Godkännande av förslag till ändrade dimensioneringsregler för frekvenshållningsreserver

Beslut

1 Energimarknadsinspektionen (Ei) godkänner Affärsverket svenska kraftnäts (Svenska kraftnät) förslag till ändrade dimensioneringsregler för frekvenshållningsreserver. Dimensioneringsregler för frekvenshållningsreserver framgår efter dessa ändringar av bilaga 1.

2 Beslutet gäller under förutsättning att samtliga berörda tillsynsmyndigheter fattar ett beslut med samma innebörd inom den tidsfrist som anges i SO.

3 Detta beslut kan komma att ändras eller upphävas efter begäran av Europeiska kommissionen.

Beskrivning av ärendet

Bakgrund

I Europa pågår ett arbete med att koppla ihop EU:s energimarknader. Syftet är att upprätta en inre energimarknad som kan trygga energiförsörjningen, öka konkurrensen och ge konsumenter möjlighet att köpa energi till överkomliga priser. Europeiska kommissionen har som ett led i detta arbete bland annat antagit flera förordningar inom elmarknadsområdet.

I Kommissionens förordning (EU) 2017/1485 av den 2 augusti 2017 om fastställande av riktlinjer för driften av elöverföringssystem (SO) fastställs gemensamma krav och principer för driftsäkerheten i elöverföringssystem. Av SO framgår att Svenska kraftnät ska vara med och ta fram ett antal metoder och villkor vad gäller driften av elöverföringssystemet. Några av dessa metoder och villkor tas fram gemensamt av samtliga systemansvariga för överföringssystem inom EU medan andra tas fram av systemansvariga för överföringssystem (systemansvariga) inom synkronområdet för Norden. I synkronområdet Norden är

Svenska kraftnät, Energinet (Danmark), Fingrid Oyj (Finland) och Statnett SF (Norge) samt Kraftnät Åland AB (Åland) systemansvariga för överföringssystem (systemansvariga i Norden).

Systemansvariga inom ett synkronområde har enligt SO rätt att i driftavtal om synkronområden gemensamt ta fram förslag till dimensioneringsregler för frekvenshållningsreserver (FCR[1]). Förslaget ska godkännas av samtliga tillsynsmyndigheter inom regionen inom sex månader från det att de tagit emot förslaget eller från det att den sista berörda tillsynsmyndigheten gjort det.

Om tillsynsmyndigheterna begär en ändring för att kunna godkänna förslaget ska de besluta om de ändrade villkoren eller metoderna inom två månader från det att de lämnats in.

FCR är de aktiva reserver som finns tillgängliga för att upprätthålla systemfrekvensen efter att en obalans inträffat och består av FCR-N[2] och FCR-D[3].

Svenska kraftnät kom den 14 september 2018 in med ett förslag till dimensioneringsregler för FCR i enlighet med artikel 153 i SO. Ei beslutade att förslaget kunde godkännas den 7 mars 2019[4].

Det aktuella förslaget

Den 27 juni 2022 kom Svenska kraftnät in med ett förslag till ändrade dimensioneringsregler för FCR. Parallellt med detta förslag kom Svenska kraftnät in med en ansökan om godkännande av förslag till ändrad metod för ytterligare egenskaper hos frekvenshållningsreserver i enlighet med artikel 154.2 i SO[5]. I förslaget till ändrad metod för ytterligare egenskaper hos frekvenshållningsreserver införs två varianter av FCR-D: Dynamisk FCR-D respektive Statisk FCR-D. Förslaget till ändrade dimensioneringsregler för FCR innebär en komplettering av den nu gällande metoden med syfte att definiera den inbördes dimensioneringen mellan Dynamisk FCR-D respektive Statisk FCR-D.

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[1] Frequency Containment Reserves.

[2] Frekvenshållningsreserv FCR-N används i normaldrifttillstånd för att lindra kontinuerliga stokastiska obalanser inom synkronområdet i syfte att bibehålla frekvensen inom intervallet ±100mHz. Eftersom aktivering av FCR-N sker i enlighet med systemfrekvensen, sker utbyte av aktiveringsenergi för FCR-N på kontinuerlig basis.

[3] Frekvenshållningsreserv FCR-D är en störningsreserv som används vid andra drifttillstånd än normaldrifttillstånd. Aktivering är ett svar på en oförutsedd händelse (n-1) som ska beaktas vid beräkning av kapacitet mellan elområden redan innan säkerhetsmarginalen dras bort.

[4] Ei:s ärendenummer: 2018-102164.

[5] Ei:s ärendenummer: 2022–102495.

Ei har analyserat förslaget tillsammans med de övriga tillsynsmyndigheterna i synkronområdet Norden, Försyningstilsynet i Danmark, Energiavirasto i Finland och den norska tillsynsmyndigheten Norges vassdrags- og energidirektorat samt Ålands energimyndighet (tillsynsmyndigheterna).

Efter den gemensamma bedömningen, kom tillsynsmyndigheterna överens om att det aktuella förslaget behövde ändras för att respektive tillsynsmyndighet skulle kunna godkänna det.

Ei skickade därför, den 21 december 2022, en begäran till Svenska kraftnät om att ändra det aktuella förslaget. Svenska kraftnät kom in med ett reviderat förslag den 3 februari 2022.

Både det ursprungliga förslaget och det reviderade förslaget är gemensamt framtaget av de systemansvariga i Norden. Förslaget avser det nordiska synkronområdet (Sverige, Finland, Norge och östra Danmark (DK2)).

Samråd

Systemansvariga för överföringssystem ska i enlighet med artikel 11 i SO samråda med intressenter, inklusive de berörda myndigheterna i varje medlemsstat, om de utkast till förslag till villkor eller metoder som beskrivs i artikel 6.3. Samrådet ska vara i minst en månad. De synpunkter som kommer fram under samrådet ska tas i beaktan när metoden färdigställs.

Svenska kraftnät har uppgett att de under perioden den 6 maj – den 6 juni 2022 har genomfört ett samråd om förslaget. Svenska kraftnät har i förslaget som lämnats till Ei bifogat ett förklarande dokument som beskriver hur de, tillsammans med de andra systemansvariga i synkronområdet Norden har beaktat synpunkterna.

Samordning under ärendets handläggning

Ei har berett ärendet tillsammans med de övriga tillsynsmyndigheterna.

Den 9 mars 2023 kom tillsynsmyndigheterna överens om att det reviderade förslaget till ändrade dimensioneringsregler för FCR bör godkännas.

Bestämmelser som ligger till grund för beslutet

Förordning SO

Syftet med förordningen är att … c) fastställa gemensamma processer och strukturer för lastfrekvensreglering, d) säkerställa förutsättningarna för bibehållen driftsäkerhet i hela unionen, e) säkerställa förutsättningarna för bibehållen kvalitetsnivå för frekvenser i alla synkronområden i hela unionen, … h) bidra till en effektiv drift och utveckling av elöverföringssystemet och elsektorn i unionen (artikel 4.1).

Systemansvariga för överföringssystem ska utarbeta de villkor eller metoder som krävs enligt denna förordning och överlämna dem till de behöriga tillsynsmyndigheterna för godkännande i enlighet med artikel 6.2 och 6.3 eller till den enhet som utses av medlemsstaten för godkännande i enlighet med artikel 6.4 inom de respektive tidsfrister som anges i denna förordning (artikel 5.1).

Förslag till följande villkor eller metoder, och eventuella ändringar av dessa, ska vara föremål för godkännande av alla tillsynsmyndigheter i den berörda regionen, vilket en medlemsstat har möjlighet att yttra sig över till den berörda tillsynsmyndigheten: d) Metoder, villkor och värden som anges i de driftavtal om synkronområden som avses i artikel 118, när det gäller följande: ii) Dimensioneringsregler för frekvenshållningsreserver, i enlighet med artikel 153 (artikel 6.3.d.ii)

Förslaget till metoder ska innehålla ett förslag till tidplan för genomförande och en beskrivning av metodens förväntade inverkan på målen för förordningen (artikel 6.6).

Om godkännandet av metod kräver ett beslut av mer än en tillsynsmyndighet ska de behöriga tillsynsmyndigheterna samråda och samordna med varandra för att nå en överenskommelse. Tillsynsmyndigheterna ska fatta beslut om de inlämnade villkoren eller metoderna i enlighet med punkterna 2 och 3 (däribland metoder för att bygga de gemensamma nätmodellerna) inom sex månader från det att tillsynsmyndigheten tagit emot metoden eller ifrån det att den sista berörda tillsynsmyndigheten tagit emot metoden (artikel 6.7).

