APPENDIX 2

SCHEDULING AND ACCOUNTING

A2 – Appendix 2: Scheduling and Accounting

Appendix Chapters

A. Scheduling of Power Exchange
B. Online Observation
C. Accounting of Unintentional Deviations

Introduction

This Appendix to Policy 2 explains and motivates the basic technical and organisational principles of Scheduling, Online Observation and Accounting mechanism for the UCTE, as it is applied in the SYNCHRONOUS AREA by the TSOs of the various CONTROL AREAS/BLOCKS.

In order to prevent systematic faults in the context of LOAD FREQUENCY CONTROL (see Policy 1) it is an important issue to check the UCTE wide consistency of the input variables used by the single parties involved. For this purpose the task of co-ordination is performed, which takes into account the exchange schedules (Process: Schedule Management), the real – time measurements (Process: Online Observation) and the compensation programs (Process: Accounting). The task of UCTE co-ordination is organised on the basis of the three hierarchical levels CO-ORDINATION CENTRE, CONTROL BLOCK and CONTROL AREA (see figure 1).

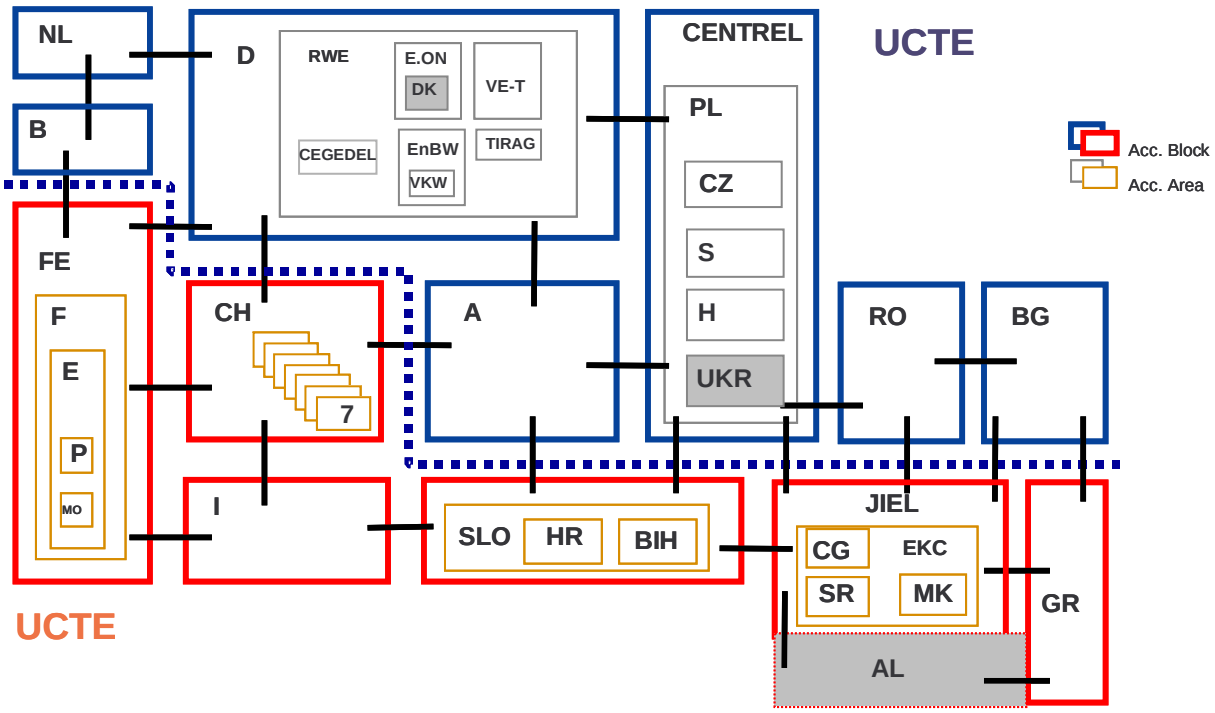


Figure 1: Hierarchical Levels of UCTE Co-ordination[1]

[1]Situation after re-synchronisation of the second synchronous zone

History of changes

v0.4	**draft**	**5.04.2004**	**OH Team**	**draft for internal consultation**
v0.3	**draft**	**12.03.04**	**OH Team**	**comments RWE**

Current Status

This document summarises technical descriptions and backgrounds of a subset of current UCTE rules and recommendations related to scheduling and accounting issues, with additional items.

This document and other chapters of the UCTE Operation Handbook as well as excerpts from it may not be published, redistributed or modified in any technical means or used for any other purpose outside of UCTE without written permission in advance.

