UNIVERSITY POLITEHNICA of BUCHAREST

RBM Administrator Help

Regional Balance Mechanism (RBM) - Software Documentation

UNIVERSITY POLITEHNICA OF BUCHAREST

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PROJECT

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Content

1. General SEETSOC Approach

To provide the appropriate RBM solution, SEETSOC assessed and analyzed functions and transactions on the current national BMs and identified the following basic options:

- A central platform for the RBM that is operated by the Operator of the SEE – RBM trading platform (RBM – O), as Imbalance Settlement Responsible (ISR) and the contracting party of corresponding BEPs for all transactions concluded in the RMBE

- TSOs as Balance Energy Participants (BEPs), as well as control area BRPs, submit day–ahead (D-1) and intraday (D) bids to RBM platform, separately for up- and down-ward regulation

- The Balance Energy (BE) price is determined for the required BE, which is found at the intersection of sell-bid and buy-bid merit order curves for each type of BE

- The allocation of interconnection capacity for the central RBM platform is cost-free, i.e., balancing bids are activated only when they can be transferred through non–congested borders

- Selected bids are transformed into BE transactions (as imbalance quantity – price pairs) after their execution and settlement

- Offer execution and corresponding BE volume is the result of TSOs' purchasing orders for the use of accepted BE bids

- The imbalance price in each balancing interval is determined so that the BE value equals the total power imbalance value.
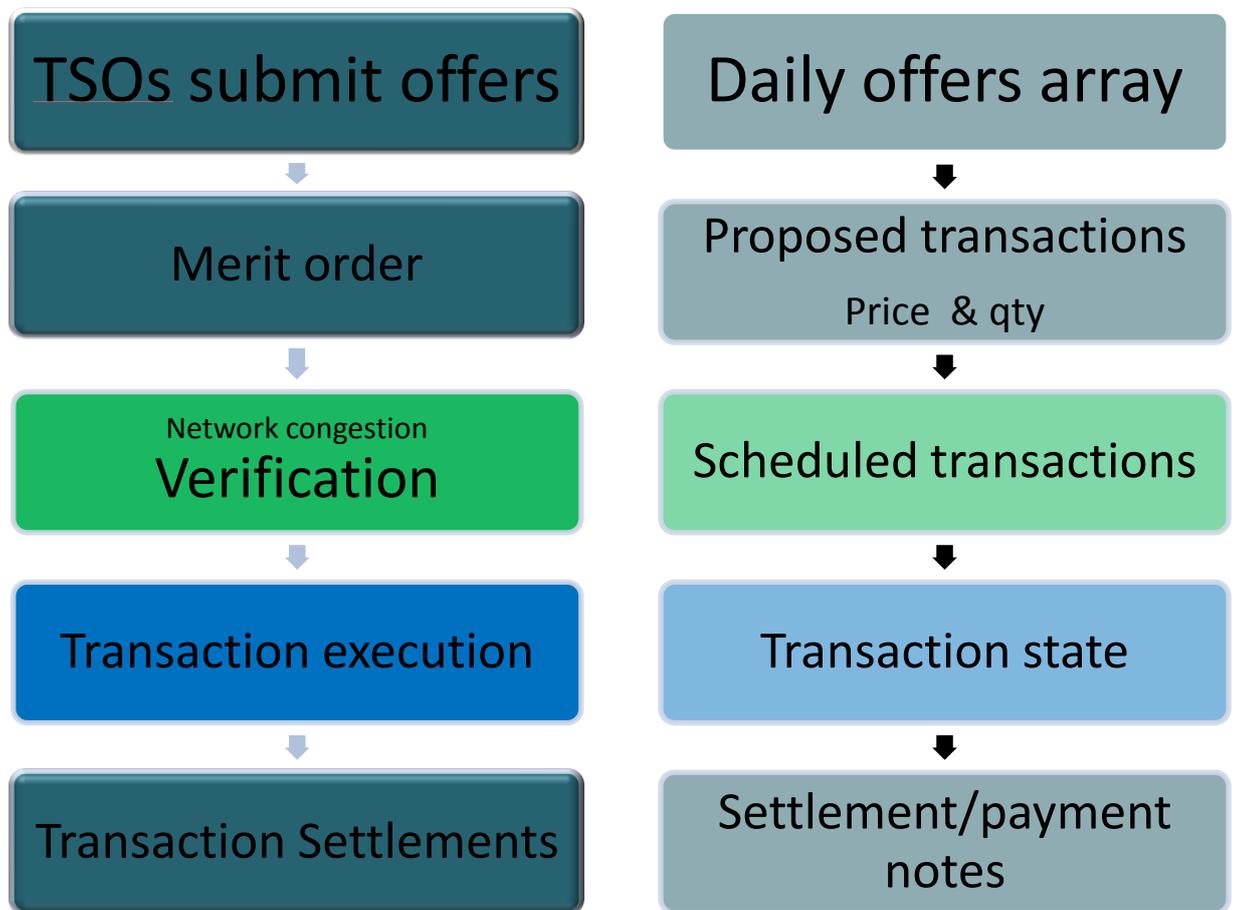
Figure 1. RBM processes and results.