Om byrån eller samtliga behöriga tillsynsmyndigheter gemensamt begär en ändring för att godkänna de villkor eller metoder som lämnats in i enlighet med artikel 6.2 respektive 6.3, ska de berörda systemansvariga för överföringssystemen inom två månader från byråns eller tillsynsmyndigheternas begäran lämna in ett förslag till ändrade villkor eller metoder för godkännande. Byrån eller de behöriga tillsynsmyndigheterna ska besluta om de ändrade villkoren eller metoderna inom två månader från det att de lämnats in (artikel 7.1)

De systemansvariga för överföringssystemen med ansvar för att lämna in förslag till metod i enlighet med förordningen, ska samråda med intressenter, inklusive de berörda myndigheterna i varje medlemsstat, om de utkast till förslag till metod som förtecknas i artikel 6.2 och 6.3. Samrådet ska vara i minst en månad (artikel 11.1).

De förslag till metod som lämnats in av de systemansvariga för överföringssystemen på regional nivå ska offentliggöras och lämnas in för offentligt samråd på regional nivå (artikel 11.2).

De systemansvariga för överföringssystemen med ansvar för att ta fram förslag till metod ska beakta de synpunkter från intressenter som framkommit vid samråden innan förslaget lämnas in för formellt godkännande. I samtliga fall ska en välgrundad motivering för eller emot införande av synpunkterna från samrådet tillhandahållas, tillsammans med det förslag som lämnas in, och offentliggöras i god tid före, eller samtidigt med, offentliggörandet av förslaget till villkor eller metoder (artikel 11.3).

Senast tolv månader efter denna förordnings ikraftträdande ska alla systemansvariga för överföringssystem i varje synkronområde tillsammans utarbeta ett förslag till dimensioneringsregler för frekvenshållningsreserver i enlighet med artikel 153 (artikel 118.1.a).

Alla systemansvariga för överföringssystem i varje synkronområde ska åtminstone en gång per år bestämma den reservkapacitet i form av frekvenshållningsreserver som krävs för synkronområdet och varje systemansvarigs skyldighet att tillhandahålla initiala frekvenshållningsreserver i enlighet med punkt 2 (artikel 153.1).

Alla systemansvariga för överföringssystem i varje synkronområde ska i driftavtalet om synkronområdet ange dimensioneringsregler i enlighet med följande kriterier:

a) Den reservkapacitet i form av frekvenshållningsreserver som krävs för synkron-området ska klara åtminstone referensincidenten och, för synkronområdet Norden, resultaten av den sannolikhetsbaserade dimensioneringen av frekvenshållningsreserver, utförd i enlighet med led c.

b) Referensincidentens storlek ska bestämmas i enlighet med följande villkor: … ii) För synkronområdet Norden ska referensincidenten vara den största obalans som kan bli följden av en momentan ändring av aktiv effekt, från t.ex. en enstaka kraftproduktions-modul, enstaka förbrukningsanläggning eller enstaka sammanlänkning för högspänd likström eller av en utlöst växelströmsledning, eller ska vara den maximala momentana förlusten av förbrukning av aktiv effekt till följd av en eller två utlösta anslutnings-punkter. Referensincidenten ska bestämmas separat för positiv och negativ riktning.

c) För synkronområdet Norden ska alla systemansvariga för överföringssystem i synkronområdet ha rätt att fastställa en sannolikhetsbaserad dimensionering av frekvenshållningsreserver, med hänsyn tagen till mönster för last, produktion och tröghet, inklusive syntetisk tröghet, samt tillgängliga medel för att sätta in minsta tröghet i realtid, i enlighet med den metod som avses i artikel 39, med syfte att minska sannolikheten för otillräckliga frekvenshållningsreserver till mindre än eller lika med en gång på 20 år.

d) Den andel reservkapacitet i form av frekvenshållningsreserv som krävs för varje systemansvarig för överföringssystem som skyldighet att tillhandahålla initial frekvenshållningsreserv ska baseras på summan av nettoproduktion och förbrukning i det egna kontrollområdet, dividerat med summan av synkronområdets nettoproduktion och förbrukning under en period av ett år (artikel 153.2).

Ellagen (1997:857)

I ett beslut av nätmyndigheten enligt sådana riktlinjer som har antagits med stöd av förordning (EG) nr 714/2009 ska det anges att beslutet kan komma att ändras eller upphävas efter begäran av Europeiska kommissionen (12 kap. 1 b §).

Ei:s motivering till beslutet

Formella förutsättningar för att kunna godkänna ansökan

Ei har samordnat detta beslut med övriga berörda tillsynsmyndigheter. Svenska kraftnät har genomfört samråd om förslaget. De formella förutsättningarna i SO för förslagets beredning är därmed uppfyllda.

Provning i sak

Svenska kraftnäts förslag till ändrade dimensioneringsregler för FCR innebär en komplettering av den nu gällande metoden i syfte att definiera den inbördes dimensioneringen mellan Dynamisk FCR-D och Statisk FCR-D. Dynamisk FCR-D och Statisk FCR-D är två varianter av FCR-D som införs i ett nytt förslag till ändrad metod för ytterligare egenskaper hos frekvenshållningsreserver i enlighet med artikel 154.2 i SO.

Ei bedömer att förslaget till ändrade dimensioneringsregler för FCR är tillräckligt väl beskrivet och väl avvägt. Förslaget till ändrade dimensioneringsregler beskriver hur dimensioneringen går till enligt det som SO kräver. Förslaget innehåller en rimlig tidsplan för genomförandet. Svenska kraftnäts förslag till dimensioneringsregler bedöms uppfylla de övergripande målen som anges i SO. Sammantaget anser Ei att förslaget kan godkännas.

Beslutet i detta ärende förutsätter för sin giltighet att samtliga berörda tillsynsmyndigheter inom regionen fattar ett beslut med samma innebörd.

De gemensamma bestämmelserna kommer att börja tillämpas först när samtliga berörda tillsynsmyndigheter har beslutat att godkänna bestämmelserna. När bestämmelserna har beslutats av tillsynsmyndigheterna ska Svenska kraftnät offentliggöra de godkända bestämmelserna enligt artikel 8.1 i SO.

Ei:s beslut kan komma att ändras eller upphävas efter begäran av Europeiska kommissionen.

Fortsatt hantering

Ei tillsammans med de övriga tillsynsmyndigheterna i Norden bedömer att det kommer att finnas ett behov av att ytterligare klargöra hur systemansvariga i Norden beräknar andelen Dynamisk FCR-D samt vilken typ av dynamiska egenskaper denna andel kommer att bero på. Samtidigt konstaterar tillsynsmyndigheterna att systemansvariga inte har den information som krävs för att tillhandahålla dessa detaljer. De tillsynsmyndigheterna begär därför att systemansvariga tar fram ett nytt förslag så snart modellen för beräkning av Dynamisk FCR-D har utvecklats.

Detta beslut har fattats av avdelningschefen Carl Johan Wallnerström. Föredragande var analytikern Reza Baradar.

Beslutet har fattats digitalt och saknar därför underskrifter.

Carl Johan Wallnerström

Reza Baradar

Bilagor

1- Ansökan - Amended Nordic synchronous area methodology for the dimensioning rules for FCR in accordance with Article 153 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

2- Så här gör du för att överklaga beslutet.

Skickas till

Affärsverket svenska kraftnät (delges)

Byrån för samarbete mellan energitillsynsmyndigheter, ACER (för kännedom)

Amended Nordic synchronous area methodology for the dimensioning rules for FCR in accordance with Article 153 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

3 Feb 2023

All TSOs of the Nordic synchronous area, taking into account the following:

Whereas

(1) This document is the common methodology developed by all Transmission System Operators within the Nordic synchronous area (hereafter referred to as "**TSOs**") for the dimensioning rules for FCR in accordance with Article 153 of Commission Regulation (EU) 2017/1485 establishing a guideline on electricity transmission system operation (hereafter referred to as "**SO Regulation**"). This methodology is hereafter referred to as "**Methodology**". The Methodology is an amended version of the methodology dated 10 September 2018 that was approved by the Nordic regulators in March 2019.

