Methodological paper:

Unscheduled flows

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Version of 15 October 2018

Content

1. Introduction

(1) This document is one of a set of documents describing various methodologies applied in the electricity wholesale markets volume of the annual ACER/CEER Market Monitoring Report (MMR), which is intended to present the results of the monitoring of the performance of the internal electricity market in the European Union (EU).

(2) This paper describes the methodology used to decompose so-called (un)scheduled flows (UFs). The general approach is first described, then the necessary caveats are described and, finally, the required data and the sources are listed.

(3) While facilitating cross-border wholesale trade is a key objective of the Internal Electricity Market (IEM), UFs have two negative effects[1]: (i) they may cause TSOs to reduce the capacity available for cross-border trade; and (ii) they may lead to more need for remedial actions by TSOs (to ensure operational security). The first effect may lead to a loss of social welfare, which corresponds to foregone benefit with respect to a situation in which this cross-border capacity would be available for cross-border trade. The second effect relates to network security and the market's efficiency in general, and may contribute to more redispatching, counter-trading and/or curtailment cost. Additionally, if remedial actions were not available (e.g. due to insufficient coordination among TSOs or lack of flexible generation), UFs could lead to insecure grid operation.

(4) The definitions used in this paper are consistent with the underlying Regulation[2]. Additionally, the following definitions apply[3]:

1. Scheduled flows (known as schedules, SCHs) represent administrative (calculated) flows resulting from capacity allocation.

2. Unscheduled allocated flows (UAFs) are flows allocated on a given border, but scheduled on a different one. As such, they represent the difference between actual flows coming from capacity allocation (allocated flows, AFs), and those SCHs. UAFs stem mostly from insufficient coordination and inefficient capacity calculation and allocation, but could also be the result of a scheduling methodology, which does not follow the physical flows resulting from capacity allocation.

3. Loop flows (LFs) are flows originating from internal-to-bidding-zone exchanges, i.e. the source and the sink of the flow are located in the same bidding zone, but the flow travels through neighbouring bidding zones. LFs often refer to flows that start in a given bidding zone and cross one or more neighbouring bidding zones before returning to the initial bidding zone.

4. UFs are the difference between physical (real-time) flows (PFs) and SCHs; UFs represent the sum of UAFs and LFs. TSOs affected by UFs are not directly notified to handle these physical flows; therefore, they face additional challenges when maintaining network security, which in turn can affect market efficiency.

2. General approach

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[1] See Chapter 5, in particular Section 5.1 of the Electricity Wholesale Markets volume of MMR 2015, for more information about the challenges UFs present to the further integration of the IEM

[2] Mainly the CACM Regulation, i.e. Commission Regulation (EU) 2015/1222 of 24 July 2015, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015R1222&from=EN.

[3] For more information (including graphical representation) and some examples, see https://docstore.entsoe.eu/Documents/MC%20documents/150929_Joint%20Task%20Force%20Cross%20Border%20Redispatch%20Flow%20Definitions.pdf

(5) The approach to decomposing UFs relies on the following main principles:

1. Generic flow decomposition equations, which are presented below

$$AFs = SCHs + UAFs$$

$$UFs = UAFs + LFs$$

$$PFs = SCHs + UFs = AFs + LFs$$

2. The assumption of one equivalent network element per border.

3. The reliance on a set of representative power transfer distribution factors (PTDFs[4]) which, combined with realised net positions, allows AFs to be derived.

3. Calculation process

(6) The flow decomposition relies on the following calculation steps to estimate UFs per border[5]

I. The generic flow decomposition equations (described above) are used, assuming one equivalent network element per border.

II. SCHs usually are publicly available[6], but are not always fully in line with the operational values used by TSOs. In the Core (CWE) region, additional aggregated flow (AAF) and external flow values provided by ENTSO-E allow us to refine SCHs as follows

a. Between CWE countries, the AAF value replaces the schedule. For example:

$$SCH_{DE-NL} = AAF_{DE-NL}$$

$$SCH_{DE-FR} = AAF_{DE-FR}$$

b. On the CH – DE and CH – FR borders, the actual schedule is the sum of the raw schedule and the (oriented) “external flow DE – FR”.

$$SCH_{CH-DE} = SCH_{CH-DE,raw} - ExternalFlow_{DE-FR}$$

$$SCH_{CH-FR} = SCH_{CH-FR,raw} + ExternalFlow_{DE-FR}$$

III. UFs are computed as the difference between PFs and SCHs

$$UFs = PFs - SCHs$$

IV. AFs are derived relying on ENTSO-E data. Combining six representative sets of PTDFs[7] with hourly realised net positions leads to approximate hourly AFs on each border.

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[4] For more information on PTDFs, see Section 3.1 of the Electricity Wholesale Markets volume of MMR 2016

[5] When UFs (UAFs, or LFs) from a given bidding zone go through one neighbouring bidding zone then come back to the originating bidding zone, the overall UF (UAF, or LF) value at the border will often appear to be zero (as the flows entering the neighbouring bidding zone will be netted by the exiting flows). However, this does not mean that such flows do not affect the neighbouring bidding zone. For example, at the border between Portugal and Spain, overall LFs are zero, but significant LFs still affect individual Portuguese-Spanish interconnectors (or internal Portuguese network elements). See http://www.centrodeinformacao.ren.pt/PT/publicacoes/PublicacoesGerais/Capacidade%20de%20Interliga%C3%A7%C3%A3o%20entre%20Portugal%20e%20Espanha.ppt (slide 23)

[6] For example, through ENTSO-E’s transparency platform (TP). Where information from the ENTSO-E’s TP is incomplete or unreliable, Vulcanus schedules are used instead.

[7] For example, in the 2017 MMR, representative sets of PTDFs from January, March, May, July, September and November were used.

V. UAFs are then derived by subtracting SCHs from AFs

$$UAFs = AFs - SCHs$$

VI. Finally, LFs are derived as

$$LFs = UFs - UAFs$$

4. Caveats

(7) When applying the methodology described above, the following caveats and considerations apply:

- SCHs, AFs and PFs are not always defined at bidding-zone-border level; they are sometimes defined between scheduling areas, so they need to be disaggregated.
- The line equivalent border does not fully represent how electricity would flow on the border.
- Hourly PTDFs should be used when computing hourly AFs; a representative set of seasonal PTDFs is considered a representative proxy.

5. Data

Table 1: Data required and sources used for the UFs analysis

Description	Unit	Time granularity	Geographic granularity	Source
Cross-zonal (realised[8]) schedules	MW	Market time unit	Bidding zone border	Vulcanus[9]
Cross-zonal allocated flows	MW	Market time unit	Bidding zone border	ENTSO-E
Physical cross-zonal flows	MW	Market time unit	Bidding zone border (currently provided for scheduling area borders)	Vulcanus
Additional aggregated flows	MW	Market time unit	Bidding zone border	ENTSO-E
External flow DE – FR	MW	Market time unit	Bidding zone border	ENTSO-E

[8] Realised schedules (evaluated D+7) as provided by Vulcanus. Alternatively, ENTSO-E transparency platform data, which includes long-term, DA and ID schedules, may be used.

[9] For more information about Vulcanus, see https://docstore.entsoe.eu/Documents/MC%20documents/140123_Technical_Report_-_Bidding_Zones_Review__Process.pdf (p.25)