) *Ancillary services:* the control reserves created for frequency and voltage maintenance are reduced by at least 20% for at least 30 minutes because individual ASPs have cancelled service provision.

The control reserve of the national grid company is fully utilised for a longer period of time[6] despite activation of tertiary control.

b) *Operating facility contingency:* the (n-1) security criterion is not met, even when topological measures or redispatching are applied.

c) *Short-circuit current:* the calculated maximum short-circuit current exceeds the limits for the operating facilities permanently.

An alert grid state can occur even without a critical grid situation.

(4) **Disrupted grid state:**

The following three states are distinguished here.
The grid is considered to be in an **emergency state** when at least one of the following criteria is met:

a) *Voltage values:* fall outside the limits specified by the national grid company for the TS.

b) *Frequency deviation:* exceeds 200 mHz in a steady-state.

c) *Ancillary services:* the power and energy reserves for frequency and voltage maintenance are exhausted and inadequate.

d) *System protection plan:* at least one measure has been activated (automatic low frequency demand disconnection scheme, blocking of transformer tap changer if voltage collapse threatens, etc.).

e) *IT contingency:* at least one important IT-system for system management (e.g., control system, communication system, grid security analysis, grid control, etc.) belonging to the national grid company is unavailable for more than 30 minutes.

f) *Thermal loadability:* current flow values exceed the limits for the operating facilities permanently.

g) *Disconnections or operating facility contingencies:* disable individual operators of transmission-connected systems from being supplied or able to feed-in.

Especially in this case, the national grid company can declare a major disturbance (major disturbance in Switzerland or only a «regional disturbance» in a dedicated area) and activate the grid restoration plan (cf. section 5.4) to return the grid to a normal state.

The grid is considered to be in a **blackout state** if at least 50% of the final end consumer of the control area is not supplied or if the TS is without power for at least 3 minutes.

The national grid company declares a major disturbance (major disturbance in Switzerland or only a «regional disturbance» in a dedicated area) and activates measures from the grid restoration plan to return the grid to a normal state.

The grid is considered to be in a **grid restoration state** if all the activities in the TS are geared towards restoring the supply and returning the grid to the normal grid state.

A disrupted grid state can occur even without a critical grid situation.

[6] Longer time period: discretionary leeway given to the head of grid operations management based on the current grid situation.

2.1.2. Critical grid situations

(1) A critical grid situation is declared to alert the operational and alarm organisations of the national grid company and other players. It gives the national grid company the option of issuing additional measures (cf. section 5.3).

(2) The national grid company can declare a critical grid situation if a current assessment shows this to be necessary to guarantee secure grid operation. In other words, it can do so if the conditions for a disrupted or alert grid state are fulfilled and recovery from these states is possible only using measures that require the right to issue directives as per section 2.1.3. In particular, this is the case when:

a) there is an impending disturbance with far-reaching consequences for the operation of the TS of Switzerland, or

b) there is an impending disturbance that could spread to the grid operations of FTSOs and operators of transmission-connected systems.

(3) The declaration of a critical grid situation is a reportable event that the national grid company must promptly report to the parties concerned (operators of transmission-connected systems, market players, FTSOs, RSCs). The national grid company also informs the parties when a critical grid situation comes to an end.

(4) For regional disturbances, a critical grid situation is declared only within regional limits.

(5) When taking additional measures based on its right to issue directives, the national grid company is guided by the principle that the measures should affect other players as little as possible.

(6) If a non-contractually regulated measure is ordered with increasing frequency of occurrence and scope, the national grid company and the players concerned will strive for a contractual arrangement.

(7) Every critical grid situation is documented by the national grid company. The players involved are integrated into the analysis and formation of conclusions based on prescribed measures. The documentation serves as a basis for improving grid operations.

2.1.3. Right to issue directives subject to grid state

(1) The national grid company is authorised and obliged to impose measures (cf. section 5.3) on the players concerned:

a) to maintain a normal grid state, or

b) to restore the grid from a disrupted or alert state to a normal grid state.

(2) The measures imposed by the national grid company must be implemented as a rule. The following applies, depending on the current grid state:

a) **When the TS is in a normal grid state:** A player can refuse to employ the measures imposed by the national grid company if the measures could imperil the secure operation of the player's operating facilities, connected DSs, power plants or customer systems. The national grid company must be informed accordingly.

b) **When the TS is in an alert grid state:** A player can refuse to employ the measures imposed by the national grid company if the measures could lead to contingencies in the player's operating facilities, connected DSs, power plants or customer systems. The national grid company must be informed accordingly.

c) **When the TS is in a disrupted grid state:** A player must implement the measures imposed by the national grid company. The player receiving the instructions is obliged to promptly inform the national grid company if the measures endanger the secure operation of the player's operating facilities or connected DSs, power plants or customer systems or could provoke a supply or power plant contingency.

(3) Measures that endanger life and limb do not have to be implemented.

2.2. (n-1) security in the transmission system

(1) The TS is (n-1)-secure if the operational safety limits of grid elements in the TS are not exceeded after an contingency affecting one grid element in the «responsibility area» or on the «external observability list» of the national grid company.

(2) Violation of the (n-1)-criterion in line with (1) can be tolerated in grid operational planning and grid operations management only if the national grid company has remedial actions at its disposal (topological, redispatching measures, etc.) that can be activated when necessary and that rectify the violation of the (n-1)-criterion.

(3) The national grid company takes the following cases into account when testing grid security in the TS:

a) (n-1)-security is not possible, or the national grid company waives compliance with it: possible for grid elements that are not significant for the security of the TS as a whole if such an agreement was reached with the players in question on a general or situational basis,

b) Contigency scenarios that are coordinated with FTSOs,

c) Additional contingency scenarios, e.g., (n-k), bus failure, generating or consumption failure.

(4) By coordinating during expansion and outage planning, the national grid company and DSOs ensure that the operation of the TS is generally (n-1)-secure within itself (cf. section 7 (6) and section 2.2).

(5) In real-time operation, (n-1) security should be restored as quickly as possible through suitable remedial actions (cf. section 5.3.3 (2)). When preparing and activating these remedial actions, the national grid company clarifies how other players will be affected and coordinates the measures with them. All the information required for this purpose is mutually exchanged.

2.3. Outage planning

(1) Outage planning is used to coordinate the outage of grid elements of the TS, as well as grid elements that belong to the «external list of contingency». It also takes into account the outage of grid elements that belong to the «external list of information».

Outages are necessary to implement new connections, as well as maintenance and renovation measures for operating facilities in or connected to the transmission system.

The parties coordinate the time and duration of the outages.

The planned outages should not endanger the normal grid state in the TS and DS, and the effects on the market (e.g., operation of power plants) should be as minimal as possible. The national grid company checks for possible effects on grid security and transport capacities at the time in question in order to detect conflict situations at an early stage.

(2) FTSOs and operators of transmission- or distribution connected systems whose grid elements belong to the national grid company's «external list of contingency» coordinate the outages of their grid elements with the national grid company (cf. section 1.5).

The same applies to grid elements of the national grid company that belong to the «external list of contingency» of an FTSO or DSO. If FTSOs or DSOs detect that the national grid company's outage planning will cause limits to be exceeded for their grid elements, they have to report this to the company. The national grid company will factor this information into its outage planning.

The mutual exchange of information and coordination must take place by the deadlines the national grid company stipulated for the coordination procedure.

The following principles apply with regard to the planned outages:

a) An contingency of a grid element in the national grid company's «responsibility area» must not cause grid elements and systems belonging to the national grid company's «external observability list» to exceed safety limits.

b) An contingency of a grid element on the national grid company's «external observability list» must not cause grid elements and systems in the national grid company's «responsibility area» to exceed safety limits.

c) An contingency of a grid element in the national grid company's «responsibility area» belonging to the «external observability list» of a DSO must not cause the DSO to exceed safety limits in its «responsibility area». The DSO informs Swissgrid of safety limit violations in its grid as part of the coordination procedure.

Exceptions to a) - c) are possible on a general or situational basis, provided they are coordinated between the players. Exceptions are necessary, e.g., if the principles cannot be adhered to even with a complete grid or as a result of planned outages. Necessary remedial actions have to be coordinated for this purpose, if technically possible.

(3) If, due to a outage in the TS, there is no longer any redundant connection of the link to the TS (known as radial operation) or no connection whatsoever, the planned outage requires the approval of the operator of the transmission-connected system affected by the outage.

(4) If no agreement is reached during the coordination procedure conducted by the national grid company for the various time horizons for grid elements on the national grid company's «external list of contingency» or an impermissible impairment to security or a reduction of transport capacities is still evident, the national grid company will decide bindingly whether or not to implement changes or reject planned outages after discussing the matter with all the players involved. The following list of priorities applies in the process (in order of decreasing priority):

a) Guarantee the supply in Switzerland.

b) Guarantee grid security in the TS, taking into consideration the national grid company's «external observability list».

c) Guarantee the availability of at least two contractually bound grid restoration cells.

d) Guarantee the execution of work mandatorily required for the operation of the TS or DS or for power plant operations, that cannot be delayed.

e) Guaranteed transport of the planned production from power plants.

f) Comply with other previously arranged outages.

(5) Changes to outage planning for grid elements on the «external observability list» must be promptly communicated to the national grid company as part of the outage planning process (annual, monthly and weekly planning) by no later than the deadline published by the national grid company in the work instructions for DSOs and PPOs. This is to ensure that the analyses required for secure operation of the TS can be performed. All changes to outage planning for grid elements in the national grid company's «responsibility area» and on its «external list of contingency» are subject to review and confirmation (coordination) by the national grid company in accordance with preceding paragraphs (2) through (4).

(6) The resulting outage planning for the national grid company's «external list of contingency» is binding for all parties involved. The national grid company compiles a complete overview of all outages relevant to the TS and keeps it up to date based on the latest planning and new or updated information. A complete overview is made available to the players concerned.

(7) Outages that affect the level of cross-border transport capacity will be published.

(8) Operators of transmission-connected systems ensure that their operating facilities that have not been registered as unavailable are ready for use. PPOs connected to the TS also ensure that their power plants which are registered as unavailable do not generate any power during the respective time period. Deviations, e.g., commissioning tests, must be coordinated with the national grid company.

2.4. Switching actions

(1) The national grid company is responsible for all switching actions in the TS. Exceptions are contractually regulated.

2.4.1. Coordination of switching actions

(1) Switching actions for grid elements on the national grid company's «external list of contingency» are permissible only when coordinated with the national grid company. General approval for certain operating states is permissible if the operator of the transmission-connected system and the national grid company have agreed to this.

(2) Switching actions involving TS grid elements that are part of the «external list of contingency» of a DSO connected to the TS are permissible only when coordinated with the DSO. General approval for certain operating states is permissible if the DSO connected to the TS and the national grid company have agreed to this.

(3) Switching actions and measures that are operationally necessary to maintain the secure operation of the TS and DS (e.g., bus bar configuration, transformer stepping, connection and disconnection of lines, etc.) can always be performed by the respective system operators. It is important to ensure that the parties exchange information on switching actions affecting significant grid elements and systems on the «external observability list» of the national grid company or the DSO.

2.4.2. Switching actions in an emergency

(1) The provisions in this section 2.4 do not affect the rights and obligations of sites that are authorised to perform switching actions to immediately take the steps necessary to ward off imminent risk to persons and property. The national grid company and other players concerned must be informed about such measures immediately.

