

A2 – Appendix 2: Scheduling and Accounting

Appendix Chapters

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

Current Status

This document outlines additional information such as figures and timetables related to the Policy2 document

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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 TSO 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 and Settlement). 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 and 2).

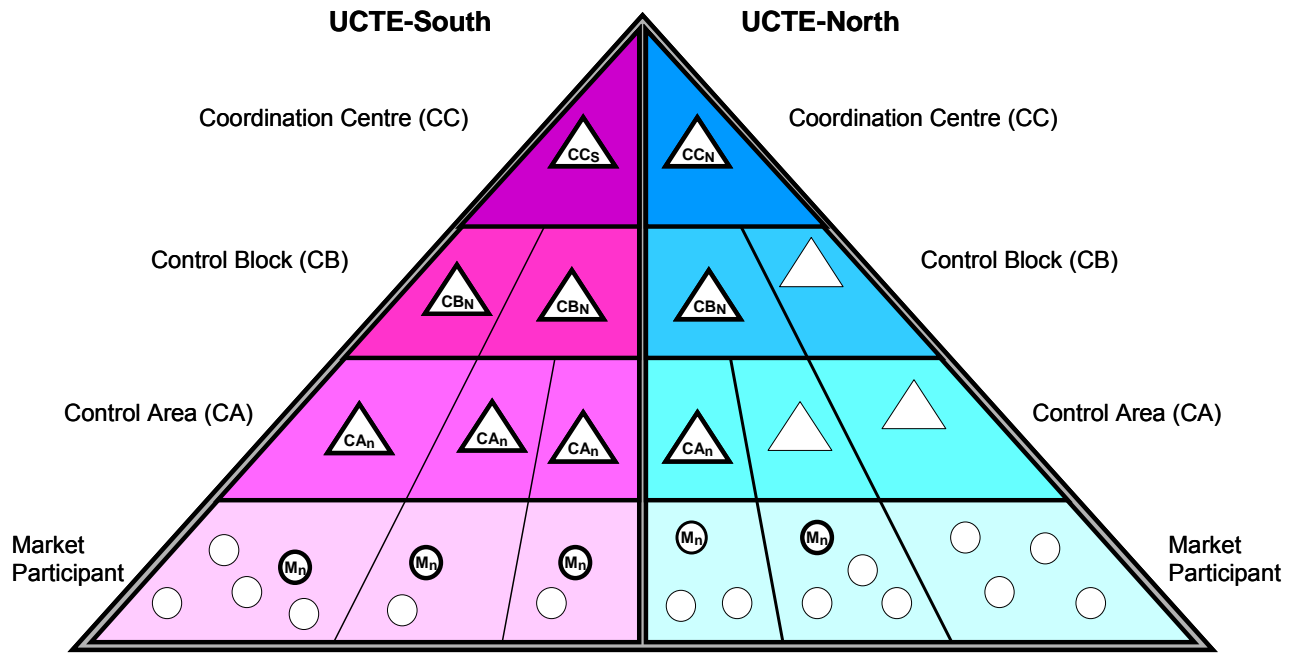


Figure 1: UCTE Pyramid

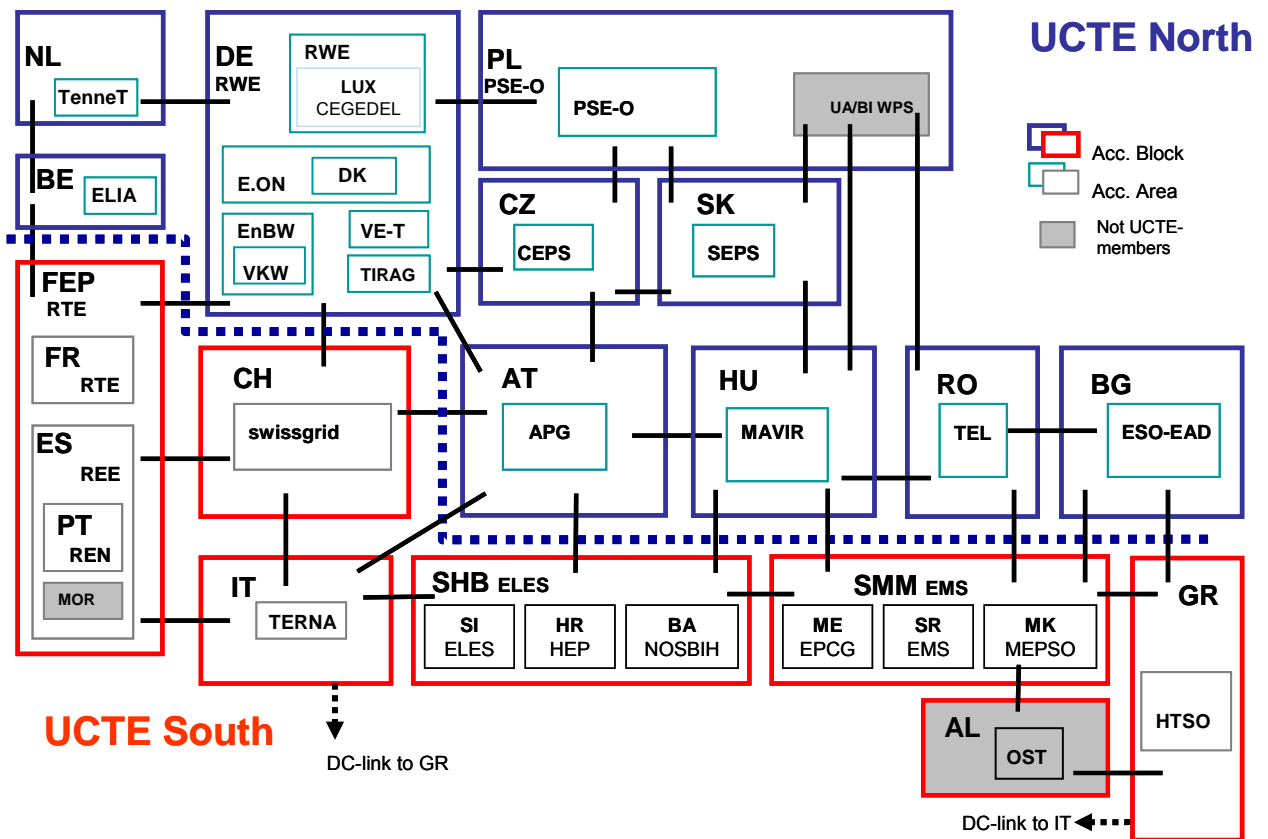


Figure 2: Hierarchical Levels of UCTE Co-ordination

A. Scheduling of Power Exchange

1. Basics

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. For further explanations the export direction counts positive and the import direction negative. 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:

$$ES_{kl\alpha\beta t}$$

The market participant β declares a corresponding exchange schedule $ES_{lk\beta\alpha t}$ within the Control Area l . The following equation applies:

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

Each Control Area operator k provides the nominated exchange schedules per time unit t and per border to an adjoining Control Area l $ES_{kl t}$. For each border between two Control Areas k and l the following equation applies.

$$(2) \quad ES_{kl t} = -ES_{lk t}$$

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 verify the equations introduced above an information exchange has to be set up among the parties involved. In figure 3 several types of information exchanges are introduced (Market Party Schedule, CAS, CAX, CBS (including CBSb and CBSm), CCT) including a description of sender and receiver of the information. Obviously, the Market Party Schedule has to include the details of trades respectively contracts 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. The CAX, CBS and CCT has to include the same level of details.