2. RBM Process

The RBM for both the day–ahead and intraday transactions determines the transaction volumes and payments resulting from the selected offers in a three – step procedure, namely:

- Placing of offers for each balancing interval and each BE type followed by their formal acceptance / rejection.
- Offer selection. A fixed and firm schedule bidding for the BE is carried out that ensures transaction selection and pricing, i.e. the establishment of RMBE clearing prices.

- Notification and transaction settlement. The schedule is executed during the dispatching day (D). For each balancing interval, the imbalance quanty – price pair is established based on the final dispatch order for the BE purchase.
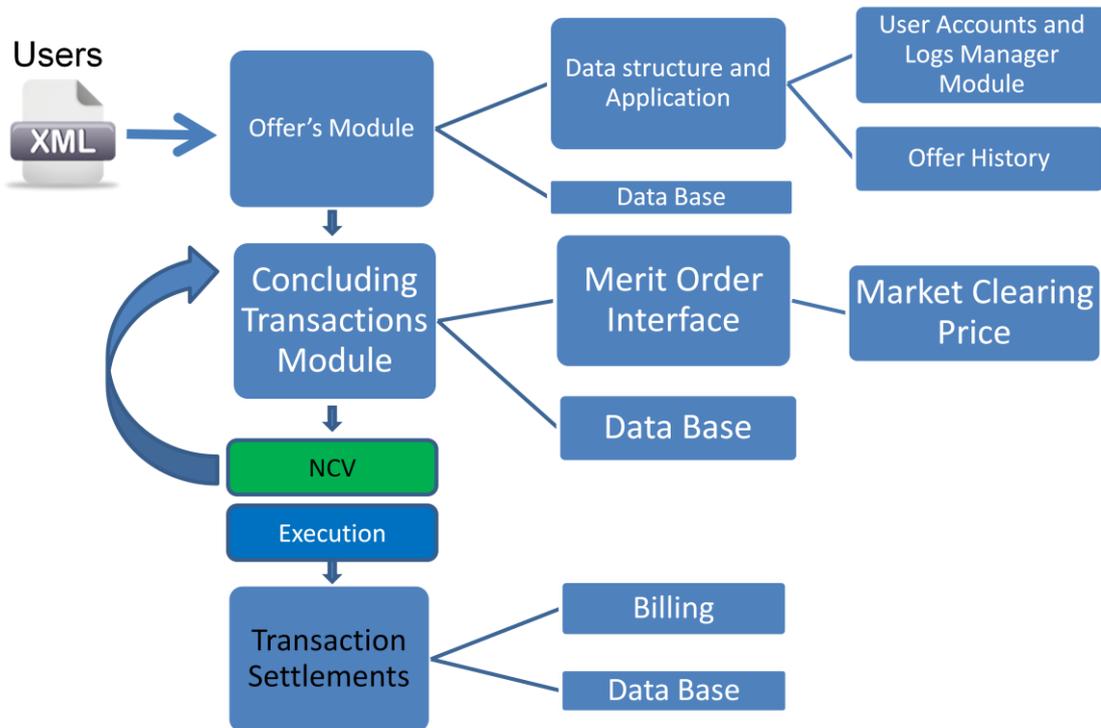
Figure 2. Regional Balancing Mechanism (RBM).

2.1. Day-Ahead balance energy transactions

- The Sell-type offers are sent by the TSOs with exceeding balance energy, whereas the Buy-type offers are sent by the TSOs with deficient balance energy.
- The offers are selected in Merit Order (MO) for each regulation type and each hour of Delivery Day (D). The cheapest units for both the generation uploaded or downloaded are selected.
- The unitary price of the unit last called upon in each hour is found at the intersection of the corresponding sell and buy merit order curves; this defines the price of BE for the specific hour, i.e., the RMBE clearing price for the particular balancing interval.