2.5. Congestion management

(1) The purpose of congestion management is to detect and prevent emerging congestion in the TS (especially (n-1)-violations) and to rectify any congestion that occurs.

(2) The national grid company and the DSOs inform each other when they identify structural congestion in their «responsibility areas».

(3) The national grid company routinely calculates the available transport capacities for cross-border electricity exchange based on the availability of the operating facilities, as well as the expected infeeds and the final consumption in the continental European interconnected grid. Available transport capacity is determined in collaboration with the FTSOs in accordance with regulations that have been agreed upon at the international level. The available transport capacity is successively allocated to market players using market-based procedures (cf. section 3.2).

(4) If the preventative measures mentioned in paragraph (3) are not enough to remedy congestion, the national grid company will resort to the measures described in section 5.3.3.

2.6. Requirements for PPOs, DSOs and BGMs regarding control of generation and final consumption in the event of a schedule change

(1) Schedule changes must take place in a linear fashion over a period of ten minutes, beginning five minutes before the schedule change.

(2) To avoid unnecessary use of control power, the PPOs must adhere to the regulations described in paragraph (1) when implementing their production schedules.

(3) To prevent excessive load variations, the DSOs must stagger the planned connection and disconnection of end consumers in such a way as to produce, or balance, a roughly linear change in the final consumption within the time period specified in paragraph (1).

(4) Paragraphs (2) and (3) may be deviated from only if the resulting schedule change for the corresponding balance group follows the required ramp curve. This ensures that the behaviour of the balance responsible parties corresponds to the ramp curve required in paragraph (1).

2.7. Duty to provide information

2.7.1. Duty of the national grid company and other players in Switzerland to provide information to each other

(1) The national grid company and other players in Switzerland exchange a multitude of structural, forecast, schedule and real-time data for the purpose of handling the numerous interface processes. The needs-based data exchange (form, content, cadence, etc.) is arranged in bilateral agreements. These agreements regulate confidentiality, the right to transfer data for business purposes, and more. The players strive for common standards and unified formats for data exchange.

(2) Data is exchanged between the players for the following purposes, among others:

a) Creation of an observability area and grid model: structural data, forecast data for production and final consumption, real-time data

b) Balance responsible parties management: Schedule data

c) Ancillary services: Data from pre-qualification tests, tender data, tender results and performance data

d) System commissioning (initial commissioning and system restoration after interruption of operation): Data from conformity tests

e) Outage planning: Deadlines

(3) If dynamic issues lead to grid operation challenges before steady-state limits are reached, the national grid company must also perform a dynamic grid calculation in addition to a steady-state grid calculation. This applies to both grid operational planning and grid operations management. In such cases, the national grid company will transparently disclose the grid problems vis-à-vis the players concerned. At the national grid company's request, operators of transmission-connected systems will provide the data required for this purpose (e.g., parameters of generators for existing power plants, provided such records are available).

2.7.2. Duty of the national grid company and players abroad to provide information to each other

(1) In the course of international grid operational planning, grid security calculation and creation of the Common Grid Model, the national grid company, FTSOs and RSCs exchange the required grid element parameters, data on planned availability and real-time data. If third-party data is required for international processes, it is forwarded by the national grid company, and the third parties are informed of this fact.

(2) The national grid company is obliged to inform FTSOs and RSCs in real time regarding the grid state and/or the presence of a critical grid situation in the TS via a joint information exchange system.

(3) The national grid company is obliged to coordinate operational measures with transnational impacts with affected FTSOs (coordination of available cross-border capacity, coordination of the schedules reported by the BGM, topological measures, redispatching/countertrade, etc.).

(4) The national grid company coordinates the relevant operational safety limits with the FTSOs.

(5) The national grid company reports results and disturbances in the Swiss TS in accordance with the various reports required from the ENTSO-E and/or RSCs. Furthermore, the national grid company conducts research regarding disturbances in its «responsibility area», or it participates in research into disturbances affecting its «responsibility area».

2.8. Training, instruction and certification

(1) The personnel of the national grid company in real-time operation works around the clock to ensure that the TS stays operational. These employees are trained to perform the corresponding tasks professionally and receive additional training and certifications on a regular basis (the certification must be renewed every five years). The instruction and training programme covers basic information on technology and the market, current operating processes, personal protection and operational safety, dealing with stress, and cooperation and coordination with FTSOs, DSOs and PPOs. The training is conducted «on the job» in the control centre under the guidance of experienced employees, in internal courses and at a simulation centre run by the national grid company or specialised third-parties on the basis of real operating scenarios. In addition, the employees are taught language skills to ensure they are ready to communicate with other control centres in English and in one of Switzerland's three official languages (German, French or Italian) at all times.

(2) Operators of transmission-connected systems are responsible for training their control centre personnel to ensure that the latter are able to perform their tasks correctly when operating their own systems or cooperating with the national grid company. The training also covers the detection and rectification of alert states in the system or grid, as well as knowledge of the processes on the interface to the national grid company.

(3) The national grid company organises training for its control centre personnel in cooperation with that of the operators of transmission-connected systems and neighbouring FTSOs as necessary but at least once a year in order to deepen their understanding of the characteristics of the grid and systems (simulator training, knowledge sharing). In addition, relevant personnel from the national grid company and from operators of transmission-connected systems have to participate in training measures in accordance with section 5.6 Instruction and Training for disturbed grid situations.

3. Energy exchange and capacity allocation

3.1. Energy exchange via balance responsible parties

3.1.1. Background

(1) This section contains general principles for energy exchange via balance responsible parties (BG).

(2) The establishment of BGs and schedule management are based on the guidelines of the Balancing Concept. These principles are described in greater detail in the balance responsible party contract.

(3) To enable the secure management of cross-border electricity exchange, this section also sets out general principles for the calculation and allocation of the agreed cross-border grid capacities by the national grid company. These principles are described in more detail in the allocation rules and any frame agreements and/or operational implementation documents of the national grid company.

3.1.2. Responsibilities

(1) In particular, the national grid company is responsible for

a) carrying out checks for approving market players as BGMs and managing the BG register,

b) checking, confirming and making any necessary changes to submitted schedules or rejecting them,

c) coordinating cross-border schedules with FTSOs, and

d) identifying, allocating and testing available grid capacities in the TS for the commercial exchange of electricity.

(2) The BGMs are responsible for ensuring that the principles and policies contained in the balance group contract are observed.

3.1.3. Principles of energy exchange between balance responsible parties

(1) The national grid company ensures transparent and non-discriminatory use of the TS for all market players.

(2) Exchanges between different BGs and with foreign market players is possible only on the basis of schedules.

(3) Types of schedule exchange:

a) between different BGs in Switzerland,

b) across control areas between a BG in Switzerland and a player in a neighbouring country authorised to submit schedules.

(4) Adequate capacity rights are a prerequisite for exchanging electricity with other countries across control areas. More information can be found in the allocation rules (cf. section 3.2).

(5) For a market player to gain access to the electricity market, a separate balance responsible party is needed, or a contract needs to be signed between the market player in question and a BGM authorised by the national grid company.

(6) Other provisions are derived from the electrical industry documents MMEE-CH and the Balancing Concept, as well as the auction rules for capacity auctions at the Swiss borders, the balance group contract and other agreements between the players concerned.

3.2. Provision and allocation of capacity rights for cross-border exchange of electricity

(1) The available grid capacities arranged with the FTSOs (cf. section 2.5) are published separately on the Internet for each border and direction.

(2) Capacity rights are awarded to market players on the basis of market-based procedures. Different allocation procedures are possible for different borders and/or directions and different time periods (year, month, D-1, ID).

(3) In coordination with FTSOs, the national grid company defines the sequence of operations and conditions for an allocation procedure for each border pursuant to paragraph (2) in separate allocation rules, which it then publishes. Implementation of the allocation procedure can also be assigned to an external service provider.

(4) All BGMs who have been authorised to submit schedules in Switzerland or the respective foreign control areas are eligible to participate in an allocation procedure in accordance with paragraph (3).

(5) If an allocation procedure pursuant to paragraph (2) is adopted between the Swiss control area and a neighbouring control area, cross-border schedules may be submitted only if the BGM has sufficient capacity rights.

4. Ancillary services

4.1. General

(1) Ancillary services are an important means of ensuring the secure operation of the entire electrical system. The national grid company is responsible for ensuring that adequate ancillary services are available.

(2) This section describes the procurement of ancillary services. Section 5 describes how those services are used and delineates additional measures for when the procured services are insufficient.

(3) To ensure the availability of ancillary services, the national grid company relies on services or offers from pre-qualified ancillary service providers (ASP). Energy for offsetting active power losses is also purchased by the national grid company on the power exchange.

(4) The procurement of ancillary services must, by law, conform to a market-based, transparent and non-discriminatory procedure that allows secure and reliable operation of the TS while ensuring efficient use of the required resources. This procedure can also be organised across borders.

(5) To ensure that the grid is operated reliably and legal obligations are met, the national grid company organises adequate provision of the following ancillary services:

a) primary control («Frequency Containment Reserves (FCR)»),

b) secondary control («Automatic Frequency Restoration Reserves (aFRR)»),

c) tertiary control (fast «manual Frequency Restoration Reserves (mFRR)» and slow «Replacement Reserves (RR)»),

d) voltage maintenance,

e) black start and island operation capability,

f) compensation of active power losses.

(6) The following ancillary services are provided by the national grid company or contracted out to third parties:

a) system coordination,

b) balance management,

c) operational measurement in the TS.

4.2. General requirements for the provision of ancillary services

(1) Each ASP must meet the requirements in sections 4.2 to 4.5 that apply to the ancillary services for which the ASP is pre-qualified.

(2) A player must meet the following requirements to be approved as an ASP by the national grid company:

a) evidence that the technical and organisational conditions have been met as part of a pre-qualification procedure, and

b) a signed frame agreement for providing the respective ancillary services as drawn up by the national grid company.

(3) Unless otherwise agreed, all ASPs of the national grid company must provide a point of contact that can be reached 24/7. The ASP is responsible for implementing this in practice. Similarly, the national grid company must provide the ASPs with a point of contact that can be reached 24/7.

(4) If the agreed availability of ancillary services can no longer be guaranteed or if there are quality restrictions, the ASP must immediately inform the national grid company of the cause and duration of the restrictions.

(5) Additional technical and organisational conditions for provision and supply of ancillary services not covered in paragraph (2) can also be arranged in writing between the national grid company and the ASP.

(6) Service contracts for the provision of ancillary services are awarded in line with a market-based, transparent and non-discriminatory procedure.

(7) If the procedure does not result in the procurement of sufficient ancillary services, the national grid company is authorised to oblige qualified players to provide ancillary services, taking into account facility availability and outage planning.

(8) When procuring ancillary services, the national grid company takes into consideration that it must be possible to provide the services at all times. In this context, the national grid company must bear in mind that the transmission of the necessary primary, secondary or tertiary control power must not interfere with the secure transmission of the forecast peak load.

(9) The ASPs must provide the national grid company with corresponding information for billing purposes and as proof that the ancillary services were performed.

4.3. Requirements for the provision of primary, secondary and tertiary control

4.3.1. General

(1) The following guidelines apply to the ASPs involved in the provision of primary, secondary and tertiary control.

(2) The minimum technical requirements for ASPs involved in the provision of primary, secondary and tertiary control are defined in the pre-qualification documentation. The ASPs must provide the national grid company with the information defined there in writing.

(3) Pre-qualified systems for providing primary, secondary or tertiary control can be combined in a portfolio and participate in primary, secondary or tertiary control in this form.