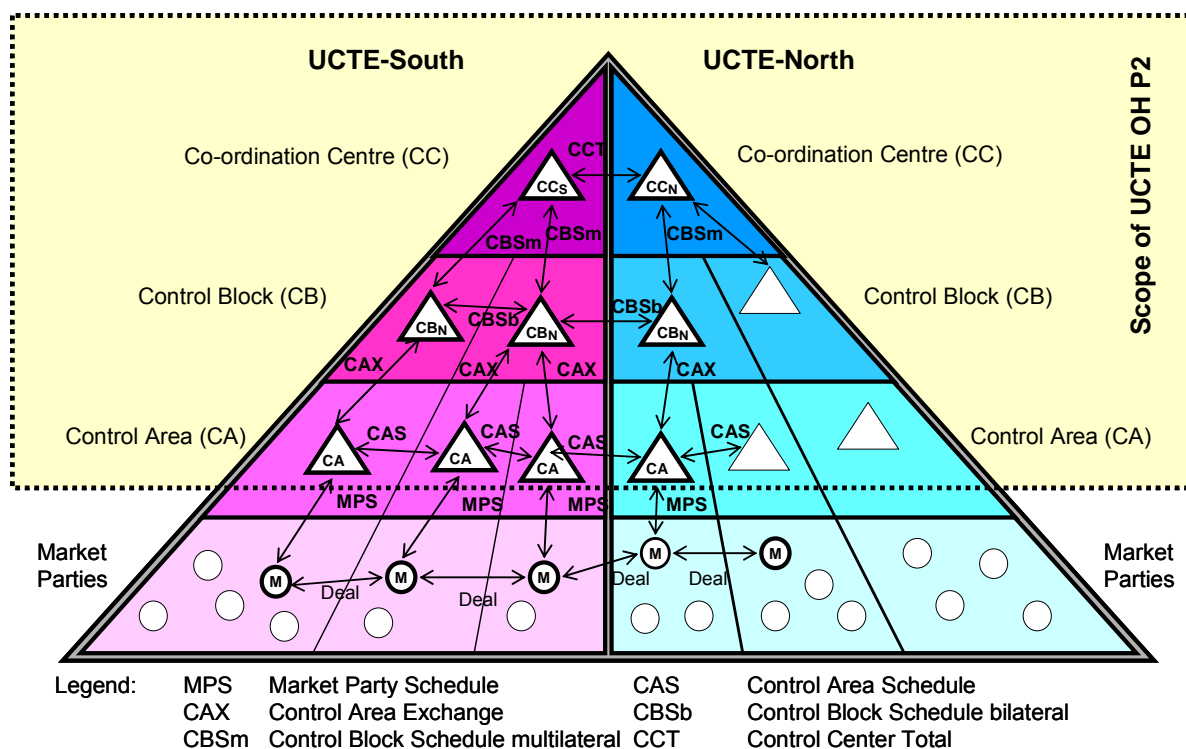


Figure 3: Information exchange for the scheduling process in the UCTE Pyramid

The hierarchical procedure of the schedule management co-ordination starts with the nomination of schedules of the Market Parties towards the related Control Area. This nomination process stops at Gate Closure Time and is followed by the exchange and matching of a CAS between the Control Area Operators to check the validity of equation (1). In case of any discrepancies the affected market parties and time units are identified and the Market Parties are asked for correction. If the discrepancy can not be solved until Cut-Off Time pre-agreed rules have to be applied. After successful matching on Control Area level the operator sends a confirmation report to the market parties in question.

The co-ordination procedure continues with the control block matching which starts after completion of the control area matching by the submitting of CAX from the control area operators to the control block operator concerned. The control block operator has to match his internal Control Area borders (checking equation (2)). In addition he assembles and transmits the CBSb. After receiving the CBSb he matches the external control area borders of his control block (checking equation (2)).

The last step of the co-ordination procedure is the co-ordination centre matching which starts after completion of the control block matching by the submitting of CBSm from the control block operators to the co-ordination centre operators concerned. The co-ordination centre operator has to match his internal control block borders (checking equation (2)). In addition he assembles and transmits the CCT. After receiving the CCT he matches the external control area borders between UCTE North and South (checking equation (2)).

B. Online Observation

1. Definitions

During online operation each control area operator k calculates the control program CTP_{kt} from the total exchange schedules agreed during the schedule management process and its compensation program CP_{kt} for each time unit t :

$$(3) \quad CTP_{kt} = \sum_l ES_{klt} + CP_{kt}$$

The control program CTP_{kt} represents the planned total exchange of the control area. For the sum of compensation programs the following equation applies:

$$(4) \quad 0 = \sum_k CP_{kt}$$

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 $ET_{kl\gamma t}$. The following equation applies in the range of accuracy of the measurement:

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

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 physical exchange flow ET_{kt} . For each border between two Control Areas k and l the following equation applies in the range of accuracy of the measurement:

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

During online operation each control area operator k calculates its total real exchange ET_{kt} :

$$(7) \quad ET_{kt} = \sum_l ET_{klt}$$

The load frequency controller uses the control deviation CD_{kt} :

$$(8) \quad CD_{kt} = (ET_{kt} - EVT_{kt}) - CTP_{kt}$$

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, resulting in a permanent frequency deviation, the following equation has to apply in the range of accuracy of the measurement:

$$(9) \quad 0 = \sum_k CD_{kt}$$

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 ET_{klyt} and its control deviation 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 ET_{klyt} and its control deviation 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).

C. Accounting and Settlement of Unintentional Deviations

The following figures and timetables refer to Policy 2 part C Accounting and Settlement and should support the understanding of the processes. All figures are examples and the values are fictional.

Daily settlement report for Control Block FEP

Recording period:	11.11.06 - 11.11.06	Issuing date	13.11.2006
		Issuing time	16:29:16
		Page	1
		Tariff:	UCTE

Tariff	HT1	HT2	HT	NT	Total	Unit
Account at recording start	-200.00	0.00	0.00	-859.00	-1'059.00	MWh
Accounting relevant schedule	15'400.00	0.00	0.00	157'615.00	173'015.00	MWh
Accounting relevant flow	15'244.00	0.00	0.00	157'200.00	172'444.00	MWh
Unintentional Deviation during period	-156.00	0.00	0.00	-415.00	-571.00	MWh
Account at recording end	-356.00	0.00	0.00	-1'274.00	-1'630.00	MWh

Figure 1: “Example of Daily Settlement Report – mandatory overview part”

Detailed daily settlement report for Control Block FEP

Period:	11.11.06 - 11.11.06	Date	13.11.2006
		Time	16:29:16
		Page	1
		Tariff:	UCTE

Accounting relevant schedule

Tariff	HT1	HT2	HT	NT	Total	Unit
RTE_swissgrid	5'000.00	0	0	58'015.00	63'015.00	MW
RTE_ENBW	300.00	0	0	1'600.00	1'900.00	MW
RTE_RWE	2'800.00	0	0	22'000.00	24'800.00	MW
RTE_TERNA	4'300.00	0	0	48'000.00	52'300.00	MW
RTE_ELIA	3'000.00	0	0	28'000.00	31'000.00	MW
Total program	15'400.00	0.00	0.00	157'615.00	173'015.00	MW