A. Scheduling of Power Exchange

[UCTE-Ground Rule for the co-ordination of the accounting and the organisation of the load-frequency control, 1999]

[ETSO ESS Implementation guide, R2V2]

[ETSO EIC]

1. Definitions

In the operational planning phase the market participants have to nominate their border - crossing trades by the use of an exchange schedule to the control area operator. The exchange schedule counts positive in export direction and negative in import direction. For each time unit t the market participant α has to declare within the Control Area k a cross - border trade with the market participant β in the Control Area l by means of the exchange schedule $\boldsymbol{ES}_{kl\alpha\beta\tau}$.

The market participant β declares a corresponding exchange schedule $\boldsymbol{ES}_{kl\beta\alpha\tau}$ within the Control Area l. The following equation applies:

(1) $$ES_{kl\alpha\beta t} = -ES_{lk\beta\alpha t}$$

Each Control Area operator k accumulates the declared exchange schedules per time unit t and per border to an adjoining Control Area l to the total exchange schedule $\boldsymbol{ES}_{klt}$. For each border between two Control Areas k and l the following equation applies.

(2) $$ES_{klt} = -ES_{lkt}$$

The exchange schedules form an essential input quantity for the LOAD-FREQUENCY CONTROL. Thus the validity of the equations (1) and (2) has to be checked for every time unit and for every border. Equation (2) has to be checked on the different levels of co-ordination, i.e. CONTROL AREA, CONTROL BLOCK and CO-ORDINATION CENTRE.

2. Procedure

To prove the validity of the equations introduced above an information exchange has to be set up among the parties involved. In figure 2 five types of information exchanges are introduced (Market Party Responsible Schedule, CAS, CAX, CBS, CCT) including a description of sender and receiver of the information. Obviously, the Market Party Responsible Schedule has to include the detail of exchange schedules between market participants α and β. Since the data exchange between CONTROL AREAS has the purpose to prove equation (1) the CAS has to provide the same degree of detail. The following data exchanges are all needed to prove equation (2) at different hierarchical levels of co-ordination. Thus the CAX, CBS and CCT has to include the detail of exchange schedules between CONTROL AREAS k and l.

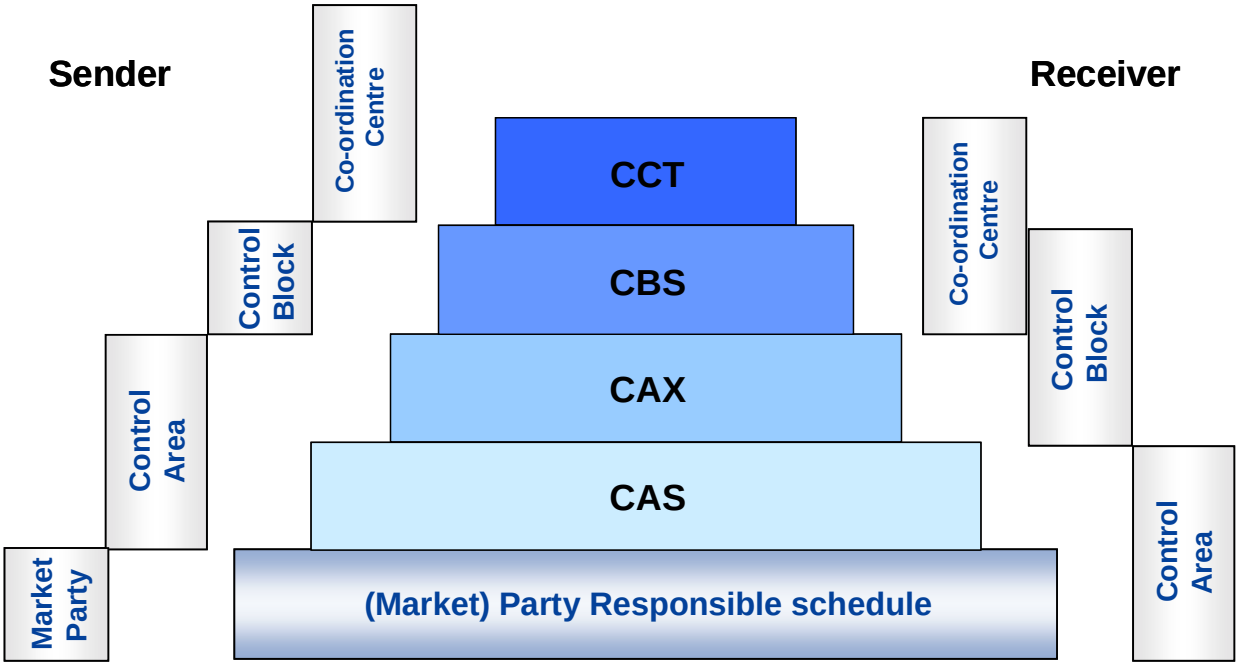


Figure 2: Information Exchange Type at different hierarchical Levels of UCTE Co-ordination

The hierarchical procedure of the schedule management co-ordination starts with the verification of exchange schedules between control areas. After the receipt of the final exchange schedules from the Market Party Responsibles the Control Area Operators exchange a CAS and check the validity of equation (1). In case of any discrepancies the affected market participants and time units are identified and the Market Party Responsibles are asked for clarification. If the discrepanncy can not be solved before a pre-defined gate closure time (see Chapter 3) the exchange schedule is rejected.