(4) The following documents are relevant for primary, secondary and tertiary control:

a) frame contract,

b) pre-qualification requirements,

c) tender documents.

These documents contain the guidelines for operational readiness, technical parameters, ordering period and technical availability. Special requirements are also stipulated in sections 4.3.2 to 4.3.4.

(5) To ensure trouble-free and continuous use, the ASPs must provide the national grid company with defined schedule data and measured values.

(6) If the control power procured on a market basis in accordance with this section is not enough to balance the Swiss control area, the national grid company will resort to the measures described in section 5.3.3.

4.3.2. Special requirements for providers of primary control

(1) Each year, ENTSO-E determines how much primary control power has to be made available for continental Europe and what percentage Switzerland has to provide. The national grid company then procures this amount.

(2) The technical equipment and infrastructure of the systems participating in the provision of primary control must meet the following conditions:

a) At a quasi steady-state frequency deviation of ± 200 mHz, the required primary control reserve must:

- be at least 50% active within 15 seconds and 100% active within 30 seconds at most and

- after 15 seconds and up to 30 seconds, the power adjustment must take place linearly and be capable of being delivered for at least 15 minutes.

b) In the event of a frequency deviation of less than ±200 mHz, the corresponding primary control reserve that is released shall be provided at least proportionally in the same time intervals specified under letter a).

c) In the event of a frequency deviation of more than ±200 mHz, the available power reserves must be delivered proportionally. They must not be artificially limited.

d) The insensitivity of a pre-qualified power plant must not exceed ±10 mHz.

(3) Operational readiness, frequency of occurence, ordering period and technical availability are based on the frame contract for the supply of primary control power, the pre-qualification requirements, the tendering conditions and the tender results for the provision of control power. These requirements may differ for different system types depending on whether the systems can supply primary control power for an unlimited or limited time.

(4) The ASP must make it possible for the national grid company to record and test the behaviour of the generation and consumption units participating in primary control provision during frequency fluctuations. In this way, the participation of individual power plants in the provision of primary control can, if necessary, be checked by the national grid company using measurement records or special tests.

4.3.3. Special requirements for providers of secondary control

(1) Operational readiness, frequency, ordering period, technical availability, the speed of changes in power, the and frequency of occurrence of power and the minimal secondary control range are based on the frame contract for the supply of secondary control power, the pre-qualification requirements, the tendering conditions and the results of the tender for the provision of control power or the results of the control energy market.

(2) The ASP must make it possible for the national grid company to record and test the behaviour of the generation and consumption units participating in secondary control provision during frequency fluctuations.

4.3.4. Special requirements for providers of tertiary control

(1) The national grid company specifies the active power required for the provision of tertiary control upon request.

(2) Operational readiness, frequency of occurence, ordering period and technical availability are based on the frame contract governing the supply of tertiary control, the pre-qualification requirements, the tendering conditions and the results of the tender for the provision of control power or the results of the control energy market.

(3) The ASP must make it possible for the national grid company to record and test the behaviour of the generation and consumption units participating in tertiary control provision during frequency fluctuations.

4.4. Voltage maintenance

4.4.1. General

(1) In consultation with the operators of transmission-connected systems, the national grid company mandates guidelines for voltage maintenance and reactive power exchange on grid connection points in the TS. The national grid company likewise coordinates with neighbouring FTSOs regarding reactive power exchange at the borders of the Swiss control area.

(2) The national grid company specifies the voltage setpoints for each time interval for the grid connection points in the TS.

(3) Operators of transmission-connected systems must make it possible for the national grid company to record and check the exchange of reactive energy, provided the national grid company is not already the owner of the metering equipment.

(4) The national grid company specifies provisions for voltage maintenance in contracts with operators of transmission-connected systems.

(5) If the voltage maintenance measures described in this section are not enough to keep the voltage within operational limits, the national grid company will resort to the measures described in section 5.3.2.

4.4.2. General requirements for voltage maintenance

(1) The national grid company defines services connected with voltage maintenance. These are active, half-active and super-obligatory voltage maintenance.

(2) PPOs connected to the TS must participate in active voltage maintenance.

(3) All other operators of transmission-connected systems must participate in half-active voltage maintenance. They can also participate voluntarily in active voltage maintenance.

(4) All participants in active voltage maintenance can voluntarily provide super-obligatory reactive power.

4.4.3. Special requirements for active voltage maintenance

(1) In a pre-qualification procedure, participants in active voltage maintenance prove that they are technically able to meet the national grid company's requirements for reactive power exchange.

(2) The participants in active voltage maintenance must regulate the reactive power exchange in such a way that the actual voltage at the grid connection points at the level of the transmission system tends towards the setpoint voltages predefined by the national grid company in accordance with the voltage plan.

(3) Participants in active voltage maintenance must provide the national grid company with operational information about their systems (active power vs. reactive power graph, etc.).

(4) The technical, operational and organisational prerequisites are derived from the contractual regulations governing voltage maintenance and the pre-qualification requirements.

(5) To provide continuously adjustable reactive power by means of voltage control, participants' technical equipment and infrastructure must fulfil the following conditions at the grid connection point that connects the grid to the TS:

a) The systems of participants in active voltage maintenance must be operational in a voltage range of 90% to 110% of the nominal operating voltage (generators may fulfil this requirement in combination with the transformer).

b) With regard to nominal rated power and rated voltage, the systems must be capable of operating continuously in the following range: Power factor cos φ+ = 0.925 over-excited to cos φ- = 0.950 under-excited.

(6) All participants in active voltage maintenance must be operationally capable of providing the available reactive power within a few minutes with constant active power output.

4.4.4. Special requirements for half-active voltage maintenance

(1) Participants in half-active voltage maintenance should, if possible, regulate the reactive power exchange in such a way that the actual voltage at the grid connection point at the level of the transmission system tends towards the setpoint voltages predefined by the national grid company in accordance with the voltage plan.

(2) Participants in half-active voltage maintenance can voluntarily switch to active voltage maintenance upon successful completion of the pre-qualification procedure.

4.4.5. Special requirements for super-obligatory voltage maintenance

(1) The technical, operational and organisational prerequisites for super-obligatory reactive power reserves are regulated in accordance with a standard contract concluded between the national grid company and the participant in super-obligatory voltage maintenance.

(2) The participant in super-obligatory voltage maintenance informs the national grid company of the limits of the technically available reactive power for all the systems involved in the provision of voltage maintenance.

4.5. Black-start and island operation capability

(1) The national grid company relies on grid restoration cells when restoring the grid (grid restoration state: restoration of the grid from an emergency state or blackout state to a normal grid state).

(2) The requirements for a grid restoration cell are:

a) It contains at least one power plant with black start capability.

b) It has one or more power plants capable of island operation.

c) The power plants in the grid restoration cell have access to the TS.

d) It has a sufficiently large rotating inertia.

e) It has connectible end consumers in an appropriate ratio to the power of the rotating inertia.

f) It must be capable of maintaining island operation for at least a defined minimum time period.

g) It must be able to process a direct control signal from a system controller.

h) It must be able to synchronise with other grids or isolated grids if instructed to do so by the national grid company.

i) It must conduct and document the contractually agreed tests.

j) It is obliged to coordinate planned outages of its relevant operating facilities and power plants with other grid restoration cells and the national grid company.

(3) Power plants capable of black start have the following characteristics:

a) Ability to redirect for own use so they can subsequently yield active power (applies only to thermal power plants)

b) Ability to supply a island grid with regulated voltage and frequency over an extended period of time (island operation capability)

c) Ability to start up independently without external voltage from the grid (black start capability)

d) Power plants capable of black start have synchronisation equipment that enables activation on a dead isolated grid.

(4) The national grid company can obligate the grid restoration cells to adjust their outage planning.

(5) Detailed regulations and remuneration for grid restoration cells are governed by contracts concluded between the national grid company and the ASPs concerned.

(6) The ASP must make it possible for the national grid company to record and test the provision of services.

(7) The operational measures associated with grid restoration are described in section 5.4.

5. Measures during operation of the transmission system and disturbance management

5.1. General

(1) The national grid company is responsible for operating the TS and disturbance management for the TS. In this context, the national grid company has the right to issue directives as defined in section 2.1.3.

(2) This section deals with the necessary measures, responsibilities and roles that serve to maintain a normal grid state. It also deals with restoring the grid to a normal state from a disrupted or alert state. When taking additional measures based on its right to issue directives, the national grid company is guided by the principle that the measures should affect other players as little as possible.

(3) A disturbance within the meaning of the TC is an event that causes the grid to go from a normal state to an alert or disrupted grid state. A disturbance can have a variety of causes, from environmental influences and technical failure to human error.

(4) When an emergency or blackout state occurs, the national grid company declares a «major disturbance in Switzerland» or a «regional disturbance» in a geographically limited area (cf. section 5.4) in accordance with the grid restoration concept and declares the disturbance over once it has been rectified.

(5) The prerequisites and conditions for measures taken by the national grid company are specified in the TC and/or in the corresponding contracts. In particular, the contracts contain provisions governing cost allocation and/or remuneration.

5.2. Responsibilities in the case of a disturbance

5.2.1. General

(1) In the event of a disturbance that affects the TS, the national grid company and operators of transmission- or distribution-connected systems [7] must immediately take all economically viable measures that are required from a technical point of view in order to restore a normal grid state.

This means:

a) Identify: recognise and localise disturbances quickly,

b) Limit: limit disturbances and minimise expansion,

c) Inform: exchange information in a timely manner with the players concerned,

d) Rectify: rectify disturbances securely and quickly in the affected sections of the grid,

e) Document: analyse disturbances, identify causes and form conclusions. The players concerned are involved in this process.

(2) The national grid company has packages of measures (system protection plan and grid restoration concept) that describe, list and reference pre-defined processes for disturbance management. These prepared measures are coordinated with the relevant players and tested regularly.

(3) If a disturbance occurs in the TS, the national grid company ideally begins by implementing the prepared and agreed measures.

[7] Depending on the disturbance, system operators that are not connected directly to the TS may also have an important task to perform in connection with disturbance management. They are also mentioned for that reason.

(4) If the prepared measures are insufficient, the national grid company declares a critical grid situation and takes additional measures. This is coordinated with the players concerned, if possible.

5.2.2. Tasks of the national grid company in the event of a disturbance

(1) When a disturbance is reported or independently identified, the national grid company makes an initial assessment of the situation with the involvement of the players concerned. In the process, the national grid company decides what grid state the grid is in and whether there is a critical grid situation (cf. section 2.1.2) or even a major disturbance in Switzerland.

(2) When the grid is in a disrupted state, the disturbance manager for the national grid company is obliged to perform the following tasks:

a) Inform all the impacted players (FTSOs/RSCs, operators of transmission-connected systems) regarding the occurrence of a disturbance. In this way, operators of transmission-connected systems who are not yet affected are given time to take precautionary measures of their own to prevent the disturbance from spreading. Depending on the type of disturbance, system operators connected to the DS and market players are also informed,

b) Determine the strategy for rectifying a disturbance and restoring failed grid elements or restoring the grid,

c) Coordinate with operators of transmission-connected systems and issuing directives concerning the measures they must take,

d) The disturbance manager keeps the players informed regarding the development and end of a disturbance.

(3) The national grid company can ask the operators of transmission-connected systems to designate regional disturbance managers who are subordinate to and cooperate with the national grid company's disturbance manager. The national grid company reserves the right to delegate specific rights and obligations to the regional disturbance managers.