Compensation schedule for unintentional deviation during period

	HT1	HT2	HT	NT	Total	Unit
FEP_Comp	-60.00	0.00	0.00	-66.00	-146.00	MW

Accounting relevant flow

EIC-Z-Code	HT1	HT2	HT	NT	Total	Unit
ALVCROD1ZHAT	1'200.00	0	0	14'000.00	15'200.00	MWh
ALVCROD1ZHBT	0	0	0	0	0.00	MWh
ALVCROD2ZHAT	1'100.00	0	0	13'000.00	14'100.00	MWh
ALVCROD2ZHBT	0	0	0	0	0.00	MWh
BOOCCAM_ZHBT	0	0	0	0	0.00	MWh
Total flow	2'300.00	0.00	0.00	27'000.00	29'300.00	MWh

Figure 2: “Example of Daily Settlement Report – detailed part”

Final weekly settlement report for Control Block FEP

Recording period: 11.11.06 - 17.11.06
 Compensation period: 23.11.06 - 29.11.06

Issuing date 21.11.2006
 Issuing time 16:29:16
 Page 1
 Tariff UCTE

Tariff	HT1	HT2	HT	NT	Total	Unit
Hours during compensation period	10	0	0	20		hour
Account at recording start	-200.00	0.00	0.00	-859.00	-1'059.00	MWh
Accounting relevant schedule	15'400.00	0.00	0.00	157'615.00	173'015.00	MWh
Accounting relevant flow	15'244.00	0.00	0.00	157'200.00	172'444.00	MWh
Uninintentional Deviation during period	-156.00	0.00	0.00	-415.00	-571.00	MWh
Account at recording end	-356.00	0.00	0.00	-1'274.00	-1'630.00	MWh
Compensation schedule	-36.00	0.00	0.00	-64.00	-100.00	MW

Figure 3: “Example of Weekly Settlement Report – mandatory overview part”

Detailed final settlement report for Control Block FEP

Recording period: 11.11.06 - 17.11.06
 Compensation period: 23.11.06 - 29.11.06

Date 21.11.2006
 Time 16:29:16
 Page 2
 Tariff: UCTE

Accounting relevant schedule

Tariff	HT1	HT2	HT	NT	Total	Unit
RTE_swissgrid	5'000.00	0	0	58'015.00	63'015.00	MW
RTE_ENBW	300.00	0	0	1'600.00	1'900.00	MW
RTE_RWE	2'800.00	0	0	22'000.00	24'800.00	MW
RTE_TERNA	4'300.00	0	0	48'000.00	52'300.00	MW
RTE_ELIA	3'000.00	0	0	28'000.00	31'000.00	MW
Total program	15'400.00	0.00	0.00	157'615.00	173'015.00	MW

Compensation schedule for unintentional deviation during period

	HT1	HT2	HT	NT	Total	Unit
FEP_Comp	80.00	0.00	0.00	-66.00	-146.00	MW

Accounting relevant flow

EIC-Z-Code	HT1	HT2	HT	NT	Total	Unit
ALVCROD1ZHAT	1'200.00	0	0	14'000.00	15'200.00	MWh
ALVCROD1ZHBT	0	0	0	0	0.00	MWh
ALVCROD2ZHAT	1'100.00	0	0	13'000.00	14'100.00	MWh
ALVCROD2ZHBT	0	0	0	0	0.00	MWh
BOCCAM_ZHBT	0	0	0	0	0.00	MWh
Total flow	2'300.00	0.00	0.00	27'000.00	29'300.00	MWh

Figure 4: “Example of Weekly Settlement Report – detailed part”

Timetable 1: for daily accounting and settlement process

Note: the following timing (if not expressed differend) is valid for the next workday

Action	data only for one day		Data for more than one Day (e.g. after weekend, holidays, etc.)	
	Gate closure	Cut Off time (Agreement deadline)	Gate closure	Cut Off time (Agreement deadline)
Meter data delivery to neighbouring TSO	10:00 AM	1:00 PM	10:00 AM	1:00 PM
Accounting data delivery to neighbouring TSO	1:30 PM	2:00 PM	1:30 PM	4:00 PM
Delivery of agreed accounting data by TSO to control area Note: if disagreement: available data have to be send		2:00 PM		4:00 PM
Delivery of agreed accounting data to control block		2:30 PM		4:30 PM
Delivery of agreed accounting data to coordination centre (CC)		3:00 PM		5:00 PM
Accounting data delivery to neighbouring CC		3:15 PM		5:15 PM

Action	Deadline	data for more than one day (e.g. after weekend, holidays, etc.)	
		Deadline	Deadline
Exchange of report between coordination centre (CC)	3:45 PM	Tu 10:00 AM	
Delivery of report by CC to control block (CB)	4:00 PM	Tu 10:15 AM	
Delivery of report by CB to control area (CA)	4:15 PM	Tu 10:30 AM	

Timetable 2: For weekly accounting and settlement process

Note: the following timing is valid for Tuesday respectively the next working day after Tuesday

Timetable 2a: Timing of final weekly accounting data delivery	
Action	Cut Off time (Agreement deadline)
Accounting data delivery to neighbouring TSO	1:00 PM
Delivery of agreed accounting data by TSO to control area	1:30 PM
Delivery of agreed accounting data to control block	1:45 PM
Delivery of agreed accounting data to coordination centre	2:00 PM
Accounting data delivery to neighbouring CC	2:15 PM