The co-ordination procedure continues with the control block verification. The control block verification starts after completion of the control area verification by the submitting of CAX from the control area operators to the control block operator concerned. First the control block operator validates the complete data set received by checking equation (2) for the internal control area borders of its control block. Second the control block operators exchange CBS and validate the external control area borders of its control block by checking equation (2).

The last step of the co-ordination procedure is the co-ordination centre verification. The co-ordination centre verification starts after completion of the control block verification by the submitting of CBS from the control block operators to the co-ordination centre concerned. First the co-ordination centre operator validates the complete data set received by checking equation (2) for the internal control area borders of its co-ordination centre. Second the co-ordination centre operators exchange CCT and validate the external control area borders of its co-ordination centre by checking equation (2).

Taking into account the significant number of participants in the scheduling process, as well as the different verification levels, common procedure and methodology must be applied in order to enable automation of the process. First of all common ETSO Exchange Scheduling System (ESS) shall be used for scheduling. Second, all participants in the scheduling process shall be recognised by the ETSO Exchange Identification Code (EIC). Third, all the data exchange shall be executed via Electronic Highway.

3. Gate Closure (Day - Ahead D-1 and Intra-Day D)

Due to different market models and regulatory framework there are different rules and gate closure times for the nomination of exchange schedules by market participants in the UCTE countries. To enable an orderly procedure of the UCTE co-ordination common gate closure times have to be defined for the different hierarchical levels of co-ordination. As a pre-condition, these gate closure times have to be after the latest gate closure time in any country involved. On the other hand they must allow sufficient time for the execution of the data exchange, validation, verification and troubleshooting at each level of the co-ordination.

Figure 3 and 4 give an overview on the co-ordination process and point out the common gate closure times for both the day – ahead process and the intra – day process.