(2) This Methodology is subject to approval in accordance with Article 6(3) of the SO Regulation.

(3) The Methodology takes into account the general principles and goals set in SO Regulation as well as Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (hereafter referred to as "Regulation (EU) No 2019/943"). The goal of the SO Regulation and Regulation (EU) No 2019/943 is the safeguarding of operational security, frequency quality and the efficient use of the interconnected system and resources. Article 118(1)(a) of the SO Regulation sets for this purpose requirements for the TSOs to "*jointly develop common proposals for: […] the dimensioning rules for FCR in accordance with Article 153;"*

(4) Article 153(2) of the SO Regulation describes the scope of this Methodology:
"2. All TSOs of each synchronous area shall specify dimensioning rules in the synchronous area operational agreement [..]". Article 153(1) of the SO Regulation stipulates how these dimensioning rules shall be applied: *"1. All TSOs of each synchronous area shall determine, at least annually, the reserve capacity for FCR required for the synchronous area and the initial FCR obligation of each TSO in accordance with paragraph 2".*

(5) Article 153(2) of the SO Regulation further states that the "*dimensioning rules"* shall be specified "*in accordance with the following criteria:*
(a) the reserve capacity for FCR required for the synchronous area shall cover at least the reference incident and [..] the results of the probabilistic dimensioning approach for FCR carried out pursuant to point (c);
(b) the size of the reference incident shall be determined in accordance with the following conditions:
[..]
(ii) [..] the reference incident shall be the largest imbalance that may result from an instantaneous change of active power such as that of a single power generating module, single demand facility, or single HVDC interconnector or from a tripping of an AC line, or it shall be the maximum instantaneous loss of active power consumption due to the tripping of one or two connection points. The reference incident shall be determined separately for positive and negative direction;
(c) for the CE and Nordic synchronous areas, all TSOs of the synchronous area shall have the right to define a probabilistic dimensioning approach for FCR taking into account the pattern of load, generation and inertia, including synthetic inertia as well as the available means to deploy minimum inertia in real-time in accordance with the methodology referred to in Article 39, with the aim of reducing the probability of insufficient FCR to below or equal to once in 20 years; and

(d) the shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of 1 year.

(6) The TSOs concluded that *"the maximum instantaneous loss of active power consumption due to the tripping of [..] two connection points"* that is suggested in Article 153(2)(b)(ii) of the SO Regulation shall not set the 'reference incident' for the Nordic synchronous area. The reason for this is that the TSOs do not consider the probability for two simultaneous outages of demand facilities significant.

(7) In addition to the types of *'instantaneous change of active power'* that may set the reference incident as suggested by Article 153(2)(b)(ii) of the SO Regulation, the TSOs consider that tripping of one busbar may be evaluated as a reasonable N-1 disturbance. This may be relevant during especially longer outages on a busbar.

(8) The Nordic Frequency Containment Process (FCP) applies two types of Frequency Containment Reserves (FCR). FCR for normal operation (FCR-N) is used for continuous imbalances to keep the frequency within the ± 100mHz range. For this reason, the purpose of FCR-N is not to mitigate the consequences of a disturbance such as a reference incident. The purpose of FCR-D is to mitigate the impact of incidental disturbances, including the reference incident. The criteria that are specified in Article 153(2)(a)-(c) of the SO Regulation refer to (reference) incidents and can therefore only be applied to FCR-D. With respect to the dimensioning rules for FCR, the scope of this Methodology shall therefore be limited to the dimensioning rules for FCR-D.

(9) Article 153(2)(d) of the SO Regulation about the initial distribution of FCR does not make an explicit differentiation between FCR-N and FCR-D. However, in contradiction to Article 153(2)(a)-(c), Article 153(2)(d) can be applied to both FCR-N and FCR-D. The TSOs therefore consider Article 153(2)(d) of the SO Regulation applicable to both FCR-N and FCR-D.

(10) The Nordic Methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation in general requires that the response from FCR-N and/or FCR-D providing units and groups shall be dynamic and continuously follow the changes in the system frequency. The Methodology for additional properties of FCR however allow for a limited amount of FCR-D with only a static response. This Methodology contains additional rules for the minimum dimensioning of Dynamic FCR-D.

(11) The TSOs have discussed a probabilistic methodology that can be used for a probabilistic dimensioning approach for FCR-D as mentioned in Article 153(2) of the SO Regulation. The TSOs decided on not using this methodology at the moment because the process for how to translate a certain risk level, inertia level and actual probability for incidents and other inputs to suitable measures, including FCR-D dimensioning needs to be further defined. For this reason, the TSOs do not use *"the right to define a probabilistic dimensioning approach for FCR"* in accordance with Article 153(2)(c) of the SO Regulation.

(12) In regard to regulatory approval, Article 6(3) of the SO Regulation states:
"The proposals for the following terms and conditions or methodologies shall be subject to approval by all regulatory authorities of the concerned region, on which a Member State may provide an opinion to the concerned regulatory authority: […]

(d) methodologies, conditions and values included in the synchronous area operational agreements in Article 118 concerning:
(ii) the dimensioning rules for FCR in accordance with Article 153;

(13) According to Article 6(6) of the SO Regulation the expected impact of the Methodology on the objectives of the SO Regulation has to be described and is presented below.

(14) The Methodology generally contributes to and does not in any way hamper the achievement of the objectives of Article 4 of the SO Regulation. In particular, the Methodology serves the objectives to (1)(c) determining common load-frequency control processes and control structures, (1)(d) ensuring the conditions for maintaining operational security throughout the Union, (1)(e) ensuring the conditions for maintaining a frequency quality level of all synchronous areas throughout the Union and (1)(h) contributing to the efficient operation and development of the electricity transmission system and electricity sector in the Union. The Methodology contributes to these objectives by specifying the dimensioning rules for FCR-D, which is one of the key reserves that is used in the common Nordic load-frequency control processes. Sufficient FCR-D guarantees the operational security by reducing the risk for automatic Low Frequency Demand Disconnection (LFDD), automatic reduction of generation and for system blackouts due to under or over frequency. The dimensioning rules balance the impact of both cost for FCR-D and outage risk and therefore ensure efficient operation of the electricity transmission system.

(15) The TSOs together operate the Nordic synchronous system. Consequently, the TSOs and all the power consumers, generators, balance service providers and networks directly or indirectly connected to the TSOs' networks, influence the frequency quality level and experience the same frequency level. The dimensioning of FCR-D in this Methodology has been analysed, discussed and agreed by the TSOs and will only be effective if all providers of FCR-D will provide the contracted amounts in accordance with their specifications.

(16) In conclusion, the Methodology contributes to the general objectives of the SO Regulation to the benefit of all market participants and electricity end consumers.

SUBMIT THE FOLLOWING AMENDED METHODOLOGY FOR THE DIMENSIONING RULES FOR FCR TO ALL REGULATORY AUTHORITIES OF THE NORDIC SYNCHRONOUS AREA:

Article 1 - Subject matter and scope

1. The dimensioning rules for FCR described in this Methodology are the common methodology of TSOs in accordance with article 153 of the SO Regulation. The Methodology applies solely to the Nordic synchronous area.

   The Nordic synchronous area covers transmission systems of East-Denmark (DK2), Finland, Sweden and Norway.

   This Methodology has been developed by Energinet, Fingrid Oyj, Kraftnät Åland AB, Svenska kraftnät and Statnett SF.

2. The Methodology covers the dimensioning of FCR for the Nordic synchronous area (only) and shall be applied by the Nordic TSOs (only).

Article 2 - Definitions and interpretation

1. For the purposes of the Methodology, the terms used shall have the meaning of the definitions included in Article 3 of the SO Regulation.

2. For the purposes of this Methodology, the definitions in the methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation shall apply, regarding FCR-N, and static and dynamic FCR-D.

3. In this Methodology, unless the context requires otherwise:
   a. the singular indicates the plural and vice versa;
   b. the headings are inserted for convenience only and do not affect the interpretation of the Methodology; and
   c. any reference to legislation, regulations, directives, orders, instruments, codes or any other enactment shall include any modification, extension or re-enactment of it when in force.

Article 3 – Dimensioning rules for FCR-D

1. Following the dimensioning rules in this article, the Nordic TSOs will dimension FCR-D daily, separately for FCR-D upwards and FCR-D downwards.