Timetable 2b: Timing for delivery of settlement report and programs for compensation of unintentional deviations	
Action	Deadline
Exchange of report between coordination centre (CC)	3:30 PM
Delivery of report by CC to control block (CB)	4:00 PM
Delivery of report by CB to control area (CA)	4:30 PM

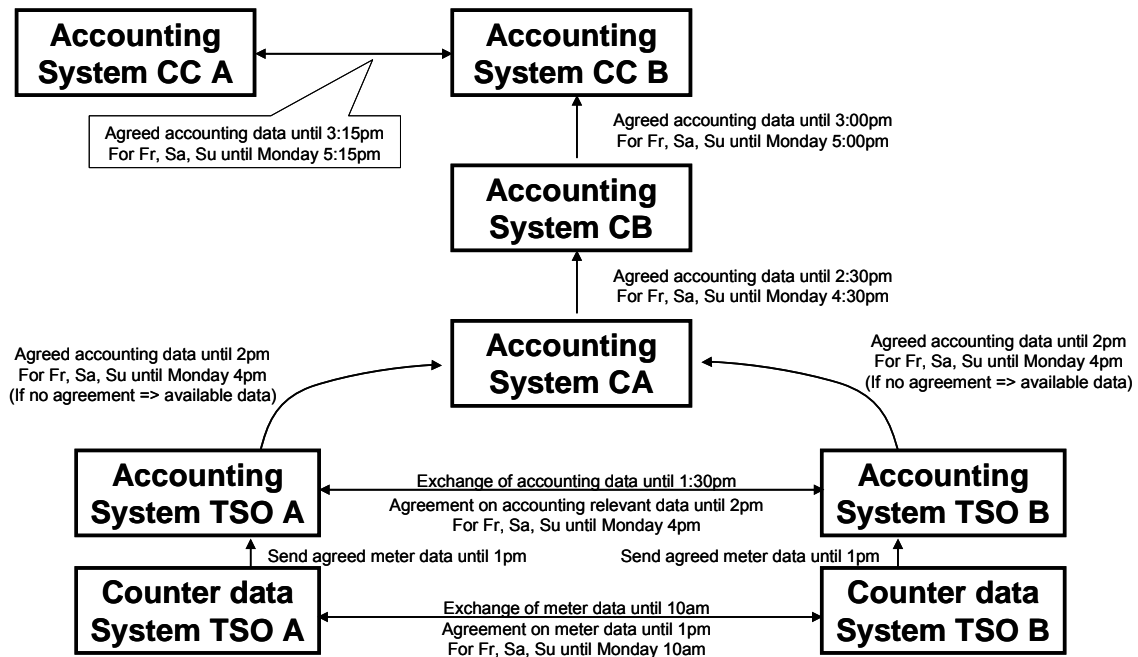


Figure 5: Timing of daily accounting data exchange

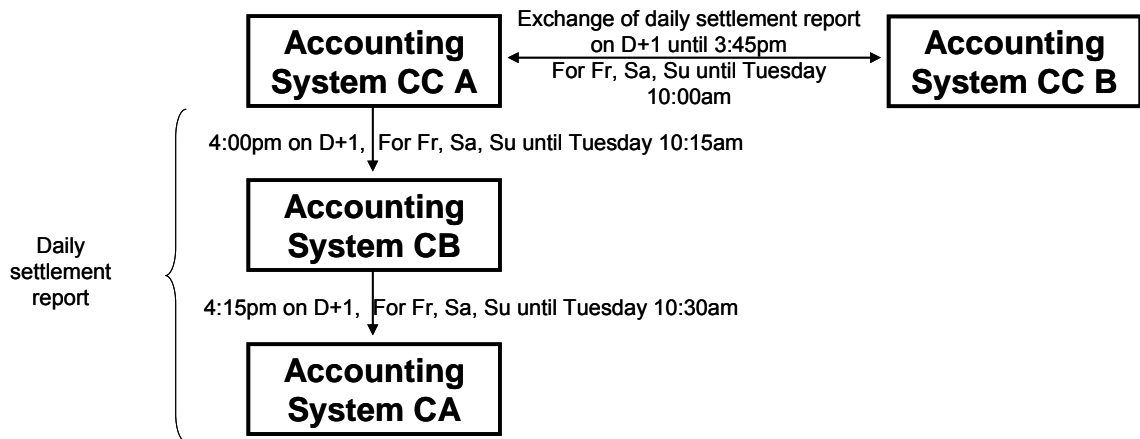


Figure 6: Timing of daily settlement report

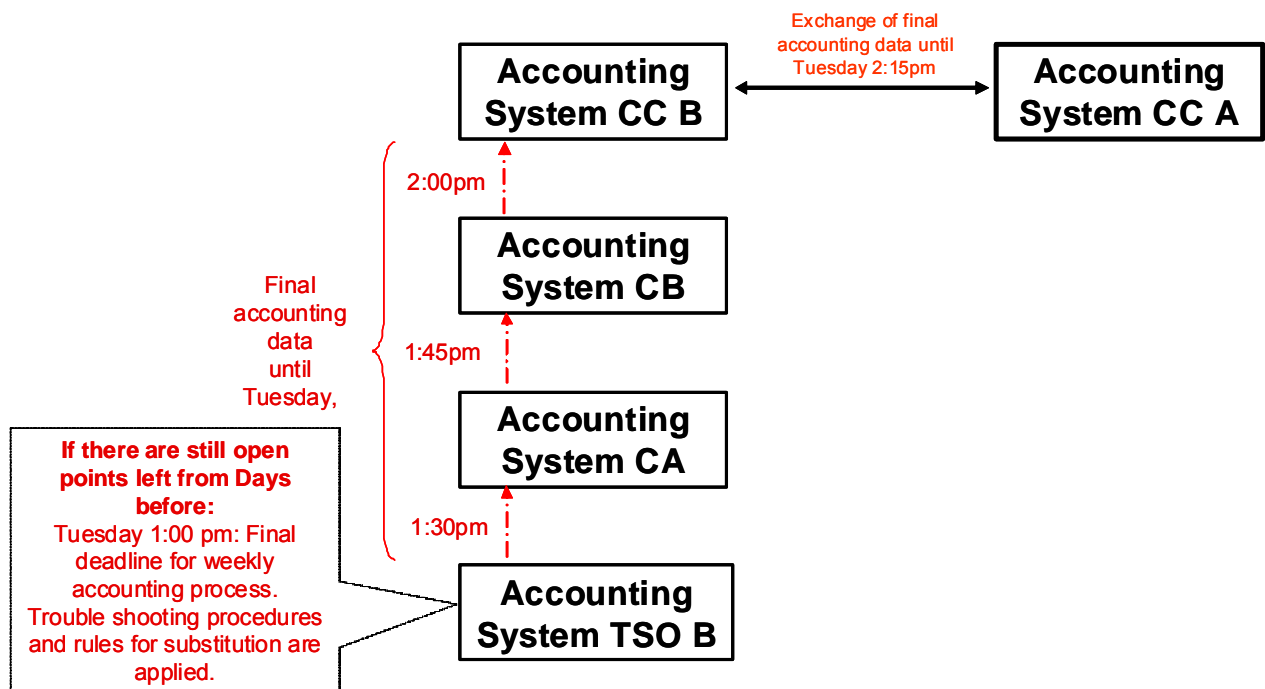


Figure 7: Timing of final weekly accounting data

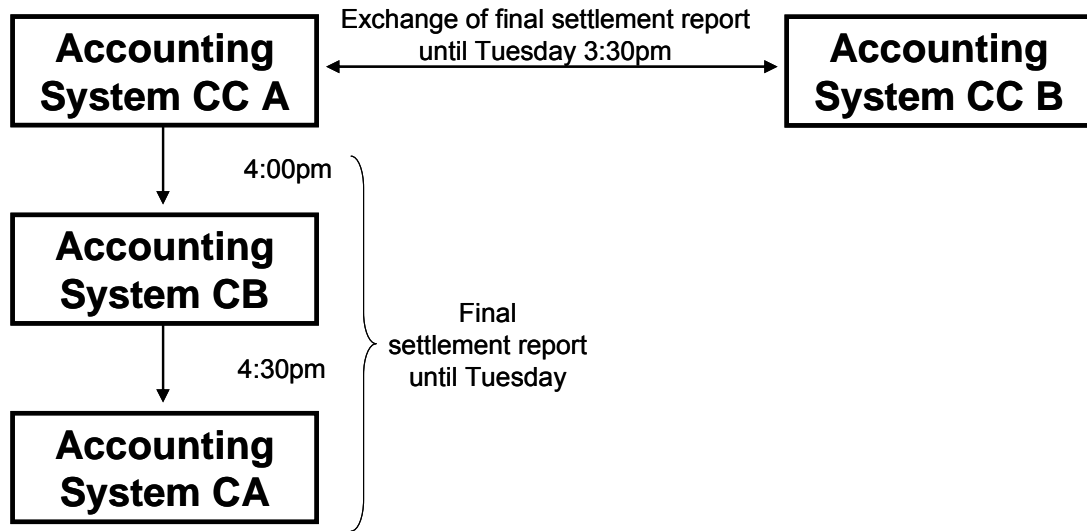


Figure 8: Timing for final weekly settlement report

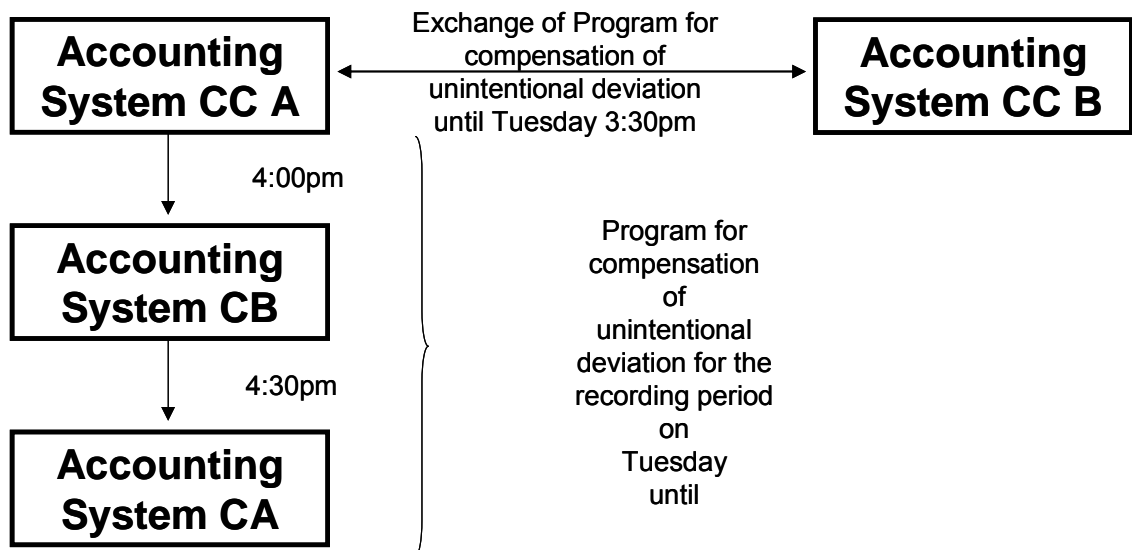


Figure 9: Timing for distribution of program for compensation of unintentional deviations

UD = Unintentional Deviation

h_c = number of compensation Hours in tariff

T = Tariff

RP = Responsible Party for calculation of UD on dedicated UCTE pyramid level

P = Party (In UCTE accounting process involved Party on dedicated UCTE pyramid level excluding the RP)

$CP_{T,h}(h_c)$ = Compensation Power per hour in compensation period per tariff for upper UCTE pyramid level

$CP_{P,T,h}(h_c)$ = Compensation Power per hour in compensation period per party and tariff

$CP_{RP,T,h}(h_c)$ = Compensation Power per hour in compensation period for the RP per tariff