(4) In serious cases, such as a major disturbance in Switzerland, after an automatic frequency correction, a manual load shedding or restrictions by market players, the national grid company, the operators of transmission-connected systems and the authorities coordinate their communication.

5.2.3. Tasks of operators of transmission-connected systems in the event of a disturbance

(1) In the event of a disturbance, operators of transmission-connected systems are obliged to do the following:

a) Immediately notify the national grid company of disturbances that could potentially impair the secure operation of the TS (this includes disturbances on all systems belonging to the national grid company's «external observability list»). The disturbance report contains information on the cause of the disturbance, its expected duration and (if known) how it will affect other operating facilities,

b) Help the national grid company determine the strategy and define the necessary measures for rectifying a disturbance,

c) Implementation of the measures ordered by the national grid company (taking into consideration the right to issue directives in section 2.1.3),

d) Coordination of measures with the S-PPOs and S-CSOs connected to the DS.

5.3. Measures for maintaining and restoring a normal grid state

(1) The following subsections describe various packages of measures for different causes (not exhaustive, cf. Figure 9). As a rule, the measures are agreed upon and coordinated. A distinction is drawn between measures that can be taken by the national grid company without

declaring a critical grid situation and those that can be ordered only after a critical grid situation has been declared (cf. section 2.1.2).

	Frequency maintenance	Voltage maintenance	Congestion management
Measures	Primary, secondary and tertiary control	Use of compensation coils, compensation systems, topological measures, transformer taps	CH congestion warnings
	Request for MEAS and emergency reserves from FTSO	Voltage plan change	Recalculation of NTC, adjustment of ATC
	Coordinated measures of the TSO (50/100mHz procedure)	Activation of super-obligatory reactive power	Stopping of D-1 and intraday allocation of capacity
		Activation of redispatching	Activation of topological measures, redispatching and countertrade
Additional measures in the event of a critical grid situation	Intervention in the use of power plants connected to the TS	Manual load shedding	Intervention in the use of power plants connected to the TS
	Automatic low frequency demand disconnection scheme		Immediate termination of shutdowns
			Reduction of issued capacity rights
			Manual load shedding

Figure 9: Overview of measures (incomplete)

(2) Measures must be taken based on transparent and non-discriminatory principles.

(3) When choosing suitable measures, the national grid company uses the following criteria:

a) Avoidance of risks to persons and systems,

b) Use of measures that cause no limit violations, if possible,

c) Use of measures that have the least possible impact on the affected players,

d) Estimation of the risks and consequences may be connected with the implementation of different possible courses of action, such as

- Risks connected with errors or short circuits when performing topology changes or as a result of those changes,
- Risks connected with non-availability due to changes in active power or reactive power in utility power generation systems or consumption systems and
- Risks connected with functional disturbances in the operating facilities.

(4) If implementation of the measures ordered by the national grid company results in a situation where it is not possible to perform ancillary services or fulfil other obligations contractually agreed upon with the national grid company, implementation of the ordered measure shall take precedence.

5.3.1. Frequency-related measures

(1) The system balance in the European interconnected grid is generally achieved by maintaining the power balance in each control area. The system balance can be jeopardised by:

a) generation or final consumption that deviates from the forecast,

b) schedule errors,

c) contingencies affecting generation or end consumers,

d) impairment of cross-border exchange,

e) collapse of interconnected operations.

(2) In the event of a longer-lasting underfrequency that cannot be managed by standard use of control energy, the national grid company and the DSO shall take measures to normalise the grid frequency. The grid operators ensure, among other things, that:

a) energy storage device automatically switch to generation mode or disconnect from the grid if unable to switch to generation mode within the time period specified by the national grid company,

b) end consumers can be switched off, or generators can be activated on a contractual basis.

(3) The national grid company and the DSOs ensure that a operational, staggered, automatic low frequency demand disconnection scheme is available.

(4) After each incident, the national grid company analyses and documents both the effectiveness of the automatic low frequency demand disconnection scheme and the preventative measures pursuant to (2). The national grid company receives corresponding documentation from the DSO. Processes and measures are modified based on the results of the analysis after the players have been consulted.

(5) The technical requirements for setting up cut-off frequencies and automatic disconnection of power plants from the grid are described in section 6.

(6) The national grid company sets out the technical and operational requirements for frequency and voltage maintenance for the disrupted grid state in the Swiss control area. The requirements apply both to power plants in island operation and in synchronous operation on the grid. The S-PPOs connected to the TS and the S-PPOs (if contractually stipulated) connected to the DS are required to configure the power plant controllers in accordance with these guidelines.

Measures without a critical grid situation:

(7) Frequency deviations are generally managed by means of primary, secondary and tertiary control. If secondary and tertiary control power is fully activated by the national grid company and this is not enough to balance the Swiss control area, emergency reserve contracts concluded between the national grid company and neighbouring FTSOs shall be activated.

(8) The European TSO shall take coordinated countermeasures if longer-lasting frequency deviations occur.

Measures in the event of a critical grid situation:

(9) The national grid company has the option to change the infeed to the TS by ordering S-PPOs connected to the TS to change their production or use of pumps.

(10) Depending on the grid frequency, the automatic low frequency demand disconnection scheme switches off end consumers in stages, thus stabilising the grid and ensuring supply to end consumers that are still being supplied. The national grid company declares a critical grid situation after this event. When power plants, stores, pumps or end consumers reconnect after an automatic low frequency demand disconnect or return to their planned operating mode, this must take place in coordination with all parties involved and with the approval of the national grid company.

5.3.2. Voltage-related measures

(1) To manage disturbances that might occur due to an ongoing violation of the voltage profile limits, the national grid company has to to define and contractually establish preventative regulations for voltage-maintenance measures in collaboration with operators of transmission-connected systems (cf. section 4.4).

Measures without a critical grid situation:

(2) When voltage violations occur, the national grid company takes the following measures:

a) managing compensation coils, compensation systems, topological measures, modifying tap changer settings for transformers, opening idle lines,

b) modifying the voltage plan (cf. section 4.4.3),

c) issuing directives to participants in super-obligatory voltage maintenance to produce reactive power (cf. section 4.4.4),

d) using redispatching,

e) Prior to reconnecting transformers that connect the TS to the DS, DSOs connected to the TS ensure that the on-load tap changers are reset to a position that ensures a minimal voltage difference or at least to the position they occupied prior to the outage or contingency.

Measures in the event of a critical grid situation:

(3) In the event of a voltage collapse, automatic transformer tap control must be blocked. The national grid company regulates the blocking method (telecontrol or on-site), voltage threshold, flow direction of the reactive power, etc.

(4) As a last resort, it can order manual load shedding to save the grid on a local level. This may only be ordered if it will prevent the disturbance from spreading and causing even more damage. Details are provided in a related VSE industry recommendation.

Intervention in market activities

(5) Point 5.3.2 (4) constitutes an indirect intervention in market activities. The national grid company announces the beginning and end of the manual load shedding.

5.3.3. Measures designed to reduce congestions

(1) The national grid company uses the following preventative measures to avoid congestion:

a) coordinated outages,

b) cross-border congestion management (cf. section 2.5 and 3.2),

c) national congestion warnings or power restrictions (specification of regional upper limits for infeed and consumption from or into the TS),

d) preparation and clarification of topological measures.

Measures without a critical grid situation:

(2) The national grid company manages congestion in the TS by means of the following operating procedures:

a) Remedial actions (topological measures, redispatching and countertrade),

b) recalculation of the intraday capacity (NTC) and adjustment of the cross-border capacities that are still available (ATC),

c) stopping the day-ahead and intraday allocation of capacity in the direction of the congestion,

d) joint cross-border grid-saving measures with FTSOs (emergency procedures, topological measures, intervention in power plant use abroad, use of control reserves).

The S-PPO must inform the national grid company of any limitations to the power plant's availability for remedial actions, and it must provide reasons for this. The national grid company accounts for the limitations in the course of operations and regulates them contractually, if necessary.

Measures in the event of a critical grid situation:

(3) The national grid company has the option to intervene in power plant use, outages and capacity rights by means of the following measures:

a) issue directives to S-PPOs connected to the TS to adjust power plant and pump operation,

b) at short notice, terminate outages of grid elements that are part of the «external list of contingency» of the national grid company,

c) reduce capacity rights that have already been issued,

d) as a last resort, it can order manual load shedding to save the grid on a local level. This may be ordered only if it will prevent the disturbance from spreading and causing even more damage. Details are provided in a VSE industry recommendation.

Intervention in market activities

(4) Points 5.3.3 (2) c) and (3) constitute an intervention in market activities. The national grid company informs the market players about the suspension or resumption of market processes and the reduction of capacity rights.

5.3.4. Measures in the event of failure of IT systems

(1) If central IT systems of the national grid company go down, the company will activate emergency plans that have been coordinated and arranged in advance with operators of transmission-connected systems.

(2) If IT systems and means of communication for market processes go down, the processes must be limited or even discontinued. The national grid company informs the market players about the suspension and resumption of market processes.

5.3.5. Temporary grid disconnection or commissioning of systems connected to the TS

(1) The national grid company can order a system to be temporarily disconnected from the TS or temporarily commissioned due to force majeure, extraordinary events or dangerous situations, in a critical grid situation or due to measures ordered by the authorities.

5.4. Grid restoration

(1) The national grid company creates, maintains and publishes a grid restoration concept for the TS. This concept is always coordinated with the operators of transmission-connected systems and FTSOs and takes into account the requirements at the interfaces. It is tested and updated as needed but at least once every two years. Those involved in grid restoration are trained, and the training is documented.

(2) The national grid company is responsible for coordinating the measures for grid restoration or supply reestablishment after an island operation, an automatic low frequency demand disconnect, a manual load shedding or a major disturbance in Switzerland. Operators of transmission-connected systems undertake to follow the instructions of the national grid company and implement the ordered measures immediately. This means, among other things, that the following measures are permitted only with the consent of the national grid company:

a) reestablishment of supply to disconnected sections of the transmission system or operators of transmission-connected systems,

b) resumption of infeed from disconnected power plants connected to the TS.

(3) The DSOs can operate and build upon an island grid in their area of responsibility before connecting to the TS. With the approval of the national grid company, a balanced island grid can be synchronised with and connected to the TS. In the absence of synchronisation equipment, an island must first be shut down before it can be connected to the TS.

(4) The national grid company has to guarantee the availability of a sufficient number of power plants with black-start and island operation capability in order to restore power systems following an emergency or blackout state (cf. section 4.5).

5.5. Disturbance analysis

(1) The national grid company performs a systematic analysis of disturbances in the TS and draws up corresponding statistics for the TS. The national grid company uses the results to work out suitable solutions for further development and improvement of the existing processes in collaboration with the players involved.

(2) Upon request, the national grid company and the operators or owners of transmission-connected systems exchange all the information required for fault clarification and disturbance analysis.

(3) The national grid company, operators and owners of transmission-connected systems, as well as other players concerned (including authorities, where applicable) exchange information on the results of the disturbance analysis in a timely, needs-based manner.

5.6. Instruction and Training for disturbed grid situations

(1) The national grid company, operators of transmission-connected systems and S-PPOs connected to the DS are obliged to provide instruction, training and regular refresher courses for personnel responsible for operational and disturbance management to prepare them for the necessary measures in the event of a critical grid situation, island operation, restoration of supply, or grid restoration. Skills relating to communication, leadership and specific disciplines are also imparted here.