2. The input to the dimensioning process of FCR-D shall be:
   a. Planned network topology, considering maintenance of relevant network components;
   b. Estimated (gross) generation of large generation modules;
   c. Estimated demand of large connected consumers;
   d. Estimated flows on HVDC interconnectors;

3. The total reserve capacity for FCR-D upwards required for the Nordic synchronous area shall be dimensioned to be at least equal to the imbalance caused by the reference incident in the negative direction. Dynamic FCR-D upwards shall make up at least a certain share of the system level FCR-D upwards response. The share shall be determined based on the dynamic properties of the power system, mainly system inertia. The share shall be reviewed at least annually.

4. The total reserve capacity for FCR-D downwards required for the Nordic synchronous area shall be dimensioned to be at least equal to the imbalance caused by the reference incident in the positive direction. Dynamic FCR-D downwards shall make up at least a certain share of the system level FCR-D downwards response. The share shall be determined based on the dynamic properties of the power system, mainly the system inertia. The share shall be reviewed at least annually.

5. The reference incident shall be defined as the largest imbalance that may result from an instantaneous change of active power of:
   a. *A single power generating module;*
   b. *A single demand facility;*
   c. *A single HVDC interconnector;*
   d. *Tripping of an AC-line:* This may result in i) system protection scheme (SPS) activation which may trip one or more power generating units or ii) loss of a regional part of the system.
   e. *A single failure on a busbar tripping more than one generation module or demand facility.*

6. The imbalance volume of the 'instantaneous change of active power' mentioned in item 5 of this article shall be determined by the net loss of active power as seen from the grid. I.e., it should be taken into account that auxiliary load of the generation module may still consume power in the case that the unit generator breaker is tripped. Furthermore, the imbalance volume of the reference incident is determined by the maximum production, import, consumption or export that has been scheduled for the period for which the reference incident is determined.

Article 4 – Calculation of the initial distribution per TSO

1. In accordance with article 153(2)(d) of the SO Regulation, FCR-D and FCR-N shall be distributed to the TSOs pro-rata to the shares defined below.
2. The inputs to the calculation of the initial distribution are:
   a. net generation per control area for calendar year *y-2* in which the net generation of a unit is defined as the gross power generation minus the internal auxiliary power consumption of the unit;
   b. net consumption per control area for calendar year *y-2* in which 'net' means that the consumption of power plants' auxiliaries is excluded, but network losses are included.
3. The shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of one year.
4. The shares shall be revised each year before 1 October of year *y-1* and the new shares will enter into force on 1 January of year *y*.

Article 5 – Publication and implementation

1. The relevant TSOs shall publish (in accordance with Article 8 of the SO Regulation) the Methodology without undue delay after the competent NRAs have approved the Methodology or a decision has been taken by the Agency for the Cooperation of Energy Regulators in accordance with Article 6 of the SO Regulation.

2. The TSOs have already implemented the dimensioning rules for FCR-D (article 3 of this Methodology) and the rules for the initial distribution of FCR (article 4 of this Methodology), apart from the requirements on Dynamic FCR-D volumes in article 3. The dimensioning rules of Dynamic FCR-D shall be implemented no later than 2.5 years after the approval of this Methodology.

Article 6 - Language

The reference language for this Methodology shall be English. For the avoidance of doubt, where the TSOs needs to translate this Methodology into national language(s), in the event of inconsistencies between the English version published by TSOs in Nordic Synchronous Area in accordance with Article 8(1) of the SO Regulation and any version in another language the relevant TSOs shall, in accordance with national legislation, provide the relevant national regulatory authority with an updated translation of the Methodology.

Explanatory document for the amended Nordic synchronous area methodology for the dimensioning rules for FCR in accordance with Article 153 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

3 Feb 2023

1. Introduction

The Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (hereinafter **"SO Regulation"**) sets out rules on relevant subjects that should be coordinated between Transmission System Operators, as well as between TSOs and Distribution System Operators and with significant grid users, where applicable. The goal of SO Regulation is to ensure provision of an efficient functioning of the interconnected transmission systems to support all market activities. In order to deliver these objectives, a number of steps are required.

One of these steps is to determine a methodology for dimensioning Frequency Containment Reserves (FCR) for the Nordic synchronous area. Pursuant to Article 118(1)(a) of the SO Regulation, all Transmission System Operators in the Nordic Synchronous Area shall jointly develop common proposals for dimensioning rules for FCR in accordance with Article 153 of the SO Regulation.

According to Article 6(3)(d)(ii) of the SO Regulation the proposal for the dimensioning rules for FCR in accordance with Article 153 shall be submitted to the relevant national regulatory authorities (hereinafter "NRAs") for approval no later than 14 September, 2018. The initial proposal was submitted for regulatory approval to all NRAs in the Nordic synchronous area by 14 September 2018. According to Article 6(6) of the SO Regulation the Proposal needs to be submitted to ACER as well, who may issue an opinion on the Proposal if requested by the NRAs. In March 2019, the Nordic NRAs approved the proposal.

This amended methodology (hereafter referred to as "**Methodology**") adds additional requirements concerning dimensioning of Dynamic FCR-D as defined in the Nordic methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation.

This document contains an explanation of the Methodology from all TSOs of the Nordic synchronous area (hereinafter **"TSOs"**). It is structured as follows. The legal requirements for the Methodology are presented in Chapter 2. Chapter 3 explains the objective of FCR. Chapter 4 provides an overview of the existing situation. The proposed amendments are explained in Chapter 5. The proposed dimensioning rules for FCR are described in Chapter 6. Chapter 7 describes the expected impact on the relevant objectives of the SO Regulation. Finally, Chapter 8 provides the timeline for implementation and Chapter 9 describes the public consultation.

2. Legal requirements and interpretation

2.1 Legal references and requirements

Several articles in the SO Regulation set out requirements which the Methodology must take into account. These are cited below.

(1) Article 118(1)(c) and (2) of the SO Regulation constitutes the legal basis that the Methodology should take into account. Article 118 has the following content:

> *"1. By 12 months after entry into force of this Regulation, all TSOs of each synchronous area shall jointly develop common proposals for:[…]*
>
> *(a) the dimensioning rules for FCR in accordance with Article 153; […]*
>
> *2. All TSOs of each synchronous area shall submit the methodologies and conditions listed in Article 6(3)(d) for approval by all the regulatory authorities of the concerned synchronous area. Within 1 month after the approval of these methodologies and conditions, all TSOs of each synchronous area shall conclude a synchronous area operational agreement which shall enter into force within 3 months after the approval of the methodologies and conditions."*

(2) Article 153 of the SO Regulation has the following content:

"Article 153 FCR dimensioning

1. All TSOs of each synchronous area shall determine, at least annually, the reserve capacity for FCR required for the synchronous area and the initial FCR obligation of each TSO in accordance with paragraph 2.

2. All TSOs of each synchronous area shall specify dimensioning rules in the synchronous area operational agreement in accordance with the following criteria:

(a) the reserve capacity for FCR required for the synchronous area shall cover at least the reference incident and, for the CE and Nordic synchronous areas, the results of the probabilistic dimensioning approach for FCR carried out pursuant to point (c);

(b) the size of the reference incident shall be determined in accordance with the following conditions:

(i) for the CE synchronous area, the reference incident shall be 3 000 MW in positive direction and 3 000 MW in negative direction;

(ii) for the GB, IE/NI, and Nordic synchronous areas, the reference incident shall be the largest imbalance that may result from an instantaneous change of active power such as that of a single power generating module, single demand facility, or single HVDC interconnector or from a tripping of an AC line, or it shall be the maximum instantaneous loss of active power consumption due to the tripping of one or two connection points. The reference incident shall be determined separately for positive and negative direction;

(c) for the CE and Nordic synchronous areas, all TSOs of the synchronous area shall have the right to define a probabilistic dimensioning approach for FCR taking into account the pattern of load, generation and inertia, including synthetic inertia as well as the available means to deploy minimum inertia in real-time in accordance with the methodology referred to in Article 39, with the aim of reducing the probability of insufficient FCR to below or equal to once in 20 years; and

(d) the shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of 1 year."

(3) Article 3(2)(58) of the SO Regulation defines the 'reference incident' as the *'maximum positive or negative power deviation occurring instantaneously between generation and demand in a synchronous area, considered in the FCR dimensioning'.*

(4) Article 39(3)(b) of the SO Regulation explains *"The methodology referred to in Article 39 "* (as referred to in Article 153(c)):

"Article 39 Dynamic stability management

[..]