$E_{UD,T}$ = Energy on UD account (accumulated during recording phase) per tariff for upper UCTE pyramid level

$E_{UD,P,T}$ = Energy on UD account (accumulated during recording phase) per player and tariff

N_{Party} = Number of Parties on dedicated UCTE pyramid level excluding RP

n = sequence number of recording period

$$CP_{T,h}(h_c) = \text{round} \left[\frac{E_{UDn,T}}{h_c} \right]$$

$$CP_{P,T,h}(h_c) = \text{round} \left[\frac{E_{UDn,P,T}}{h_c} \right]$$

$$\begin{aligned} CP_{RP,T,h}(h_c) &= CP_{T,h}(h_c) - \left[CP_{P_1,T,h}(h_c) + CP_{P_2,T,h}(h_c) + CP_{P_3,T,h}(h_c) + \dots + CP_{P_n,T,h}(h_c) \right] \\ &= \sum_{i=1}^{N_{Party}} CP_{P_i,T,h}(h_c) \end{aligned}$$

$$E_{UDn+1,P,T} = E_{UDn,P,T} - h_c * CP_{P,T}$$

$$E_{UDn+1,RP,T} = E_{UDn,RP,T} - h_c * CP_{RP,T}$$

Figure 10: Detailed formula for the determination of the schedules for compensation of unintentional deviation

Figure 11: Example for splitting down of the program for compensation of UNINTENTIONAL DEVIATIONS among the UCTE parties

The following examples show the derivation of the programs for compensation of unintentional deviation for the recording period 13.11.2006 to 19.11.2006 and tariff H1 for the Control Blocks in Co-ordination Centre- South and North as well as for the Control Areas in Control Block Germany.