The national grid company reserves the right to define requirements for the content and measures to be included in the training programme and to request proof from the other operators of transmission-connected systems that their operating personnel and disturbance managers have successfully completed the instruction and training.

(2) To ensure effective collaboration, the national grid company will organise annual training sessions and drills to practice the necessary measures for responding to a disturbance together with the other operators of transmission-connected systems. Participation is mandatory for disturbance managers and personnel responsible for operational management.

6. Connecting to the transmission system

6.1. Scope of application

(1) The connection conditions apply in general to both existing and new grid connections to the transmission system at the corresponding grid connection point. Different agreements may be reached for existing systems, but this may be done only for new systems in connection with section 6.5.2 (7). System security and stability must not be jeopardised. Paragraphs (2) through (4) describe the different regulations governing grid connection requirements for new and existing systems and for changes to existing systems.

(2) The following applies to new systems connected to the TS:

The requirements of sections 6.3-6.6 apply to new systems connected to the TS. A system is considered a new system if the relevant permit for creating the system is legally issued after the TC enters into force. The relevant permit is the permit for the electrical systems to be connected to the TS.

(3) The following applies to existing systems connected to the TS:

Deviations from the requirements in sections 6.3-6.6 must be documented and brought to the attention of the national grid company. The national grid company then checks whether the deviations could result in a serious threat to system security and stability. If this is the case, the national grid company and the owner of transmission-connected systems must take suitable measures to safeguard system security and stability. In the process, the national grid company takes account of the time and effort required for implementation. The process outlined in VSE briefing paper 39 («Dealing with ENTSO-E network codes in Switzerland») is to be used for this purpose.

(4) The following applies to changes to existing systems connected to the TS:

Owners of transmission-connected systems undertake to inform the national grid company of changes to an existing system that will affect the electrical and grid-dynamic properties of the system (with regard to the grid connection point). After receiving the change notification, the national grid company checks whether measures are necessary to ensure system security and stability. The following principles must be followed here:

a) When renovating or expanding part of an existing system, the part to be renovated or expanded must comply with the requirements that apply at that time.

b) A simple replacement with components of the same type or technically equivalent components does not require any measures, as long as the operator ensures that the electrical and dynamic network behaviour of the system (with regard to the grid connection point) is not adversely affected. However, each newly procured component that replaces an existing component must be state-of-the-art and be able to meet the requirements in effect at the time of replacement as part of a system.

c) Parts of the system that are not affected by the change remain subject to the original requirements.

6.2. General

(1) In addition to security-relevant, technical and operational aspects, the economic aspects of a connection to the TS need to be taken into consideration as a whole. This should enable a comprehensive assessment of the connection.

(2) When setting up or modifying connections, owners of transmission-connected systems have to submit an application to the national grid company. When an existing connection is terminated, the system owner cancels the grid connection contract with the national grid company. The necessary documents are published on the website of the national grid company.

(3) For each new TS connection (cf. section 6.1 paragraph (2)) and each TS connection to be changed significantly (cf. section 6.1 paragraph (4)a), the plant owner must involve the national grid company in the planning stage. A grid connection contract must be concluded or amended. It contains the technical requirements, explanations and technical documentation,

as well as a description of the property demarcation. When a connection is terminated/dismantled, the grid connection contract must be cancelled.

When a connection application is evaluated, particular attention is paid to the following criteria:

a) Maintenance of the security of supply or the secure operation of the TS, taking into account the requested connected load, cost-effectiveness and efficiency.

b) Maintenance of the quality of supply (e.g., maintenance of voltage and frequency bands).

c) Compliance with laws, regulations, technical standards and the requirements for the connection.

d) Location of the system to be connected.

Furthermore, in consultation with the DSOW connected to the TS, the national grid company's deliberations take into account the current grid conditions and the current state of grid development.

(4) During the connection process, the system owner who wants to connect to the TS concludes an agreement with the national grid company regarding the maximum installed load. If the agreed measures for creating adequate grid conditions in the TS cannot be implemented prior to the agreed commissioning date, the connected systems are subject to reduced grid access in accordance with the current grid conditions at the grid connection place until the measures are implemented. The grid access of existing power plants is not impaired by the commissioning of a new power plant. A power plant is considered «existing» if it was already connected to the grid when a legally binding construction permit was issued for the power plant to be newly connected. In general, these statements also apply to the grid systems of end consumers and area grids.

If the grid situation permits, the system can also be granted maximum grid access from time to time until the measures are implemented.

If grid access has to be restricted until the measures are implemented, the grid access of the newly connected system is initially reduced until further processes are implemented as required for technical and/or economic optimisation in accordance with the applicable operating processes.

(5) The national grid company is responsible for implementing the connection to the TS and should meet the needs of the owner of the transmission-connected system as far as possible.

(6) A connection to the TS cannot be put into operation until the technical and contractual provisions are fulfilled (incl. conformity tests, cf. section 6.4). Prior to commissioning, the work completed has to be approved by the national grid company, and the system owner remedies any deficiencies that would endanger the environment, people and systems or have unacceptable repercussions according to expectations.

(7) For each connection to the TS, the owner of transmission-connected systems must draw up technical documentation for the constructed system in accordance with the requirements in the grid connection contract. This documentation must be submitted to the national grid company prior to commissioning. Individual parts of the documentation that are not directly relevant to the operation of the TS may also be submitted after the commissioning with the approval of the national grid company.

6.3. Technical aspects

(1) The national grid company is responsible for provisioning the grid connection bay in the TS.

(2) The national grid company defines the technical design of the grid connection bay that is located in its responsibility, as well as the measuring and control apparatuses and the number of grid connection places.

(3) In cases where different owners of transmission-connected systems connect via a shared hook-up, all the owners of transmission-connected systems are jointly responsible for complying with the technical requirements.

6.3.1. Limitation and configuration of the connection to the TS

(1) The national grid company defines the requirements for the following:

a) grid connection point,

b) metering equipment,

c) dimensioning and configuration of the connection,

d) structural requirements.

When defining the requirements, the national grid company takes into consideration the technical and commercial conditions at the grid connection point.

The voltage level for a new connection is determined based on the connected load anticipated for the grid connection point for the next 20 years and the voltage levels available on site. The following table summarises reference values that can be deviated from in justified cases.

Table 1: Connection power reference values for each voltage level

Relationship between connected load and voltage level	
Voltage level	**Connected load**
380 kV (TS)	≥ 300 MVA
220 kV (TS)	≥ 150 MVA
Connection to the DS	< 150 MVA

(2) The following criteria are taken into account when dimensioning the connection:

a) technical data of the system(s) to be connected,

b) the expected development of final consumption and generation capacities,

c) the expected development for directly connected end consumers and

d) the expected operational and maintenance costs.

6.3.2. Technical requirements for systems connected to the TS

(1) All technical installations for connecting a system to the TS must comply with recognised technical regulations, and their configuration must be coordinated with other installations of the TS and transmission-connected systems.

(2) The systems connected to the TS must fulfil the voltage and insulation levels of the TS.

(3) All parts of the system must be designed to conform at least with the operationally feasible current and voltage values and the maximum short-circuit power specified by the national grid company. Upon request, the national grid company will disclose the maximum or minimum short-circuit power applicable for each grid connection point.

(4) The neutral-point configuration of systems connected to the TS corresponds to the neutral-point configuration in the TS at the grid connection point. The owner of transmission-connected systems must install the requisite technical installations to achieve the neutral-point configuration.

(5) Owners of transmission-connected systems must provide equipment which enables the secure, synchronised connection of their systems to the TS.

(6) Systems connected directly to the TS must be designed to allow automatic reclosuring (high speed automatic reclosing) to the TS.

6.3.3. Technical coordination between owners of transmission-connected systems and the national grid company

(1) The national grid company regulates at least the following points with the system owner who wants to connect to the TS:

a) applicable security provisions and access rights for the individual systems (on-call service, blue-light organisations, etc.) for plant use and switching service,

b) interfaces between the systems of the contracting parties,

c) property borders and rights of use,

d) scope and content of technical documentation,

e) responsibilities for construction, operation, maintenance, replacements and dismantling.

f) The following points must also be defined, as needed:

- specific requirements related to the connection,
- implementation period for the connection,
- power of the connection, short-circuit power at the grid connection point and minimum required breaking power of the switching devices,
- insulation coordination (e.g., voltage series, lightning arrester),
- voltage range, duration and level of short-term overshoots or shortfalls,
- equipment to be provided for protection, parallel connection and synchronisation,
- neutral-point configuration,
- measuring, metering and IT devices to be provided,
- protection concept and configuration of protection devices,
- control and communications technology,
- considering in of enhanced and delayed DC component currents,
- sharing of grid element parameters and metered values at the grid connection point.

(2) When specific responsibilities are allocated, the owner of the connection is considered responsible for the maintenance of the operating facilities and system components they own.

(3) Owners of transmission-connected systems and the national grid company must inform one another of relevant changes that could have an impact on the connection and/or the operation of the TS well in advance.

(4) If changes are made to the systems of the national grid company or the owners of transmission-connected systems, at least the relevant sections of the contractually agreed technical documentation are revised and made available to the other party.

6.3.4. Operational coordination between operators of transmission-connected systems and the national grid company

(1) For operations, the national grid company and the operators of transmission-connected systems regulate the following for each grid connection:

a) coordination procedure for outage planning for systems connected to the TS and designation of points of contact,

b) rules governing switching actions at interfaces to the TS,

c) type and range of reactive power exchange (e.g., power factor / cos φ),

d) conditions for parallel switching actionsand synchronisation conditions,

e) type and scope of the data and signals to be provided at the grid connection point of the operator of transmission-connected systems for the operation of the TS,

f) participation in frequency- and voltage-related measures for preventing or limiting major disturbances or minimising their effects (cf. section 5.3), and

g) coordination of the switching states of the individual grid connection points.

6.3.5. Availability of the connection to the TS

(1) As a rule, the grid connection bays required for an individual connection do not feature a redundant design. Specific regulations are stipulated in the grid connection contract. If increased availability of a connection is required, the owner of transmission-connected systems must provide an adequate reason for this.

6.3.6. Grid perturbations and quality of supply

(1) Powersystem elements and distribution grids connected directly to the TS must be designed and configured in such a way that grid perturbations on the TS resulting from their operation are avoided in accordance with recognised technical regulations, and information signals are not influenced in an impermissible manner.

The TS is designed and built in a way that prevents it from causing impermissible grid perturbations in plants connected to the TS or impairing their operation.

(2) The parameters for permissible grid perturbations (changes in voltage, flicker, voltage asymmetries, harmonics, interharmonics) are based on the following documents:

a) The owners of transmission-connected systems must take into account the limits in accordance with the technical regulations in «Technical regulations for assessing grid perturbations» (DACHCZ document) and

b) the national grid company must take into account the limits in line with standards EN 50160 and IEC 61000-3-6.

(3) The national grid company defines the permitted harmonic level at the interface to the TS (taking into consideration paragraph 2) and regulates this contractually with the operator of transmission-connected systems. The national grid company supports the operator of transmission-connected systems and provides them with the necessary technical data.

(4) On this basis, the national grid company and the owners of transmission-connected systems must provide evidence that the perturbations caused by their equipment are within the permitted tolerances (as per paragraphs (2) and (3)) or if not, they must make arrangements for remedial actions.

6.3.7. Requirements for grid protection

(1) Protection devices serve to protect systems/components by means of rapid and selective disconnection of faults. As such, they guarantee security of supply.