3. In relation to the requirements on minimum inertia which are relevant for frequency stability at the synchronous area level:

(a) all TSOs of that synchronous area shall conduct, not later than 2 years after entry into force of this Regulation, a common study per synchronous area to identify whether the minimum required inertia needs to be established, taking into account the costs and benefits as well as potential alternatives. All TSOs shall notify their studies to their regulatory authorities. All TSOs shall conduct a periodic review and shall update those studies every 2 years;

(b) where the studies referred to in point (a) demonstrate the need to define minimum required inertia, all TSOs from the concerned synchronous area shall jointly develop a methodology for the definition of minimum inertia required to maintain operational security and to prevent violation of stability limits. That methodology shall respect the principles of efficiency and proportionality, be developed within 6 months after the completion of the studies referred to in point (a) and shall be updated within 6 months after the studies are updated and become available; and

(c) each TSO shall deploy in real-time operation the minimum inertia in its own control area, according to the methodology defined and the results obtained in accordance with paragraph (b).

(5) Article 6(3)(d)(ii) of the SO Regulation states:

"The proposals for the following terms and conditions or methodologies shall be subject to approval by all regulatory authorities of the concerned region, on which a Member State may provide an opinion to the concerned regulatory authority: […]
(d) methodologies, conditions and values included in the synchronous area operational agreements in Article 118 concerning:
(ii) the dimensioning rules for FCR in accordance with Article 153;

2.2 Interpretation and scope of the Methodology

Article 153(2) of the SO Regulation includes two topics. Firstly, Article 153(2)(a)-(c) stipulates the dimensioning rules for FCR. Secondly, Article 153(2)(d) prescribes how the initial FCR obligation per TSO shall be calculated.

Where Article 153(2) only describes one type of FCR, the Nordic Frequency Containment Process (FCP) applies two types of FCR: FCR for normal operation (FCR-N) is used for continuous imbalances to keep the frequency within the ±100mHz range. For this reason, the purpose of FCR-N is not to mitigate the consequences of a disturbance such as a reference incident. The purpose of Frequency Containment Reserves for Disturbance situations (FCR-D) is to mitigate the impact of incidental disturbances, including the reference incident. Article 153(2)(b)(ii) of the SO Regulation refers to the *"reference incident"* which *"shall be the largest imbalance that may result from an instantaneous change of active power such as that of a single power generating module, single demand facility, or single HVDC interconnector [..].".* This list clearly refers to incidents and therefore Article 153(2)(a)-(c) can only be applied to FCR-D. The scope of this Methodology with respect to Article 153(2)(a)-(c) shall therefore be limited to the dimensioning rules for FCR-D.

Article 153(2)(d) of the SO Regulation is about the initial FCR obligation per TSO. Also in this article there is no explicit differentiation between FCR-N and FCR-D. However, in the rules in Article 153(2)(d) can be applied to both FCR-N and FCR-D. For this reason, the TSOs consider Article 153(2)(d) of the SO Regulation applicable to both FCR-N and FCR-D.

The Nordic methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation in general requires that the response from FCR-N and/or FCR-D providing units and groups shall be dynamic and continuously follow changes in the system frequency. The methodology for additional properties of FCR, however, allow for a limited amount of FCR-D with only a static response. This Methodology contains additional rules for the minimum dimensioning of Dynamic FCR-D.

The scope of this Methodology only includes the dimensioning rules for FCR-D on a Nordic level and the calculation of the initial distribution per TSO. It does not specify how each TSO shall fulfil its share. Procurement and settlement of FCR are not in the scope of the SO Regulation and this Methodology, but inside the scope of the 'Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing'.

3. Objective of FCR dimensioning

The objective of the Frequency Containment Process (FCP) is to stop the frequency increase or decrease before the instantaneous frequency deviation reaches the maximum instantaneous frequency deviation and consequently to stabilise the frequency deviation at a steady-state value not more than the permissible Maximum Steady-State Frequency Deviation[1]. The objective shall be met by a joint action of FCR within the whole synchronous area.

The objective of FCR-D dimensioning is to specify - for the situation that a reference incident takes place - the amount of FCR-D that is required to:

- limit the instantaneous frequency deviation to less than the maximum instantaneous frequency deviation (1000 mHz in accordance with Aricle 127 of the SO Regulation) and accordingly prevent for load shedding or generation shedding;
- limit the steady-state frequency deviation to less than the maximum steady-state frequency deviation (500 mHz in accordance with Aricle 127 of the SO Regulation).

Furthermore, the dimensioning of Dynamic FCR-D defines the required share of the system level FCR-D response that shall have the cabability to follow variations in the system frequency by activation and deactivation and have a dynamic response that provides continuous frequency control when the frequency is below/above the standard frequency range.

4. The existing situation

In this chapter, the current procedure for the dimensioning of FCR is presented, together with the procedures for how the 'reference incidents' are being defined. Since the Nordic TSOs define two types of FCR, section 4.1 addresses FCR-N and section 4.2 addresses FCR-D.

4.1 Frequency Containment Reserves for Normal operation (FCR-N)

At the moment the volume for FCR-N is at least 600 MW for the synchronous system[2]. The distribution between subsystems is revised each year before 1st of October on the basis of annual consumption in the previous year). The share of each subsystem is rounded to closest integer given in MW and this will enter into force on 1st of January.

4.2 Frequency Containment Reserves for Disturbance situations (FCR-D)

At the moment the required FCR-D capacity is equal to the largest possible imbalance caused by the loss of individual major components (production units, lines, transformers, bus bars etc.) from all fault events that have been taken into account.

In accordance with the methodology approved by the NRAs in March 2019 the TSOs have started to implement the new ancillary service FCR-D downwards. The dimensioning rules of that methodology has been implemented in the Nordic SOA. The TSOs have started to procure some amount of FCR-D downwards on a market basis, and will increase the procured amount from the market as the prequalified volumes increase.

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[1] A more detailed explanation of what happens in case of an incident is included in textbox 1 of the 'Explanatory document for the Nordic synchronous area proposal for frequency quality defining parameters and the frequency quality target parameter in accordance with Article 127 of the Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation.'

[2] The value of ± 600MW is based on historic assumptions of a load random variation of ± 1% of 60GW.

The current dimensioning rules do not explicitly consider the additional network losses that may result from changing flows after a disturbance. E.g. if a nuclear plant in Sweden trips, the flows from both northern Sweden and Norway may increase which may increase the network losses which would result in a larger imbalance on a synchronous area level.

5. Proposed amendments

This section describes the proposed amendments to the methodology of 14 September 2018 that has been approved by the NRAs as of 14 March 2019.

5.1 Dimensioning of Dynamic FCR-D

The Nordic methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation in general requires that the response from FCR-N and/or FCR-D providing units and groups shall be dynamic and continuously follow the changes in the system frequency. The reasons for this include:

1. In case of a sudden, large imbalance caused by e.g. the reference incident FCR-D (upwards or downwards respectively) needs to contain the instantaneous frequency deviation within ±1000 mHz. The FCR-D response then needs to be close to fully activated within an order of seconds, in the Nordic methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation determined to be within 7.5 seconds of the incident. If the imbalance remains for some time, the FCR-D response will gradually be replaced by aFRR and mFRR, with activation times in the range of 5-15 minutes. The FCR-D response thus has to be able to dynamically deactivate proportionally to the frequency deviation within that timescale.
2. In case of an imbalance larger than 600 MW and faster than aFRR can handle, FCR-N will become saturated. In this case FCR-D will assume the responsibilities of FCR-N, i.e. to stabilize the frequency in case of stochastic imbalances. Thus, FCR-D needs to have at least the same dynamic performance, including both activation and deactivation, as FCR-N. A certain share of the FCR-D response hence needs to have the same abilities as FCR-N.
3. In case of a large incident, the system frequency will oscillate before finding an equilibrium. The FCR-D response needs to have sufficient performance and stability to both avoid causing too much oscillations as well as damp them when they occur. This requires both dynamic activation and deactivation capabilities.
4. In case of a sudden imbalance significantly smaller than the reference incident at low inertia situations, the combined response of the reserves may overreact heavily. This happens because the frequency changes so fast that more reserves than necessary are activated. The following overshoot in system frequency has to be mitigated by the dynamic response of FCR-D. This creates a strong need for a good dynamic deactivation capability of FCR-D, from a significant share of the FCR-D providing units and groups.