The table below show the split of the program for compensation of unintentional deviation between the Control Blocks in Co-ordination Centre South.

Rounding to full MW				Recording period 13.11.2006 to 19.11.2006			
				Tariff H1			
				Tariff hours in comp.- period : 10			
Name of CC respectively CB	Account before compensation	Compensation schedule	Account after compensation	Name of CC respectively CB	Account before compensation	Compensation schedule	Account after compensation
	MWh	MW	MWh		MWh	MW	MWh
CC-North	651.043	65.000	1.043	CC-North	651.043	65.000	1.043
FEP	776.000	78.000	-4.000	FEP	776.000	78.000	-4.000
IT	-461.000	-46.000	-1.000	IT	-461.000	-46.000	-1.000
SHB	-452.040	-45.000	-2.040	SHB	-452.040	-45.000	-2.040
CH	-357.003	-36.000	2.997	CH	-357.003	-37.000	12.997
AL	135.000	14.000	-5.000	AL	135.000	14.000	-5.000
JIEL	-232.000	-23.000	-2.000	JIEL	-232.000	-23.000	-2.000
GR	-60.000	-6.000	0.000	GR	-60.000	-6.000	0.000
Total	0.000	1.000	-10	Total	0.000	0.000	0.000
CC-South delta (MW)				-1.000			
Total of CC-South in tariff (MWh)				-10.000			
Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool				Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool			

Like illustrated Switzerland as Co-ordination Centre south responsible Control Block has to take over the rounding differences.