(2) Owners of transmission-connected systems work with the national grid company to formulate a protection concept for the interface to the TS. It must be checked at least once every five years or after an incident and modified as required. After a protection operation is triggered in the TS, the national grid company checks whether the protection devices have worked as planned and takes any required remedial actions in coordination with the players concerned.

(3) The owners of transmission-connected systems install the necessary protection devices in accordance with the protection concept. The national grid company and the owners of transmission-connected systems coordinate the protection devices and protection settings. As a rule, all owners of transmission-connected systems are responsible protecting their own systems.

(4) The owner of the systems is responsible for ensuring that the protection devices function reliably in all operating situations.

(5) The protection devices must be configured to the permitted loading capacity of the operating facilities being protected. The protection setting is checked and adjusted if necessary when changes are made in the TS, downstream grids or connected network systems.

(6) The protection device of the TS does not serve as a back-up protection set-up for the protection of connected systems (e.g., transformer protection). Owners of transmission-connected systems should therefore provide an appropriate back-up protection set-up for the transformers that serve as coupling elements between the TS and the connected systems. The national grid company provides additional maximum current time protection and switch fail-

ure protection on the high-voltage side in order to prevent a disturbance from spreading in the TS in the event of a protection failure or a circuit breaker failure.

(7) The national grid company coordinates the operational safety limits for the tie-lines with the neighbouring FTSOs.

6.4. Conformity monitoring and conformity tests

(1) The national grid company checks compliance with the requirements for connections between the TS and power plants of power category D (cf. Figure 10). The requirements are described in the following section 6.5.

(2) When establishing a new connection to the TS or making significant changes to its systems, every operator of transmission-connected systems must run tests and verify that its system fulfils the technical and organisational requirements stipulated in the contract and that it has no significant negative effects on other operating facilities.

(3) The national grid company must be consulted when conformity tests are performed and test schedules are supplied. The national grid company may order a test to be delayed or cancelled for operational reasons, e.g., if grid operations are jeopardised. The players involved share the results of the conformity tests with each other and may use them to train employees and to develop and improve operational procedures.

6.5. Additional requirements for power plants

6.5.1. General

(1) Requirements for power plants differ greatly depending on the type of power plant and the installed active power. Figure 10 provides an overview of the distinctions drawn in terms of power plant type and power category. The TC describes the requirements for power plants that belong to power category D. The requirements for power categories A-C are contained in the VSE implementation document « Grid connection recommendations for energy generation systems (NA/EEA).»

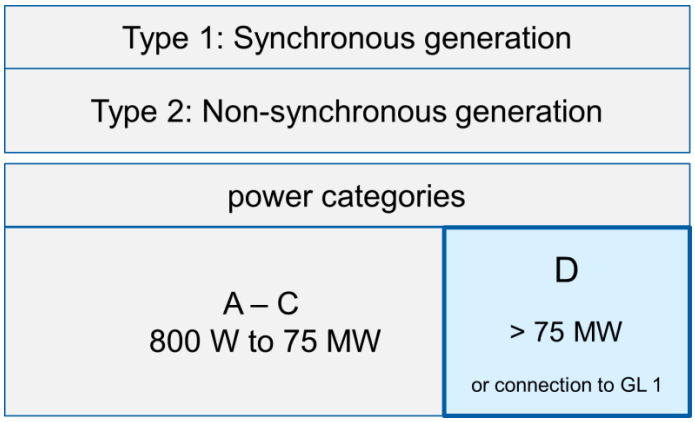


Figure 10: Power plant types and power categories

(2) Figure 11 through Figure 15 illustrate requirements for power plants belonging to power category D. This category covers all power plants that are connected to the TS or have an installed capacity exceeding 75 MW.

a) A distinction is drawn between power plants with synchronous power generation (type 1) and power plants or systems with non-synchronous power generation (type 2).

b) Each of the system-specific limits (in chart form) must be agreed upon by the national grid company and the PPO and be entered in the pre-qualification documentation for ancillary services, if necessary.

(3) The national grid company can authorise deviations from this policy in cases where fulfilling the requirements set out in sections 6.5.2 to 6.5.7 would result in disproportionate effort and investments. The corresponding deviating requirements must be contractually agreed.

(4) To create dynamic grid models, the national grid company requires S-PPOs connected to the TS to provide not only statistical data but also dynamic machine and controller data, if necessary (cf. section 2.7.1 (3)). The national grid company specifies the requirements for these models. In consultation with the S-PPO, the national grid company can request records of the electrical behaviour of power plants in order to compare them with the models (for existing power plants, if such records are available).

6.5.2. Robustness against voltage and frequency fluctuations

(1) It must be possible to operate power plants within the values for mains voltage and grid frequency shown in Figure 11 and Figure 12, i.e., they must not be automatically disconnected from the grid by voltage- or frequency-dependent disconnection devices in these ranges.

(2) The configuration of the stability-relevant parameters and time constants for the turbine and generator controllers must be contractually agreed.

(3) The national grid company can request an extended operating range, if necessary. The corresponding additional requirements must be contractually agreed.

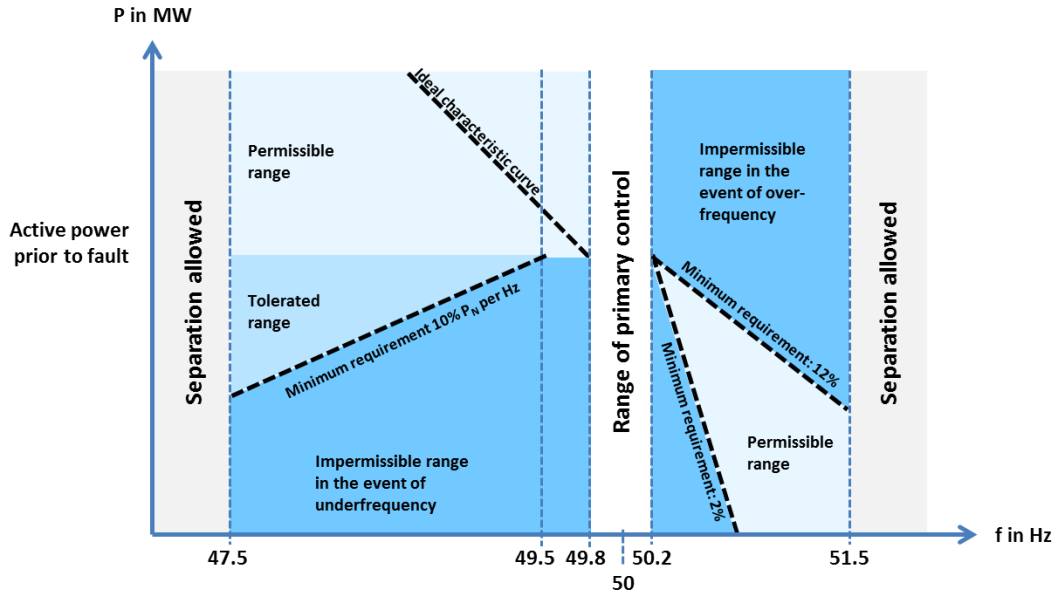


Figure 11: Robustness against frequency fluctuations

Requirements for the emitted active power of power plants at the grid connection point depending on the grid frequency (quasi-stationary approach). The percentage values and hence the droop in over-frequency on the chart relate to the **rated power for type 1** and **the current active power output for type 2**.

(4) In the event of grid frequency deviations under 49.8 Hz or over 50.2 Hz (i.e., outside the range of primary control), the effect of the droop of all machines on the grid must not be limited because active frequency support is crucial in precisely this exceptional operating range if at all possible.

(5) For frequencies above 50.2 Hz, power plants must reduce the output with a droop between 2% and 12%. The maximum reaction time before the initiation of power reduction is two seconds.

(6) The following applies in the event of a frequency under 49.8 Hz:

a) Power plants should increase their active power output, if possible, to stabilise the grid.

b) Under 49.5 Hz, a technically justified reduction in active power output of max. 10% per 1 Hz of the rated power is tolerated for type 1 power plants.

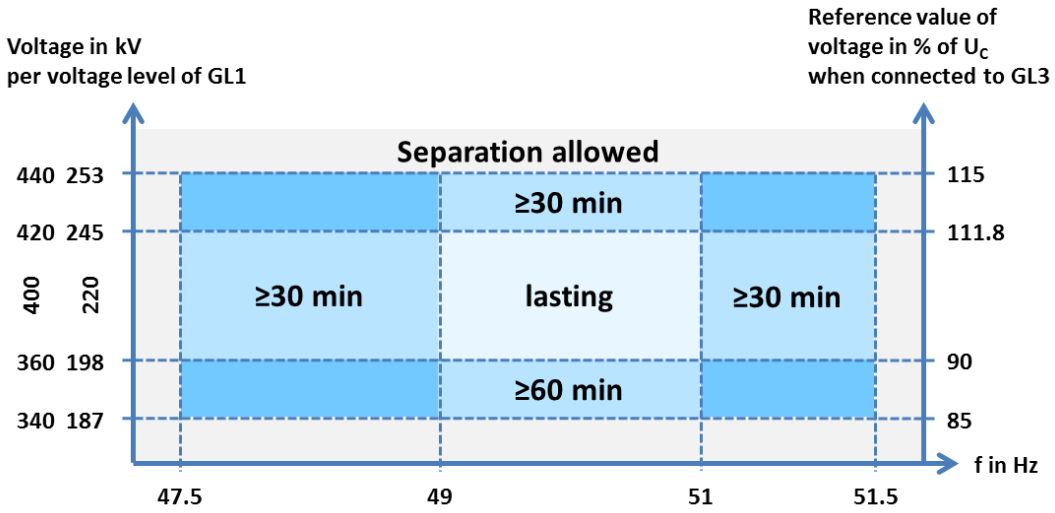


Figure 12: Robustness against frequency or voltage fluctuations

A power plant must remain connected the grid for certain minimum durations (quasi-stationary approach), even when voltages or frequencies are too high or low. The voltage values at the connection point are specified in kV for grid level 1 and in percent of the agreed voltage U_C for grid level 3. The values for grid level 3 are reference values and may vary from DSO to DSO.

(7) No power plant may disconnect from the grid in the frequency and voltage range referred to as «lasting» in Figure 12. In the ranges labelled with times, the power plant must stay connected to the grid for at least 30 or 60 minutes, where technically possible, e.g., with a transformer with an automatic tap changer. In the four corner areas (simultaneous deviation of voltage and frequency) the PPOW connected to the TS can arrange shorter time ranges in consultation with the national grid company. If the voltage or frequency deviation is even larger (grey area), immediate disconnection from the grid is permitted. The voltage values apply to the connection point.

(8) If there is a frequency drop that is above the characteristic curve shown in Figure 13, a power plant's active power output must not decrease, even if the plant is operated at rated power (P_N). This ability is central to the stability of the interconnected grid.