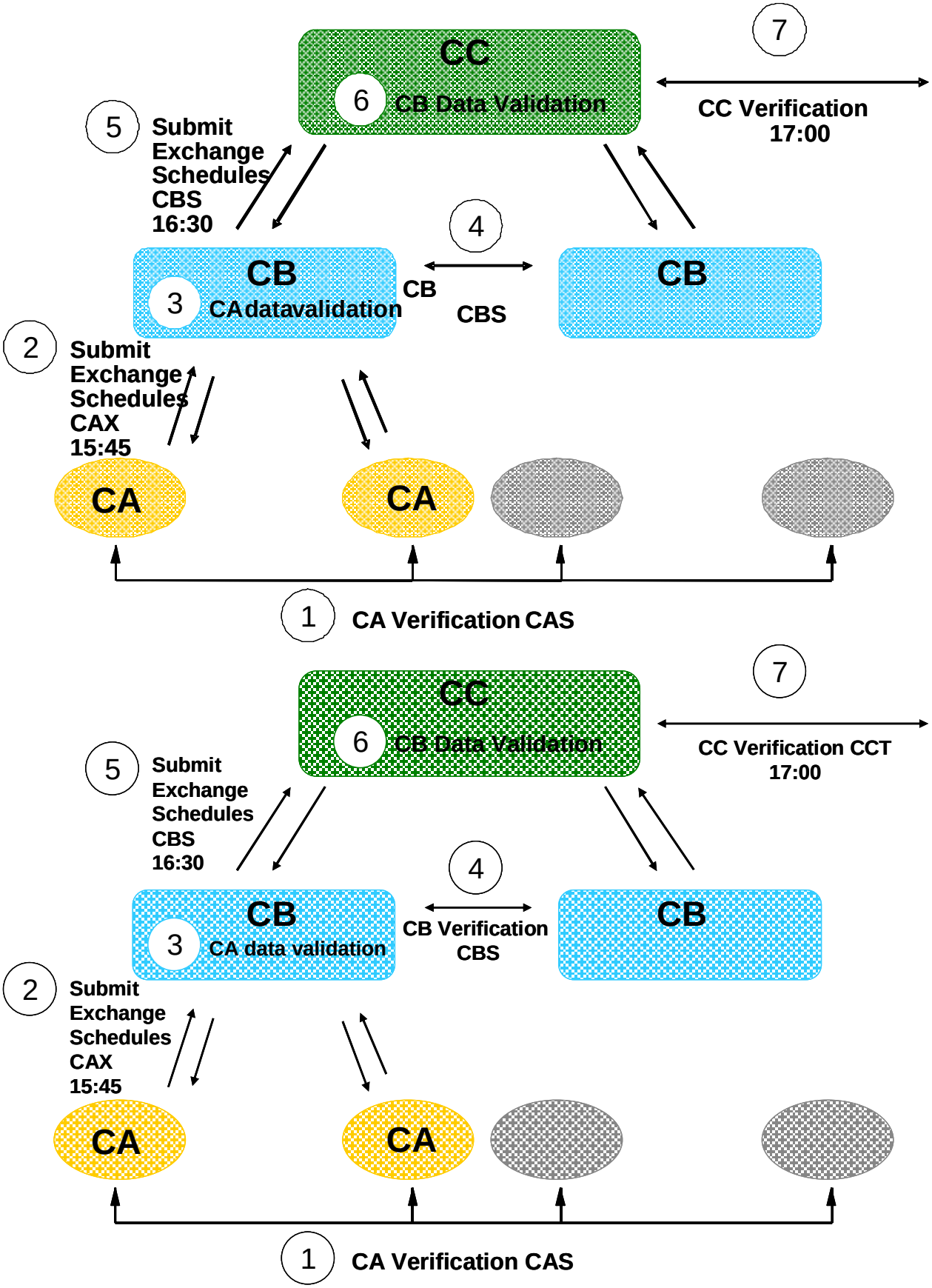


Figure 3: Gate Closure Times for the Day - Ahead Process (D-1)

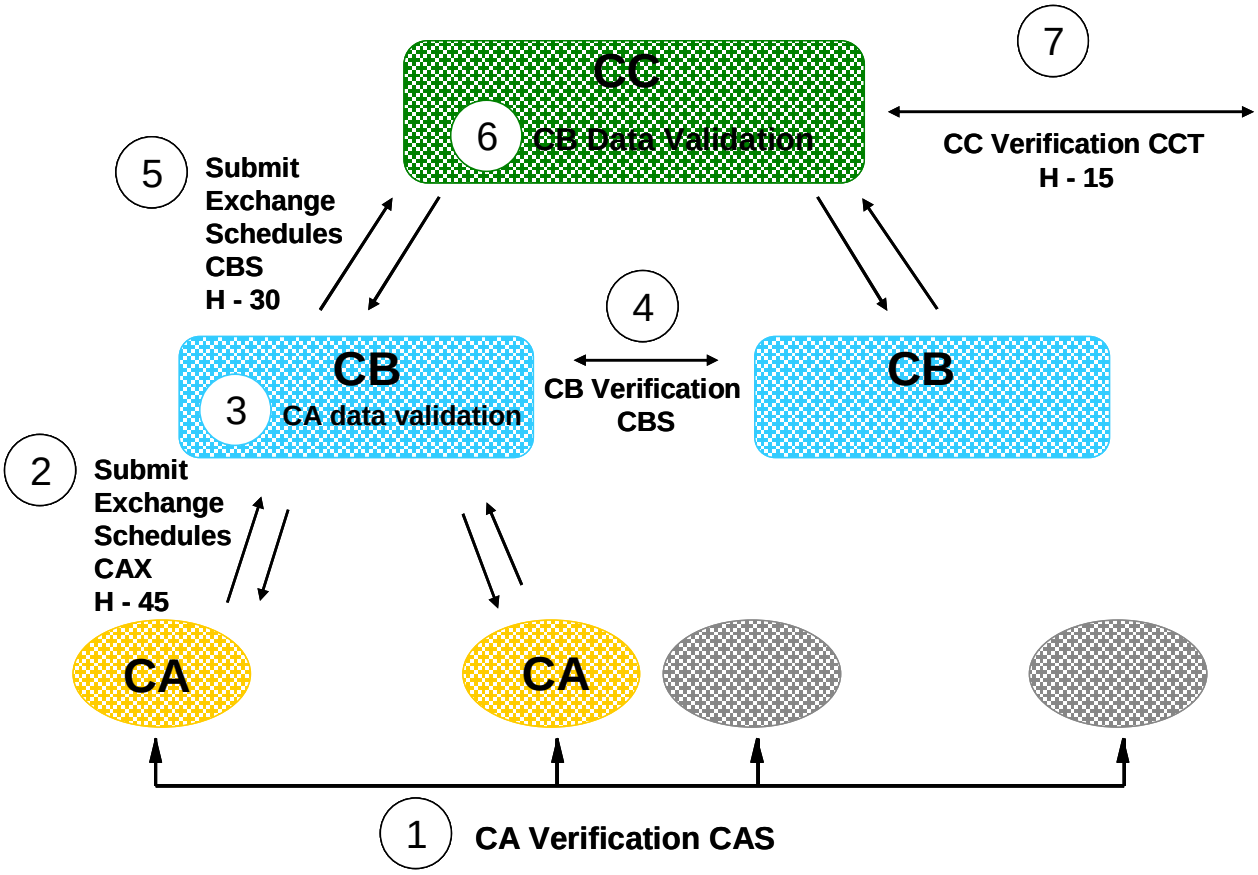


Figure 4: Gate Closure Times for the Intra - Day Process (D)