The table below shows the split of the program for compensation of unintentional deviation between the Control Blocks in Co-ordination Centre North.

Rounding to full MW				Recording period 13.11.2006 to 19.11.2006			
				Tariff H1			
				Tariff hours in comp.- period : 10			
Name of CC respectively CB	Account before compensation	Compensation schedule	Account after compensation	Name of CC respectively CB	Account before compensation	Compensation schedule	Account after compensation
	MWh	MW	MWh		MWh	MW	MWh
CC-South	-651.043	-65.000	-1.043	CC-South	-651.043	-65.000	-1.043
Centrel	252.047	25.000	2.047	Centrel	252.047	25.000	2.047
TENNET	-0.791	0.000	-0.791	TENNET	-0.791	0.000	-0.791
ELIA	104.910	10.000	4.910	ELIA	104.910	10.000	4.910
APG	49.898	5.000	-0.102	APG	49.898	5.000	-0.102
TEL	-84.830	-8.000	-4.830	TEL	-84.830	-8.000	-4.830
NEK	60.102	6.000	0.102	NEK	60.102	6.000	0.102
DE	269.707	27.000	-0.293	DE	269.707	27.000	-0.293
Total	0.000	0.000	0.000	Total	0.000	0.000	0.000
CC-North delta (MW)				0.000			
Total of CC-North in tariff (MWh)				0.000			
Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool				Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool			

In this example there occur no rounding differences in the split of the program for compensation of unintentional deviation for the Control Blocks in the Co-ordination Centre North.

The table below shows the split of the program for compensation of unintentional deviation between the Control Area in Control Block Germany.

Rounding to full MW	Recording period 13.11.2006 to 19.11.2006		
	Tariff H1		
	Tariff hours in comp.- period : 10		
Name of CB respectively CA	Account before compensation MWh	Compensation schedule MW	Account after compensation MWh
DE	-269.707	-27.000	0.293
EnBW	-85.249	-9.000	4.751
E.ON	-932.104	-93.000	-2.104
RWE	1354.543	135.000	4.543
TIRAG	78.984	8.000	-1.016
VE-T	-146.467	-15.000	3.533
Total	0.000	-1.000	10.000
CB-DE delta (MW)	1.000		
Total of CB-DE in tariff (MWh)	10.000		
Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool			

Rounding to full MW	Recording period 13.11.2006 to 19.11.2006		
	Tariff H1		
	Tariff hours in comp.- period : 10		
Name of CB respectively CA	Account before compensation MWh	Compensation schedule MW	Account after compensation MWh
DE	-269.707	-27.000	0.293
EnBW	-85.249	-9.000	4.751
E.ON	-932.104	-93.000	-2.104
RWE	1354.543	136.000	-5.457
TIRAG	78.984	8.000	-1.016
VE-T	-146.467	-15.000	3.533
Total	0.000	0.000	0.000
CB-DE delta covered by RWE (MW)	1.000		
Total of CB-DE in tariff covered by RWE (MWh)	10.000		
Positive sign = UCTE_pool to Party Negative sign = Party to UCTE-Pool			

Like illustrated RWE as Control Area responsible party for Control Block Germany has to take over the rounding differences.

UCTE registration form for accounting process including tie-lines

Requesting TSO A:	
Responsible person:	
Phone number :	
Email:	
Responsible CA:	
Responsible CB:	
Responsible CC:	

Requesting TSO B:	
Responsible person:	
Phone number :	
Email:	
Responsible CA:	
Responsible CB:	
Responsible CC:	

- New Tie line
- Mutation of the existing Tie line

Requested implementation date:	
Tie-line name and (if available) EIC T Code	
Tie line topology:	<input type="radio"/> Single tie line <input type="radio"/> T-Tie line
Accounting point location:	<input type="radio"/> at TSO A <input type="radio"/> at TSO B <input type="radio"/> on the border (losses considered)
Name of Substations:	Substation 1 _____ located at TSO _____ Substation 2 _____ located at TSO _____ If T- Tie-line Substation 3 _____ located at TSO _____
Voltage level:	<input type="radio"/> 750 KV <input type="radio"/> 110 KV <input type="radio"/> 380 KV <input type="radio"/> 63 KV <input type="radio"/> 220 KV <input type="radio"/> ≤ 63 KV
Resolution of data	<input type="radio"/> MWh <input type="radio"/> kWh
Connection Type:	<input type="radio"/> AC <input type="radio"/> DC
Time interval of time series resolution:	<input type="radio"/> 1/4h <input type="radio"/> 1/4h <input type="radio"/> 1h

- Changes in the accounting process

Requested implementation date	
Unit of account of unintentional deviation:	<input type="radio"/> MWh <input type="radio"/> kWh
Time resolution of account of unintentional deviation:	<input type="radio"/> 1/4h <input type="radio"/> 1/4h <input type="radio"/> 1h

Additional information :

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TSO A: Responsible person Date, Signature _____

TSO B: Responsible person: Date, Signature _____

Figure 12: UCTE registration form for accounting process including tie-lines