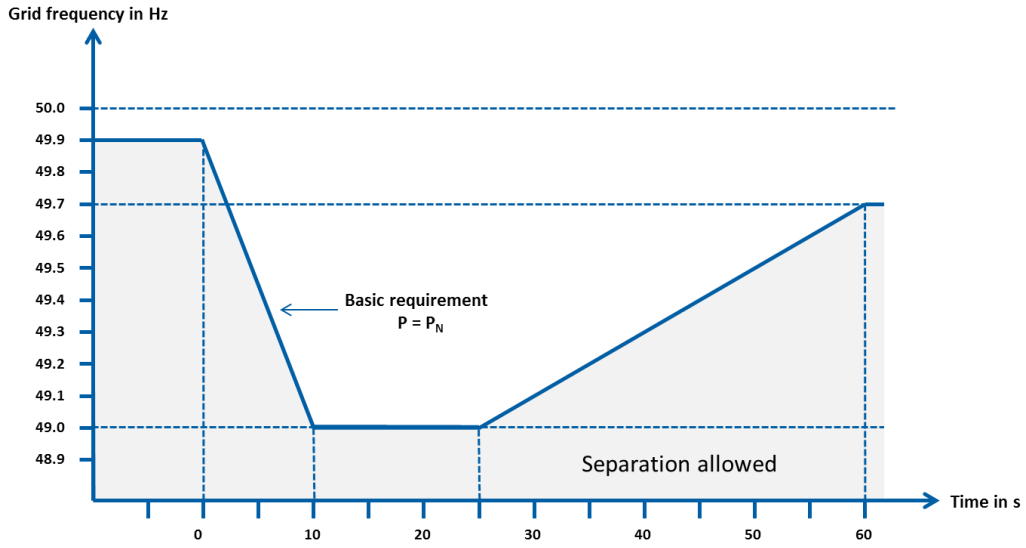


Figure 13: Unchanged active power output during a short-term frequency drop

(9) It must be possible to reconnect a power plant in the basic frequency range of 49.0 Hz to 51.0 Hz.

6.5.3. Voltage limits for reactive power provision

(1) Power plants must be capable of operating within the operating voltage and reactive power range specified in Figure 14.

(2) The national grid company can request an extended operating range, if necessary. The corresponding additional requirements must be contractually agreed.

(3) In the event of reactive power not provided by means of voltage maintenance of a synchronous machine, the technical equipment/infrastructure must be capable of feeding the agreed reactive power (absorb or consumption) into the grid within a few minutes.

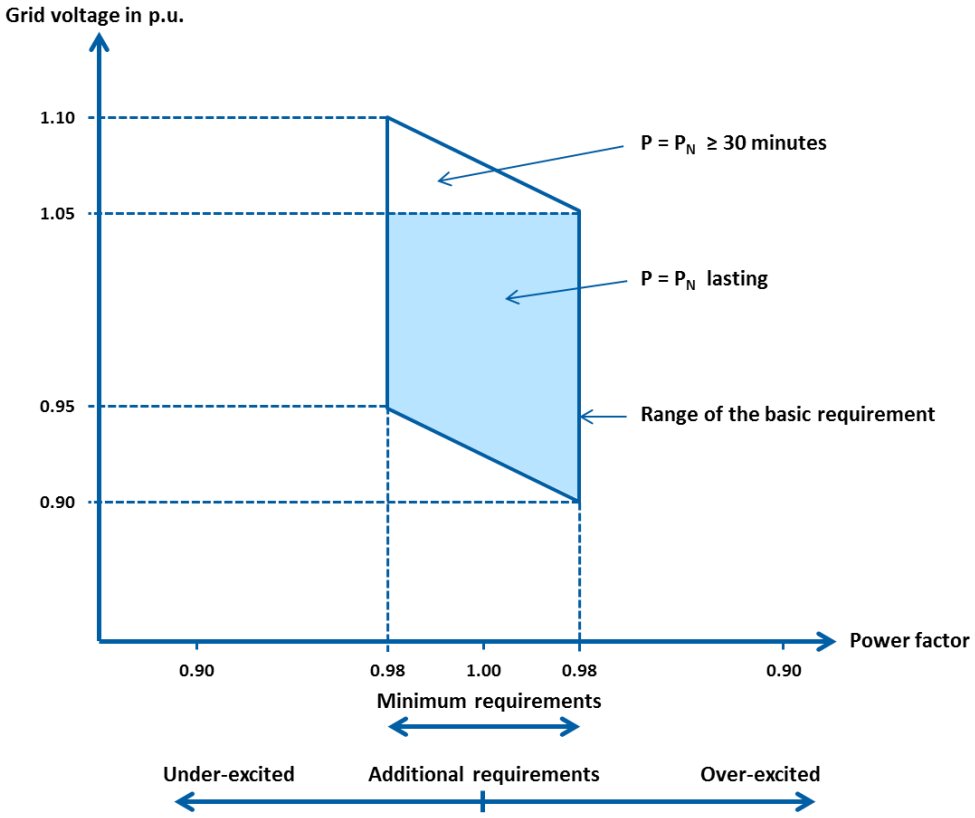


Figure 14: Requirements for reactive power provision by power plants at the grid connection point

6.5.4. Electrical protection of power plants

(1) The electrical protection of a power plant must take precedence over operational control systems such as voltage controllers and excitation systems.

(2) Protection concepts and protection settings at the interface between the national grid company and the PPO connected to the TS must be agreed upon by both parties. For power plants in power category D that are connected to the DS, the DSO and PPO must also agree upon the protection concept and the protection settings at the interface.

6.5.5. Transient stability

(1) Short-circuits close to a power plant (outside the main protection range of electrical machine protection) must not lead to instability or disconnection from the grid over the entire operating range of the generator when protective functions are used pursuant to the concept (grid pro-

tection and electrical machine protection). Exceptions are permissible only for generators with a power output of less than 20 MW and must be contractually agreed.

(2) Power plants must not disconnect from the grid when there is a drop in voltage if the grid voltage at the grid connection point is above the boundary line shown in Figure 15. Separation from the grid is always permitted below the borderline.

(3) The voltage limiting curve depicted in Figure 15 also indicates the maximum fault clearing times for three-phase short circuits for correctly functioning grid protection:

a) Fault clearing time < 0.15 s for short-circuits close to generators,

b) Fault clearing time < 0.70 s for short-circuits at a distance from generators.

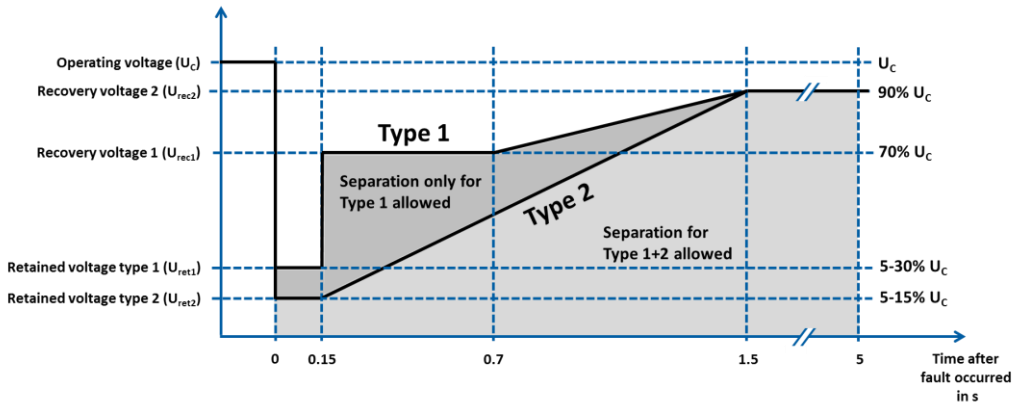


Figure 15: Limiting curve for a short circuit close to a power plant

The chart shows the curve of the permissible mains voltage at the grid connection point after a disturbance occurs (valid for power plants in power category D)

(4) The PPO must ensure that its power plant remains in a stable state throughout the maximum fault clearing times indicated in Figure 15. The borderline shows the voltage at the grid connection point. Because there is a transformer between the grid connection point and the generator terminal, the residual voltage is higher at the generator terminal that at the grid connection point.

(5) In the event of short-circuits at a distance from a power plant, fault clearing during the last stage of grid protection (up to 5 seconds) must not lead to either a precautionary disconnection of the generator or to a precautionary disconnection due to a reduction in the voltage of own-use auxiliary circuits.

6.5.6. steady-state stability

(1) Rotor or grid oscillations (active power oscillations) with natural frequencies of up to 1.5 Hz must not cause type 1 generators to produce a reduced power output or lead to a disconnection from the power system.

(2) If the national grid company deems it necessary for technical reasons relating to the grid, power plants are to be provided with options for damping rotor or grid oscillations, e.g., by means of power system stabilisers (PSS).

6.5.7. Other points

(1) New power plants that shall be connected to the TS must generally be capable of regulating active power so they are technically capable of participating in primary and secondary control. The national grid company must be informed in advance if a planned power plant does not have this functionality.

(2) If a grid region experiences a shortage of power plants capable of black start and/or island operation capability, the national grid company will call for bids for these requirements.

(3) When new power plants with a connection to the TS are being planned, the national grid company checks whether black start and/or island operation capability is required at the planned power plant location. The national grid company and owners of transmission-connected systems reach a contractual agreement regarding a possible implementation.

6.6. Additional requirements for distribution grids

(1) To enable an operational voltage set point and staggered reactivation of end consumers in a disrupted grid state, mechanisms should ideally be designed to automatically disconnect the DS from the TS in the event of a loss of voltage. A manual disconnection device is also permitted with the approval of the national grid company.

7. Grid development of the transmission system

(1) Grid development constitutes an important basis for the future availability of a high-performance, reliable and efficient TS. As such, it directly serves to ensure the security and quality of electricity supply in Switzerland in the future. Grid development is a multi-stage process.

(2) A scenario framework drawn up periodically by the Swiss Federal Office of Energy and approved by the Federal Council forms the basis for grid planning. The scenario framework is created in cooperation with the cantons, the national grid company, the other grid operators and other affected parties. The scenario framework is based on general economic data and the energy policy objectives of the federal government and takes the international environment into account.

(3) The national grid company creates a multi-year plan based on the scenario framework and its own requirements. The multi-year plan designates the required optimisation, reinforcement, expansion and dismantling measures for the TS.

To ensure coordinated grid planning and concerted multi-year planning, the players provide each other with information free of charge. This includes information on the existing grid, planned grid projects and forecasts concerning production and consumption in particular.

(4) The national grid company submits its multi-year plan to ElCom for review. ElCom reviews the multi-year plan, focusing in particular on the basic needs of the projects described therein. Then the national grid company publishes its multi-year plan.

(5) To minimise the influence of the TS on the environment and landscape, the national grid company follows the NOVA principle (**N**etz**o**ptimierung vor **V**erstärkung vor **A**usbau, in English: Grid Optimisation before Reinforcement before Expansion).

a) Grid optimisation: measures that do not change the pylon profile and cannot be perceived from the outside.

b) Grid enhancement: measures that result in a change to the pylon profile and can be perceived from the outside but do not require new transmission routes.

c) Grid expansion: if grid optimisation and grid enhancement are not enough, the grid is expanded.

(6) Grid planning also needs to take the following requirements and others into account:

a) Ensure that the TS can be operated (n-1) secure on its own.

b) Comply with the maximum and minimum short-circuit power.

c) Observe the relevant national and international laws, legal requirements and standards, as well as grid projects announced by other grid operators.

d) Take into account the protection concepts and dynamic behaviour of systems connected to the grid and the influence of the power system dynamics of the entire European interconnected grid.

e) Fulfil the requirements in line with section 6 for new and modified connections to the TS.

f) Ensure adequate control power and rotating flywheel, reactive power and black start and island operation capability.

8. Final provisions

8.1. Further development

(1) The TC is continuously being improved on the basis of changing regulatory requirements and the latest developments in technology, operations and energy efficiency. The national grid company and the defined working group review the TC regularly (at least once every two years), document adjustment requirements and, if necessary, create a new version in line with technical and legal developments.