B. Online Observation

[UCTE-Ground Rule for the co-ordination of the accounting and the organisation of the load-frequency control, 1999]

1. Definitions

During online operation each control area operator k calculates the control program $\boldsymbol{CP}_{kt}$ from the total exchange schedules agreed during the schedule management process and its compensation program $\boldsymbol{COMP}_{kt}$ for each time unit t:

(3) $$CP_{kt} = \sum_{l} ES_{klt} + COMP_{kt}$$

The control program $\boldsymbol{CP}_{kt}$ represents the planned total exchange of the control area. For the sum of compensation programs the following equation applies:

(4) $$0 = \sum_{k} COMP_{kt}$$

The real exchange of control area is represented by the physical tie - line flows crossing each border. The physical flow between control area k and control area l at each interconnection line γ measured for the time unit t is called $\boldsymbol{ET}_{kl\gamma t}$. The following equation applies in the range of accuracy of the measurement:

(5) $$ET_{kl\gamma t} = -ET_{lk\gamma t}$$

Each Control Area operator k accumulates the physical flows per time unit t and per border to an adjoining Control Area l to the total exchange schedule $\boldsymbol{ET}_{klt}$. For each border between two Control Areas k and l the following equation applies in the range of accuracy of the measurement:

(6) $$ET_{klt} = -ET_{lkt}$$

During online operation each control area operator k calculates its total real exchange $\boldsymbol{ET}_{kt}$:

(7) $$ET_{kt} = \sum_{l} ET_{klt}$$

The load frequency controller uses the control deviation $\boldsymbol{CD}_{kt}$:

(8) $$CD_{kt} = ET_{kt} - CP_{kt}$$

The same equations apply for the operation of a control block.

2. Procedure

To avoid a systematic, UCTE wide fault in the load frequency control, resultion in a permanent frequency deviation, the following equation has to apply in the range of accuracy of the measurement:

(9) $$0 = \sum_{k} CD_{kt}$$

The validity of this equation can be proven by equations (2), (3), (4), (6), (7) and (8).

In real time operation different fault scenarios can occur deteriorating the validity of equation (9). Such fault scenarios comprise wrong exchange schedules or on-line telemeasurement as well as faulty calculations of the control deviation.

In order to improve detecting, as early as possible, any error concerning on-line telemeasurements, any misunderstanding which may occur in setting the exchange programs, etc. and in order to implement without delay the appropriate corrective actions the online observation of a set of pre-defined figures is performed at the different levels of co-ordination.

On the control block level each control area operator k provides the on-line telemeasurement values per tie –line $\boldsymbol{ET}_{kl\gamma t}$ and its control deviation $\boldsymbol{CD}_{kt}$ to the control block operator concerned. With this information the control block operator receives a global overview about the situation within his control block and is in the position to validate the tie - line measurement at the internal borders in its control block.

On the co-ordination centre level each control block operator k provides the on-line telemeasurement values per tie –line $\boldsymbol{ET}_{kl\gamma t}$ and its control deviation $\boldsymbol{CD}_{kt}$ to the co-ordination centre concerned. With this information the co-ordination centre receives a global overview about the situation within the co-ordination centre and is in the position to validate the tie - line measurement at the internal borders. In close co-operation the two UCTE co-ordination centres check the validity of equation (9).

D. Accounting of Unintentional Deviations

[UCTE-Ground Rule for the co-ordination of the accounting and the organisation of the load-frequency control, 1999]

[UCTE-Ground rule for the recording and offsetting of unintentional deviations in the interconnected network of UCPTE, 1988]

1. Definitions

Due to operational reasons of intermeshed systems it cannot be avoided that UNINTENTIONAL DEVIATIONS occur in such interconnected networks, i.e. difference between the agreed or scheduled values and the actual values of power deliveries made. These UNINTENTIONAL DEVIATIONS can be dealt with by various methods. UC(P)TE has been applying certain methods since 1958 for compensation by offsetting such difference in kind, separated by tariff periods and agreed by all participating countries.

The unintentional deviations UD_{kt} of a control area k and time unit t are calculated ex - ante as difference BETWEEN physical and programmed exchange:

(10) $$UD_{kt} = ET_{kt} - ES_{kt}$$

In this equation the total executed schedules ES_{kt} are used. The physical exchange ET_{kt} is calculated on the basis of meter values. The following equation has to be applied for the physical exchange for each border between two Control Areas k and l:

(11) $$ET_{klt} = -ET_{lkt}$$

Although in the context of measurement values (equation (6)) the accuracy of the measurement equipment has to be taken into account, dealing with meter values the equation has to apply absolutely. This aim is reached by using a single meter value from one side of the tie - line (Accounting Point) for the accounting of both control areas at the border.