The TSOs do, however, not foresee that all of the dimensioned volume of FCR-D at all times needs to have dynamic properties to handle the situations stated above. The methodology for additional properties of FCR thus allows for a limited amount of FCR-D with only a static response, which enables participation from such units and groups. The exact share that has to be of the dynamic variant can be expected to be changing over time, as a main factor is expected to be the inertia levels in the synchronous area, which have seen a downwards trend as the amount of inverter-connected production increases. The TSOs hence suggest that the necessary share of Dynamic FCR-D shall be updated at least annually (in accordance with Article 153(1) of the SO Regulation) and be based on the dynamic properties of the power system, mainly system inertia, to follow this trend. The TSOs already follow this trend in accordance with article 39(3) of the SO regulation.

6. Methodology for dimensioning rules for FCR-D

Article 153(2)(a) of the SO Regulation states that *"the reserve capacity for FCR required for the synchronous area shall cover at least the reference incident and [..] the results of the probabilistic dimensioning approach for FCR carried out pursuant to point (c);"*. Section 6.1 explains how the required FCR-D will be dimensioned in order to cover the reference incident. Section 6.2 defines the reference incident. The TSOs will not apply *"a probabilistic dimensioning approach for FCR"*, which is explained in section 6.3.

6.1 FCR-D dimensioning based on reference incident (Article 153(2)(a))

In accordance with Article 153(2)(b)(ii) of the SO Regulation, "*the reference incident shall be determined separately for positive direction negative direction"*. The Nordic TSOs define the positive direction as a power surplus in the synchronous area, caused by e.g. tripping of a load or an exporting HVDC interconnector. The negative direction is defined by a power shortage and can be caused by e.g. tripping of a production unit or an importing HVDC interconnector. In accordance with Article 153(2)(a) of the SO Regulation, FCR-D shall cover at least the reference incident. This is interpreted as that FCR-D downwards shall cover at least the reference incident in positive direction and that FCR-D upwards shall cover at least the reference incident in negative direction. This is reflected by article 3(3) and 3(4) of the Methodology.

6.2 Definition of the reference incident (Article 153(2)(b)(ii))

This section 6.2 further elaborates on the definition of the reference incident as proposed in Article 3 of the Methodology in accordance with Article 153(2)(b)(ii) of the SO Regulation. In section 6.2.1, general guidance and reflections are given on the reference incident, in section 6.2.2-6.2.5 some detailed aspects for determining the size of 'reference incident' is presented, and in section 6.2.6 the daily process is presented.

6.2.1 'Reference incidents' considered for dimensioning of FCR-D

Article 153(2)(b)(ii) of the SO Regulation mentions that *the reference incident shall be the largest imbalance that may result from an instantaneous change of active power such as that of a single power generating module, single demand facility, or single HVDC interconnector or from a tripping of an AC line, or it shall be the maximum instantaneous loss of active power consumption due to the tripping of one or two connection points. The reference incident shall be determined separately for positive and negative direction;"*. The words "*such as"* in this article provide the TSOs with the task to define a more concrete list that shall be applicable to the Nordic system.

From the elements listed up in Article 153(2)(b)(ii), the following ones are considered in the FCR-D dimensioning process:

- *Single power generating module*[3] - e.g. tripping of Oskarshamn 3, Sweden.
- *Single demand facility* - e.g. tripping of one aluminium smelter hall in Norway.
- *Single HVDC interconnector*- e.g. tripping of NordLink in import/export situation, Norway.
- *Tripping of an AC-line*- e.g. tripping of line(s) Hasle-Halden resulting in system protection scheme (SPS) activation in Norway, and by this tripping of production units within the system protection scheme. Could also be tripping of one line resulting in loss of a regional part of the system.

The *"the maximum instantaneous loss of active power consumption due to the tripping of one or two connection points"* is considered to be much less relevant for the Nordic system. The TSOs concluded that it, at the time being, is not relevant to set a 'reference incident' based on tripping of *two* connection points. The reason for this is that the TSOs do not consider the probability for two simultaneous outages of demand

[3] Power generating module: Either a Synchronous Power Generating Module or a Power Park Module. Synchronous Power Generating module: An indivisible set of installations which can generate electrical energy such that the frequency of the generated voltage, the generator speed and the frequency of network voltage are in a constant ratio and thus in synchronism.

facilities significant. Tripping of one connection point has already been covered by a *single power generating module* and a *single demand facility* which are listed above.

In addition to the list in Article 153(2)(b)(ii), the TSOs consider that tripping of *one busbar* shall be evaluated as a reasonable N-1 disturbance. This may be relevant during especially longer outages for maintenance on a busbar. See example in Figure 1. Per today, this scenario is considered in the normal outage planning within each of the Nordic TSOs to ensure that any planned outage does not result in too large installed production capacity connected to a single busbar. As such, - in practice - tripping of single bus bars will not likely have an impact on the dimensioning of FCR-D in the system.

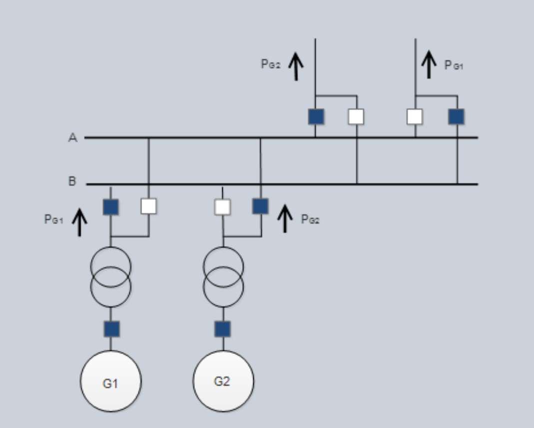
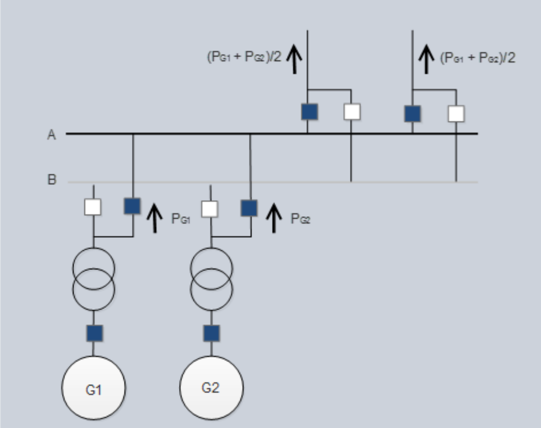
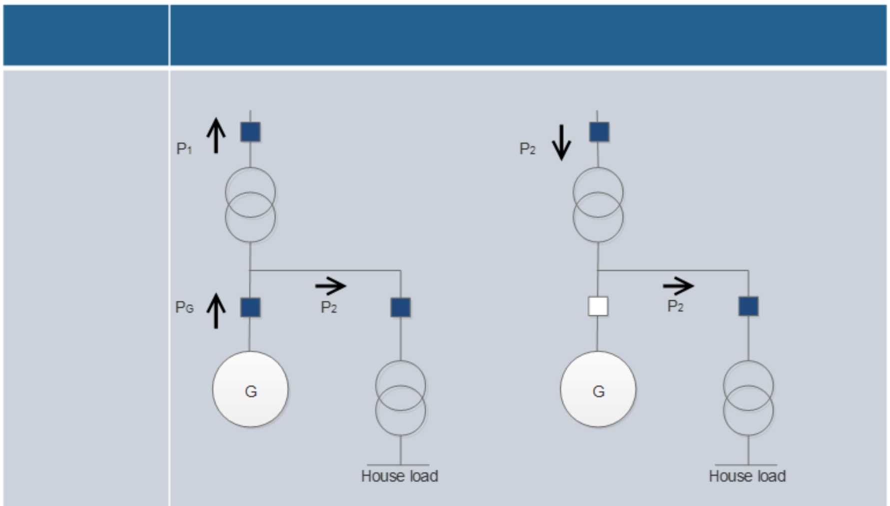
	No planned outage	**Planned outage**
		
Reference incident	P_{G1} , P_{G2}	$P_{G1} + P_{G2}$

Figure 1: Left figure: 'incident considered' is the trip of busbar B, assuming $P_{G1} > P_{G2}$. Right: The 'incident considered' becomes the sum of P_{G1} and P_{G2}

6.2.2 House load/auxiliary systems to be considered

When assessing the instantaneous loss of active power generation for power generating modules, the real value for expected loss shall be taken into account. This means that for example, for thermal units with significant house load consumption (due to auxiliary systems), the total loss of active power as seen from the grid shall be used as basis for the definition of reference incident. This in turn means that the gross power generation of a unit should be taken into account. The reason for this can be seen in Figure 2. In this example the unit generator breaker is tripped instead of the breaker connecting to the main grid busbar.