(2) The TC is amended via a consultation procedure conducted with the players concerned in accordance with an existing coordination process. Updates to annex sections 9.1 and 9.2 are exempt from this coordination process, insofar as they are of an informational character.

(3) Together with international players (FTSO, RSC), the national grid company pursues the goal of maintaining the security and reliability of the TS. In order to guarantee this, the national grid company pays particular attention to harmonising Swiss and international requirements to the greatest extent possible when reviewing and amending the provisions of this TC.

8.2. Exceptions and interim solutions

(1) If an owner or operator of an existing transmission-connected system is unable to meet the respective guidelines of this TC, or if the necessary measures cannot be taken within a reasonable period of time or only at disproportionately high effort, the deviations and any coordinated measures must be contractually agreed with the national grid company.

9. Annex

Section 9.1 of this annex contains an overview of the regulatory requirements for individual sections of the TC. Section 9.2 lists the electrical industry documents and industry contracts that serve to implement the requirements of the TC. The national grid company updates the content of this annex as needed. No consultation takes place. The national grid company ensures that the TC version with the current Annex 9 is published on its website and the website of the VSE.

Version from 11 November 2019 (first version).

9.1. Overview of regulatory requirements

The current version of the Swiss legislation can be found on the website of the federal government:

a) StromVG: https://www.admin.ch/opc/de/classified-compilation/20042411/index.html

b) StromVV: https://www.admin.ch/opc/de/classified-compilation/20071266/index.html

c) EleG: https://www.admin.ch/opc/de/classified-compilation/19020010/index.html

d) Starkstromverordnung: https://www.admin.ch/opc/de/classified-compilation/19940082/index.html

The current version of the network codes and EU regulations can be found on the website of EUR-Lex:

e) System Operation Guideline (SOGL): https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32017R1485

f) Emergency and Restoration (ER): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.312.01.0054.01.ENG

g) Requirements for Generators (RfG): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R0631

h) Network Code on Demand Connection (DCC): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.223.01.0010.01.ENG

i) Capacity Allocation & Congestion Management (CACM): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R1222

j) Forward Capacity Allocation (FCA): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2016.259.01.0042.01.ENG

k) Electricity Balancing (EB): https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32017R2195

l) EU regulation 1227/2011 concerning the integrity and transparency of the energy wholesale market (REMIT regulation): https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:326:0001:0016:DE:PDF

ElCom published the document «Legal nature and essential content of ENTSO-E network codes» on 1 March 2012:
https://www.elcom.admin.ch/dam/elcom/de/dokumente/2012/02/rechtsnatur_und_wesentlicheinhaltevonentso-e-networkcodes.pdf.download.pdf/rechtsnatur_und_wesentlicheinhaltevonentso-e-networkcodes.pdf

Table 2: Overview of regulatory requirements

Section of this document	Regulatory requirement
Foreword	StromVG Art. 4 h, 18 (1), (2), 20
1.1 General	StromVV 5 (1)
1.4 (2) Definition of players and their roles	StromVG Art. 8 (1), Art. 20 (1)

Section of this document	Regulatory requirement
1.4 (3) Definition of players and their roles	StromVG Art. 8 (1) SOGL Art. 2, 3 (89)
1.4 (8) Definition of players and their roles	SOGL Art. 2 (1)
1.4 (9) Definition of players and their roles	StromVV Art. 1 (3)
1.5 Significant grid elements and systems for the operation of the transmission system	StromVG Art. 8 SOGL Art. 33, 40, 43, 44, 48-51, 75, 84-86, 90 CACM Art. 16, 28
2.1.1 Classification of grid states	StromVG Art. 20 Par. 2 lit. c StromVG in conjunction with Art. 5 StromVV SOGL Art. 18, 19 (1), (2), 21, 55, 102 (7), 127 (3)
2.1.3 Right to issue directives subject to grid state	StromVG Art. 20 c SOGL Art. 23
2.2 (3) (n-1) security in the transmission system	SOGL Art. 35
2.3 Outage planning	SOGL Art. 83, 95-97, 99, 100, 103 EU regulation 1227/2011 concerning the integrity and transparency of the energy wholesale market (REMIT regulation)
2.6 Requirements for PPOs, DSOs and BGMs regarding control of generation and final consumption	SOGL Art. 136, 137
2.7.1 Duty of the national grid company and other players in Switzerland to provide information to each other	SOGL Art. 25, 29, 45-47, 52, 53, 111 DCC Art. 18, 21
2.7.2 Duty of the national grid company and players abroad to provide information to each other	SOGL Art. 15, 16, 19 CACM Art. 16
2.5 Congestion management	CACM Art. 14, 15
2.8 Training, instruction and certification	SOGL Art. 58, 59
3.2 Provision and allocation of capacity rights	StromVG Art. 17 (1) CACM Art. 64
4.1 General - Ancillary services	StromVV Art. 22 (1), StromVG Art. 20 b)
4.3 Requirements for the provision of primary, secondary and tertiary control	DCC Art. 27-30
4.3.2 Special requirements for providers of primary control	SOGL Art. 154
4.4 Voltage maintenance	SOGL Art. 29, 109
5 Measures during operation of the transmission system and disturbance management	StromVV Art. 5 (2) SOGL Art. 20, 22, 55
5.2.1 (2) General – Catalogue of measures for disturbance management	ER Art. 11, 43-49
5.2.2 Tasks of the national grid company in the event of a disturbance	SOGL Art. 21, ER Art. 4, 11 (6)
5.2.3 Tasks of operators of transmission-connected systems in the event of a disturbance	SOGL Art. 102 (5) RfG Art. 40

Section of this document	Regulatory requirement
5.3 Measures for maintaining and restoring a normal grid state	StromVG Art. 20 Par. 2 lit. c SOGL Art. 23 ER Art. 11
5.3.1 Frequency-related measures	SOGL Art. 152 (11)-(12) ER Art. 15 (3), 16, 18, 22 DCC Art. 19
5.3.2 Voltage-related measures	SOGL Art. 22, 29 ER Art. 17, 22 DCC Art. 19
5.3.3 Measures designed to reduce congestions	StromVG Art. 17 (3) SOGL Art. 22, 53 ER Art. 19, 20, 35 CACM Art. 35 REMIT ordinance
5.3.4 Measures in the event of failure of IT systems of the national grid company	ER Art 35 (1) d REMIT ordinance
5.4 Grid restoration	ER Art. 23, 25 DCC Art. 19
5.5 Disturbance analysis	StromVG Art. 8 (3)
5.6 Instruction and Training for disturbed grid situations	SOGL Art. 58, 59
6.1 Scope of application	StromVG Art. 13 (1), RfG Art. 3, 4, 41 DCC Art. 3, 4 TP 39 «Dealing with ENTSO-E network codes in Switzerland»
6.3.1 Limitation and configuration of the connection	StromVV Art. 3 (1)
6.3.2 Technical requirements for systems connected to the TS	SOGL Art. 30
6.3.6 Grid perturbations and quality of supply	DCC Art. 20
6.3.7 Requirements for grid protection	SOGL Art. 36 DCC Art. 16
6.4 Conformity monitoring and conformity tests	SOGL Art. 54, 56, 57, 101 RfG Art. 33-37, 40, 42-44, 46, 49, 53, 56 DCC Art. 23-26, 35-47
6.5 Additional requirements for power plants	RfG Art. 16, 19, 22
6.5.1 (1) General – power classes of power plants	RfG Art. 5
6.5.1(4) General – Dynamic simulations	DCC Art. 21
6.5.2 Robustness against voltage and frequency fluctuations	SOGL Art. 27-29
6.5.3 Voltage limits for reactive power provision	SOGL Art. 27, 28
6.5.4 Electrical protection of power plants	SOGL Art. 36
6.5.6 steady-state stability	DCC Art. 17
6.6 Additional requirements for distribution grids	SOGL Art. 29 DCC Art. 12-15

Section of this document	Regulatory requirement
7 Grid development of the transmission system	StromVG Art. 9a, 9c, 9d, 22 Par. 2 to StromVV 5a, 5c, 6c

9.2. Overview of downstream electrical industry documents and contracts

The following overview of downstream electrical industry documents and contracts is for informational purposes only and should make it easier to find the relevant provisions. Changes to the documents and contracts mentioned here are subject to the terms and conditions of amendment and termination specified in them. All changes to the name of the electrical industry documents and contracts are tracked in the following list for informational purposes.

VSE electrical industry documents are published on the VSE website:
https://www.strom.ch/de/download

Electrical industry contracts are published on the website of the national grid company.
https://www.swissgrid.ch/en/home/customers/topics/legal-system.html

Table 3: Overview of downstream electrical industry document and industry contracts:

Section of this document	Downstream electrical industry document or contract
Foreword	
1.5 Observability Area	Implementation document: Definition and implementation of the observability area of the national grid company Data exchange agreements Operating agreements with DSOs/PPOs
2 Introduction to the operation of the transmission system	Operational handbook of the national grid company (additional document applicable to the operating agreements (not published))
2.1.1 Classification of grid states	Operational handbook of the national grid company (additional document applicable to the operating agreements (not published))
2.4 Switching actions	Operating agreement for substation connection
2.7.1 Duty of the national grid company and other players in Switzerland to provide information to each other	Operating agreement with DSOs for DSs connected directly to the TS Operating agreement with PPOs for power plants connected directly to the TS Operating agreement for substation connection
3 Energy exchange and capacity allocation	VSE basic document «Market model for electrical energy (MMEE)» VSE key document «Balancing concept Switzerland (BC)» Balance group contract Auction rules published on the website of JAO
4 Ancillary services	

Section of this document	Downstream electrical industry document or contract
4.2 (7) AS emergency procurement	Allocation procedure for insufficient supply quantity in procurement of AS control power
4.3 Requirements for the provision of primary, secondary and tertiary control	Frame agreements for PRL, SRL, TRL Tendering conditions Procedural rules for pre-qualification
4.4 Voltage maintenance	Voltage maintenance concept for the Swiss transmission system from 2020 onwards Operating agreement with DSOs for DSs connected directly to the TS Operating agreement with PPOs for power plants connected directly to the TS
4.5 Black-start and island operation capability	Tendering conditions and compensation model
5 Measures during operation of the transmission system and disturbance management	Operational handbook of the national grid company (additional document applicable to the operating agreements (not published))
5.2.3 (1) Tasks of operators of transmission-connected systems in the event of a disturbance	Operating agreement for substation connection
5.3.1 (4) + (10) Frequency-related measures	VSE document: Technical requirements for automatic frequency correction taking changed specifications into account
5.3.2 (4) Voltage-related measures	VSE electrical industry document: Manual load shedding
5.3.3 Measures designed to reduce congestions	Redispatching: Operating agreement with PPO for power plants connected directly to the TS (Annex 5) VSE electrical industry document: Manual load shedding
6 Connecting to the transmission system (6.1 (6)+(7))	Application for new physical connection to the TS Grid connection contract Application for modification or cancellation of an existing grid connection to the TS Operating agreement for substation connection Operating agreement with DSOs for DSs connected directly to the TS Operating agreement with PPOs for power plants connected directly to the TS Operational handbook of the national grid company (additional document applicable to the operating agreements (not published))
6.3.7 (6) Requirements for grid protection	VSE guide «Technical requirements for protection interfaces between transformers and the transmission system»
8.1 Further development	VSE document «Coordination process for electrical industry documents in the area of responsibility of the national grid company»