For the sum of the unintentional deviations the following equation applies:

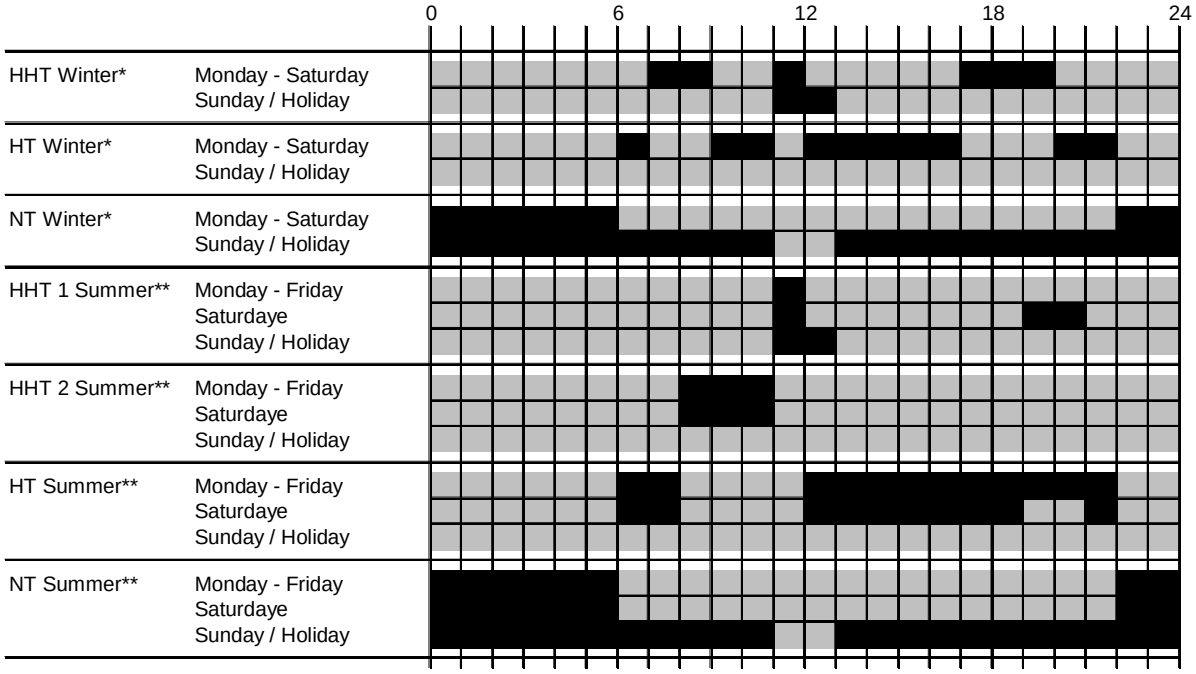
(12) $$0 = \sum_{k} UD_{kt}$$

The validity of this equation can be proven by equations (2), (10) and (11).

The unintentional deviations of each control area k are accumulated to an account $ACC_{kt}(T)$ - under consideration of a pre-defined set of tariff periods T:

(13) $$ACC_{kt}(T) = ACC_{k(t-1)}(T) + UD_{kt}$$

The tariff period is the time interval fixed by UCTE agreement, during which UNINTENTIONAL DEVIATIONS are attributed the same value for offsetting by compensation in kind. The valid tariff periods of UCTE are indicated in figure 5. The tariff periods consist of NT, HT, HHT1 and HHT2 and distinguish between the summer period and the winter period. Four UCTE wide common holidays are taken into account.



*: Winter: 01.10. - 31.03.; Holidays: 25.12. und 01.01.
**: Summer: 01.04. - 30.09.; Holidays: Easter Monday and Ascension

Figure 5: UCTE Tariff Periods used for the Accounting of Unintentional Deviations

For each control area k the account of unintentional deviations $\boldsymbol{ACC}_{km}(T)$ is settled with reference to a recording period m. The compensation of unintentional deviations is performed "in kind" within the compensation period – as an import / export of the corresponding amount of energy per tariff period T, that was accumulated in the recording period. Figure 6 gives an overview to this procedure.