Reference incident	$P_1 + P_2$

Figure 2: The 'incident considered' is the actual change of power after the trip of a generator unit. The house load shall be taken into account. 'Reference incident' equals the sum of $P_1 + P_2$ (= P_G)

6.2.3 Change of losses due to flow changes after disturbances

The imbalance that is caused by large incident may also be influenced by the change in network losses due to changed flows (see section 4.2). This effect is however very much dependent on the specific situation, including the location of the incident, the location of the FCR-D providing units and the flows just before the incident. The effect can result in both increased or decreased network losses and can therefore both increase or decrease the resulting imbalance on a synchronous area level. The TSO will not include this effect in the dimensioning of FCR-D.

6.2.4 Not considered for FCR-D dimensioning: Single disturbances with very low probability

Single failures with very low probability can occur in power system. This is the case for incidents leading to e.g. transmission tower collapse and certain less likely short circuits resulting in multiple bus bar tripping. These failures can in some cases lead to larger instantaneous imbalances than the incidents referred to in section 6.2.1.

However, taking these failures with very low probability into account would result in inefficient FCR-D dimensioning since the probability that the total amount of FCR-D would be activated is very small. Consequently, failures such as transmission tower collapse, trip of multiple bus bars etc. shall not set the 'reference incidents'.

6.2.5 Variation of active power output of a power generating module, HVDC facility

The size of the 'reference incident' depends on the actual operating point of a unit, which can differ from the nominal size of the unit. For example, a nuclear unit might

- run on "coast down" which mean reduced output in the end of its operational cycle;
- run with one generator synchronised to the main grid, in case outage on the other one (only applicable for two-turbine units like Ringhals nuclear power station).

The actual size depending on the actual operating point shall be the basis for FCR-D dimensioning in the Nordic system for each operational hour. The process for the continuous definition of 'reference incident' is defined in section 6.2.6.

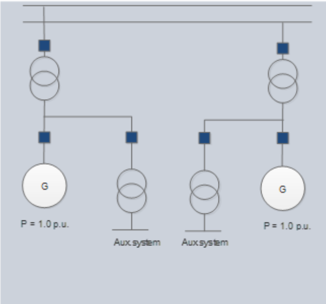
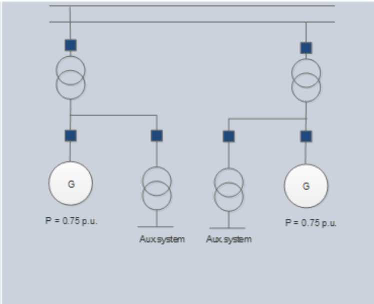
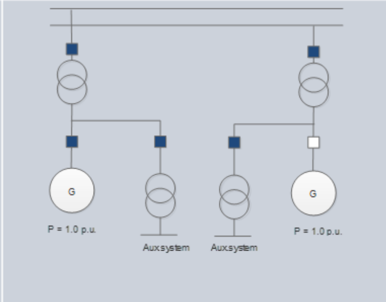
	1. Nominal operating point	2. Actual operating point	3. One SG out of service
			
Reference incident	2x1.0 p.u + house load	2x0.75 p.u + house load	1x1.0 p.u + house load

Figure 3: Size of 'reference incident' taking into account the actual operating point of a unit.

6.2.6 Daily process for defining 'reference incident'

The control centres of each Nordic TSO are responsible for daily defining the reference incident within each control area. The reference incidents from each control area are then collected to calculate the synchronous area reference incident.

6.3 Probabilistic dimensioning approach for Frequency Containment Reserves (FCR) (Article 153.2(c))

Article 153.2(c) of the SO Regulation state that the *"TSOs of the synchronous area shall have the right to define a probabilistic dimensioning approach for FCR […]".* The TSOs conducted a joint project and have discussed a probabilistic methodology that could be used for a probabilistic dimensioning approach for FCR-D as mentioned in Article 153(2) of the SO Regulation. However, the TSOss decided not to use this methodology at the moment because the process for how to translate a certain risk level, inertia level, the actual probability for incidents and other inputs to suitable measures, including FCR-D dimensioning needs to be further defined. For this reason, the TSOs do not use *"the right to define a probabilistic dimensioning approach for FCR"* in accordance with Article 153(2)(c) of the SO Regulation.

6.4 Calculation of the initial obligation per TSO (Article 153(2)(d))

In Article 153(2)(d) it is stated that *"the shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of 1 year*."

The share of FCR for TSO A is then

$$FCRshare_{TSO\ A} = \frac{Generation_{TSO\ A} + Consumption_{TSO\ A}}{\sum_{i=1}^{4}(Generation_{TSOi} + Consumption_{TSOi})} \qquad \text{(eq.1)}$$

The shares shall be revised each year before 1 October of year *y-1* on the basis of net consumption and net generation in year *y-2* and the new shares will enter into force on 1 January of year *y*.

6.5 Summary

The arguments in section 6.2 result in the rules for FCR-D dimensioning as included in Article 3 of the Methodology:

1. Following the dimensioning rules in this article, the Nordic TSOs will dimension FCR-D daily, separately for FCR-D upwards and FCR-D downwards.

2. The input to the dimensioning process of FCR-D shall be:
    a. Planned network topology, considering maintenance of relevant network components;
    b. Estimated (gross) generation of large generation modules;
    c. Estimated demand of large connected consumers;
    d. Estimated flows on HVDC interconnectors.

3. The total reserve capacity for FCR-D upwards required for the Nordic synchronous area shall be dimensioned to be at least equal to the imbalance caused by the reference incident in the negative direction. Dynamic FCR-D upwards shall make up at least a certain share of the system level FCR-D upwards response. The share shall be determined based on the system inertia, in addition to item 2 of this article. The share shall be reviewed at least annually.

4. The total reserve capacity for FCR-D downwards required for the Nordic synchronous area shall be dimensioned to be at least equal to the imbalance caused by the reference incident in the positive direction. Dynamic FCR-D downwards shall make up at least a certain share of the system level FCR-D downwards response. The share shall be determined based on the system inertia, in addition to item 2 of this article. The share shall be reviewed at least annually.

5. The reference incident shall be defined as the largest imbalance that may result from an instantaneous change of active power of:
    a. *A single power generating module:*
    b. *A single demand facility;*
    c. *A single HVDC interconnector;*
    d. *Tripping of an AC-line:* This may result in i) system protection scheme (SPS) activation which may trip one or more power generating units or ii) loss of a regional part of the system.
    e. *Single failure on a busbar tripping more than one generation module or demand facility.*

6. The imbalance volume of the 'instantaneous change of active power' mentioned in item 5 of this article shall be determined by the net loss of active power as seen from the grid. I.e. it should be taken into account that auxiliary load of the generation module may still consume power in the case that the unit generator breaker is tripped. Furthermore, the imbalance volume of the reference incident is determined by the maximum production, import, consumption or export that has been scheduled for the period for which the reference incident is determined.

The arguments in section 6.4 result in the rules for calculating the initial FCR-D distribution as included in Article 4 of the Methodology:

1. In accordance with article 152(2)(d) of the SO Regulation, FCR-D and FCR-N shall be distributed to the TSOs pro-rata to the shares defined below.
2. The input to the calculation of the initial distribution are:
    a. net generation per control area for calendar year *y-2* in which the net generation of a unit is defined as the gross power generation minus the internal auxiliary power consumption of the unit;
    b. net consumption per control area for calendar year *y-2* in which 'net' means that the consumption of power plants' auxiliaries is excluded, but network losses are included.

3. The shares of the reserve capacity on FCR required for each TSO as initial FCR obligation shall be based on the sum of the net generation and consumption of its control area divided by the sum of net generation and consumption of the synchronous area over a period of one year.

   The shares shall be revised each year before 1 October of year *y-1* and the new shares will enter into force on 1 January of year *y*.