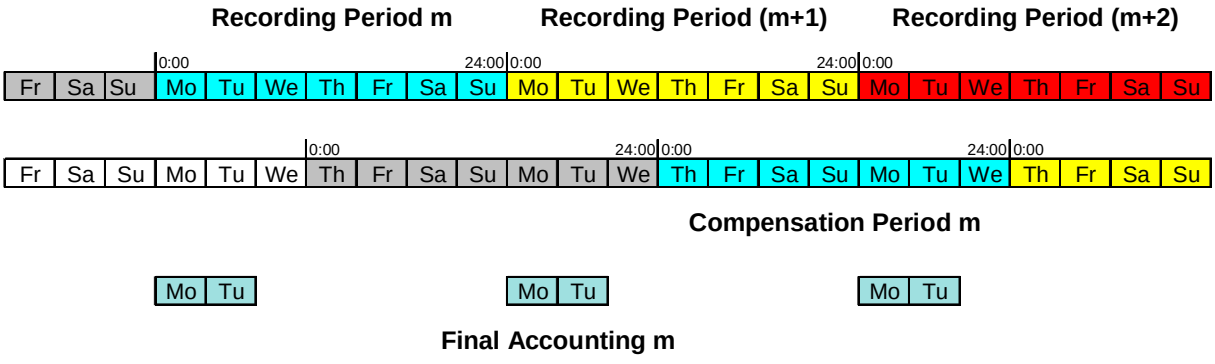


Figure 6: Definition of Recording Period and Compensation Period

The standard recording period is defined to comprise 7 days (one week), from Monday, 0:00 to Sunday 24:00 whereas the standard compensation period is defined to comprise 7 days (one week), from Thursday, 0:00 to Wednesday 24:00.

In case of bank holidays or the change of tariff seasons exceptions to the standard recording and compensation periods may occur. The co-ordination centres agree on exceptions to the definition of the recording period / compensation period and inform the control block / area operators 4 weeks before the start of the recording period accordingly. The following rules have to be taken into account:

- A recording period should last at minimum 4 days
- A compensation period should last at minimum 4 days
- The compensation period has to start always with a delay of three days off the end of the corresponding recording period. Two day difference between the end of an recording period and the start of the corresponding compensation period are needed for the performance of the final accounting; one additional day has to be taken into account to enable the control area operators to buy / sell their compensation program at the market.

With reference to the recording period m the compensation program $\boldsymbol{COMP}_{km}(T)$ is calculated for each control area k and tariff period T during final accounting:

(14) $$COMP_{km}(T) = -\frac{ACC_{km}(T)}{Count(T)}$$

In this equation Count(T) represents the number of hours referring to the tariff period T in the compensation period m.

With equation (12), (13) and (14) follows for each compensation period m and tariff period T:

(15) $$0 = \sum_{k} COMP_{km}(T)$$

For the execution of the compensation program the figure $\boldsymbol{COMP}_{km}(T)$ referring to compensation period m and tariff period T is transferred to $\boldsymbol{COMP}_{kt}$ for each time unit t of the compensation period m. Equation (15) warrants the validity of equation (4).

During the accounting procedure the control deviation $\boldsymbol{CD}_{kt}$ can be calculated on the basis of the accounting data. Equations (8) and (10) result to:

(16) $$CD_{kt} = UD_{kt} - COMP_{kt}$$

The resulting $\boldsymbol{CD}_{kt}$ is usually taken for the statistic evaluation of the performance of load - frequency control (see Policy 1).

The same equations apply for the accounting of a control block.

2. Procedure

At first glance the compensation of any UNINTENTIONAL DEVIATIONS occurring between CONTROL AREAS/BLOCKS participating in the interconnected operation could be accounted entirely independent from one another. In practice, however, the likelihood of errors in the computations made for the determination relating to the programs for compensation by one or several participating CONTROL AREAS/BLOCKS cannot be ruled out entirely. Such errors might entail inconveniencies for practical operation and for final compensation for any deviations.

Consequently, the process of compensation of UNINTENTIONAL DEVIATIONS is organised, controlled and checked following the same procedure and hierarchical levels as the procedure for scheduling: CONTROL BLOCK operator checks and harmonises compensations among CONTROL AREAS under its jurisdiction, and CO-ORDINATION CENTRES do the same among CONTROL BLOCKS in their area of responsibility. In addition to that, CO-ORDINATION CENTRES North (Brauweiller) and South (Laufenburg) harmonise COMPENSATION PROGRAM among them, bringing such total COMPENSATION PROGRAM of UCTE interconnected power systems by default to zero. Figure 7 gives an overview of the different steps of accounting co-ordination and the corresponding gate closure times.

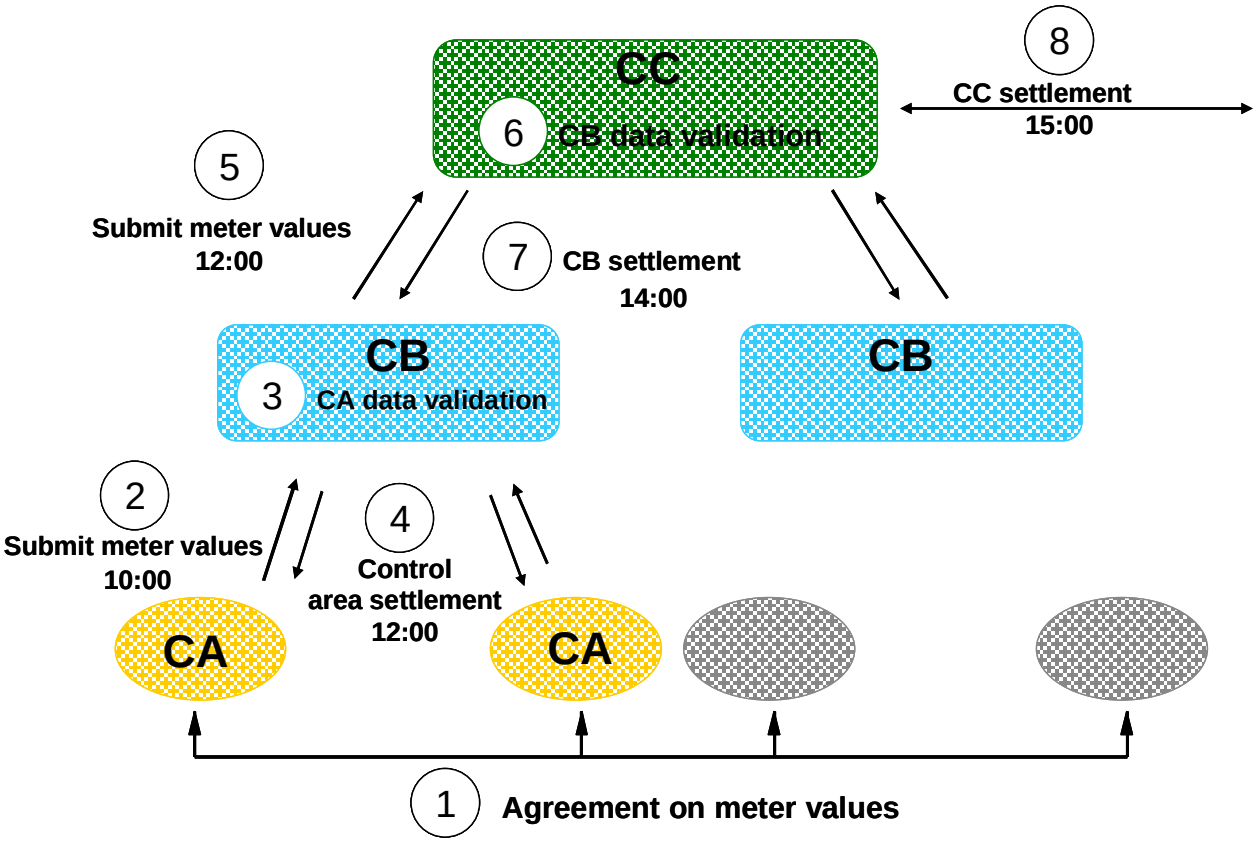


Figure 7: Process of Accounting Co-ordination at (D+1) including Gate Closure Times

The hierarchical procedure of the accounting co-ordination starts with the agreement of meter values among the control area operators joining one border. This step has to be completed until (D+1) 10:00. In case of problems concerning the metering or telecounting equipment the TSO's operating a common tie – line have to agree on unique substitute meter values.
The co-ordination procedure continues with the control area validation and settlement. The control area validation and settlement starts after completion of the verification of the meter

values by the submitting of at least the total physical flow per control area border and time unit from the control area operators to the control block operator concerned. It is recommended to submit the single meter values per tie – line and time unit to enable a faster procedure of fault detection. First the control block operator validates the complete data set received by checking equation (2) and (11) for the internal control area borders of its control block. Second the control block operator calculates the single control area's account of unintentional deviations for every tariff period for the day before (D), 24:00 and – in case of final accounting – the corresponding compensation program and submits the result to the control area operator concerned. The data has to be confirmed by the control area operator until (D+1) 12:00.

The next step of the co-ordination procedure is the control block validation and settlement. The control block validation and settlement starts after completion of the control block validation and settlement by the submitting of at least the total physical flow per control block border and time unit from the control block operators to the co-ordination centre concerned. It is recommended to submit the single meter values per tie – line and time unit to enable a faster procedure of fault detection. First the co-ordination centre validates the complete data set received by checking equation (2) and (11) for the internal control area borders of its area. Second the co-ordination centre calculates the single control block's account of unintentional deviations for every tariff period for the day before (D), 24:00 and – in case of final accounting – the corresponding compensation program and submits the result to the control block operator concerned. The data has to be confirmed by the control block operator until (D+1) 14:00.

The last step of the co-ordination procedure is the co-ordination centre settlement. The co-ordination centres calculate the sum of the control block's account of unintentional deviations for every tariff period for the day before (D), 24:00 and – in case of final accounting – the corresponding compensation program and validate the result vice - versa latest until (D+1), 15:00. The co-ordination centres submit to the control block operators the account of unintentional deviations for every tariff period for the day before (D), 24:00 after the completion of the co-ordination centre validation. The control block operators inform the control area operators accordingly.