7. Expected impact of the Methodology on the relevant objectives of the SO Regulation

The Methodology generally contributes to and does not in any way hamper the achievement of the objectives of Article 4 of the SO Regulation. In particular, the Methodology serves the objectives to:

- Article 4(1)(c) determining common load-frequency control processes and control structures;
- Article 4(1)(d) ensuring the conditions for maintaining operational security throughout the Union;
- Article 4(1)(e) ensuring the conditions for maintaining a frequency quality level of all synchronous areas throughout the Union; and
- Article 4(1)(h) contributing to the efficient operation and development of the electricity transmission system and electricity sector in the Union.

The Methodology contributes to these objectives by specifying the dimensioning rules for FCR-D, which is one of the key reserves that is used in the common Nordic load-frequency control processes. Sufficient FCR-D guarantees the right frequency quality level and consequently maintains the operational security by reducing the risk for automatic Low Frequency Demand Disconnection (LFDD), automatic reduction of generation and for system blackouts due to under or over frequency. The dimensioning rules balance the impact of both cost for FCR-D and outage risk and therefore ensure efficient operation of the electricity transmission system.

8. Timescale for the implementation

The rules for dimensioning of FCR-D, article 3 of the Methodology, have already been implemented in the existing processes, apart from the proposed requirements on Dynamic FCR-D volumes. The TSOs propose that the dimensioning rules of Dynamic FCR-D shall be implemented no later than 2.5 years after the approval of this Methodology. This corresponds to the middle-point of the five-year transition period of the Nordic methodology for additional properties of FCR in accordance with Article 154(2) of the SO regulation, which is submitted in parallel to this Methodology.

The rules for the initial distribution of FCR (article 4 of the Methodology) have already been implemented in the existing processes.

9. Public consultation

Article 11 of the SO Regulation states that: *"TSOs responsible for submitting proposals for terms and conditions or methodologies or their amendments in accordance with this Regulation shall consult stakeholders, including the relevant authorities of each Member State, on the draft proposals for terms and conditions or methodologies listed in Article 6(2) and (3). The consultation shall last for a period of not less than one month."*

This Methodology has been consulted in the period 6 May 2022 to 6 June 2022. The appendix to this document includes the views of stakeholders resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

Appendix: Results of Public Consultation

Article 11(3) of the SO Regulation states that: *"The TSOs responsible for developing the proposal for terms and conditions or methodologies shall duly take into account the views of stakeholders resulting from the consultations prior to its submission for regulatory approval. In all cases, a sound justification for including or not including the views resulting from the consultation shall be provided together with the submission of the proposal and published in a timely manner before, or simultaneously with the publication of the proposal for terms and conditions or methodologies."* Table 1 lists the views of stakeholders on this proposal resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

Table 1: Views of stakeholders resulting from the consultations and explains if and how these views have been taken into account in the Methodology.

no.	organisation	Comment	response TSOs
1	Statkraft Energi AS	CONSULTATION RESPONSE FROM STATKRAFT ENERGI AS AND STATKRAFT SVERIGE AB ON NORDIC TSOs' PROPOSAL ON FCR DIMENSIONING Statkraft supports the process of unifying the requirements for FCR in the Nordic power system, and we are generally pleased with the changes proposed in this consultation. The proposed methodology gives the Nordic TSOs some room for national adaptions. We fully support the need for some leeway to ensure that we are not unnecessarily limited by too stringent requirements not adapted to the specific conditions. At the same time, Statkraft is an actor delivering services in more than one Nordic country and for us it is important that the TSOs strive for harmonisation whenever possible. We agree with the Nordic TSOs' goal that the proposed solutions should be feasible from a market perspective, and that the requirements have been set to ensure security of supply and the functioning of the FCR market. We also understand that the TSOs must set stricter requirements than they do today, even if it results in reduced ability to deliver FCR to the market compared to the current situation. However, we want to point out that there is a trade-off for the power system between more accurate FCR and the ability for producers to offer FCR and other reserves, because the requirements not only impact our ability to offer FCR-services but may also limit our ability to offer other balancing services, such as aFRR and mFRR. Today, it is possible to	Comment acknowledged and did not result in a change of the proposal. The TSOs agree that it can be useful for a provider to provide several services from the same unit at the same time. The comment is referring to a statement that FCR may only be delivered in the operational ranges for which the unit or group has been prequalified for. In turn, it is only possible to prequalify for operation ranges for which the unit or group actually fulfils the technical requirements of FCR. The TSOs are aware of that the new requirements in some instances might limit the operating range for which it is possible to provide FCR, and hence limit simultaneous delivery of FCR and FRR, since the FRR delivery can push the FCR delivery out of the prequalified range. However, the TSOs can't allow a unit to provide FCR outside the prequalified operating range as the response will not meet the demands of the power system anymore. The TSOs will assess the impact of the new requirements when more experience is gained, in accordance with Article 10(3) of the methodology for additional properties of FCR, and re-evaluate the requirements if shown to be too restrictive.

		have simultaneous delivery of FCR, automatic frequency restoration reserves (aFRR) and manual frequency restoration reserves (mFRR) from the same unit. This is possible because FCR can be delivered on the entire operating window of each unit. The proposed FCR requirements have the potential to significantly reduce the operating window in which FCR can be provided by a generating unit. With a reduced FCR window, e.g., mFRR bids cannot be offered to the same extent as today from a unit when there is an FCR bid contracted by the TSO, without breaching the rule that offered capacity in the different markets for primary-, secondary- and tertiary reserves shall not overlap for the same market time unit. Thus, the consequences of too strictly requirements may be lack of supply of reserves and unnecessarily high costs for grid users.	
2	Statkraft Energi AS	We support the proposal to give existing FCR-providing units up to five years to transition to the new requirements. However, it is unclear to us how this will work in practice during the transition period. Will qualified and not yet qualified units offer their services in the same market? Being in the same market, with the same market price, might make it less attractive to qualify before the end of the five-year period. While Statkraft believes that a five-year transition period might be sufficient, there may be limitations in the delivery capabilities in the supplier's market of turbine governors. The TSOs should therefore be flexible with regard to the duration of the transition period beyond the five-year limit.	Comment acknowledged and did not result in a change of the proposal. The TSOs believe that the transition period should not be longer than necessary, as the new requirements are needed to meet the demands of the Nordic power system. The TSOs highlight that the prequalification has to be re-evaluated every 5 years anyway, in accordance with Article 155(6) of the SO regulation. The providers thus need to plan to handle prequalifications with an interval of 5 years. The actual prequalification process and the design of the FCR markets are a national matter, and the questions should be directed to the relevant TSO. For practical reasons, during the transition period both units and groups qualified towards the previous and the new requirements will provide FCR delivery in the same markets, but how this might affect the market design has to be handled nationally, as the markets are national.
3	Statkraft Energi AS	As we understand it, the TSOs will require a re-qualification process every five years, or in case of changes or modernization of the equipment or requirements. We understand the need for re-qualification following changes or modernization. For unchanged installations, we believe that a simplified re-qualification process could be used every other time (every tenth year), due to the potential costs related to personnel and altered production schedules following a full re-qualification.	Comment acknowledged and did not result in a change of the proposal. The reassessment requirement arises from Article 155(6) of the SO regulation. The TSOs plans to allow a reduced scope of the reassessment for unchanged units every other time, compared to full prequalification. This will be further described in the prequalification documents.

4	Statkraft Energi AS	The documentation provided in this consultation (or in the Nordic TSOs' previous consultation on the new technical requirements for FCR for the Nordic synchronous area including their summary of consultation responses) does not provide us with a sufficiently clear and specific description of information exchange and logging, including requirements for resolution and accuracy, architecture, and protocol use and implementation. A standard solution should be developed which can be reused for all FCR units. Statkraft has experience with similar data exchanges in the UK and can provide best practice examples of requirement documentation upon request.	Comment acknowledged and did not result in a change of the proposal. The scope of this methodology does not cover the implementation of information exchange, especially the IT-technical aspects like time resolution, architecture, protocol, etc. The practical aspects of the information exchange are defined in Article 40 and onwards of the SO regulation, and is handled partially on a European level, partially on a national level. The relevant guidance must be requested from the relevant TSO. The TSOs acknowledges Statkraft's offer to share experiences of best practices, and will upon request provide relevant contact information for the respective TSOs.