- The offers are checked against the available transmission capacity of cross–border interconnections in the region; this function is carried out by the **Clearing Balance Energy on RMBE** subsystem.

2.2. Intraday balance energy transactions

- An Intraday (ID) market provides a service to market participants to adjust their balance before the operational hour. This will reduce the balancing actions to be carried out by the dispatching operator in real time.
- The ID - RBM system will accept intraday offers with a view to re-optimizing dispatch of power systems within the day.
- There will be intra-day offer acceptance gates, which open/close according to the RBM system settings. The gates status will be available for all certified users in read-only mode.
- The offers are selected in Merit Order (MO) for each regulation type and each hour of Delivery Day (D), and checked against the available transmission capacity; this function is carried out by the **Clearing Balance Energy on RMBE** subsystem.

2.3. Clearing Balance Energy on RMBE

- The offers are accepted into the RBM system after offer gate opening. All certified users are able to see the offer gate status in a dedicated section of the RMB application.
- Offer reception into the system contains two steps: offer parsing and offer validation.
- ATC compliance is checked on the base of PTDFs coefficients. Generally, a PTDF is a fraction of the amount of a transaction from one zone to another. In this case, a balancing energy offer is related to a CB border.
- The clearing mechanism is based on the Merit Order with multiple sellers and buyers. The clearing price is not influenced by transmission congestion because the CB transmission capacity is allocated free of charge.

- After each offer submission, the system sends an ACK (acknowledgement) which certifies the formal acceptance/rejection of offer into the RBM system. In case of rejection, the ACK will specify the reason for the rejection.

- Under XML parsing, one error leads to the rejection of the entire XML (all offers within the XML will be rejected).

- After parsing, each formally accepted offer is validated according to the settings established in the system. The validation process releases an ACK to inform the TSOs about the validity of daily offers.

- Each offer is stored into the system (regardless of its status – accepted/rejected) with a *unique* ID together with the submission *time stamp* and *status* (*accepted* or *rejected*), and the *user* that submitted the offer.

- Until the gate closure time of offers (a general parameter for the system), users can cancel one or more bids (even the entire offer) by submitting a higher bid version with zero price and zero quantity.

2.4. Actual delivery of balancing energy - Executing Transactions

- RMBE resources are mobilized by dispatch instructions for BE purchase in each control area for each balancing interval.

- The RBM system calculates the final dispatch order as the sum of all dispatch orders for both up-ward and down-ward regulation issued for the respective hour.

- The transactions are established for each TSO as inbalance quantity – price pairs.

- Transactions settlement is based on the Surplus/Deficit Inbalance Prices for each balancing interval.

3. Product Overview

The RBM system has a modular design using standard interfaces and XML-formatted messaging, web-based interfaces and web services for the system users. It could also be a stand-alone program which can be installed anywhere in a TSO's operational network and integrated into the existing Market Management Systems (MMS) which are used in the TSO-run centralized electric markets.

3.1. Actors

An overview of the Use Cases in which the actors (external users) and systems interact with the RBM system is given in the use cases diagram in the UML (Figure 3) .
The participating actors are as follows:
In addition, the entire system rests upon a complex authentication and authorization subsystem. Users can be members of either of the following two groups:

- *Users*: These users can upload offers, but they cannot view offers uploaded by other members and they cannot modify any data stored on the server. They can amend previously uploaded offers, but only by uploading a new version.

- *Administrators*: Members of this group can freely access and modify all data stored on the server, but has to notify the users whose data is being affected and cannot upload offers themselves.

The SEETSOC RBM application uses an authentication and authorization method known as role-based authorization (RBA). The basic idea behind RBA is that every user of the system can have one or more associated *roles,* and an action can only be *performed* by someone who holds a single particular *role*. Users obtain their role by being part of a *group*, which is why we will use the terms *group* and *role* interchangeably.

In the SEETSOC RBM application, an user can be part of either one of the two major groups: User (also called Participant) and Administrator. In general, we recommend that an user be part of only one of these groups, but the application does not otherwise forbid

double membership. In addition, each user has a single, individual group, of which only he is a member (which is explained below, but currently not used in the application).
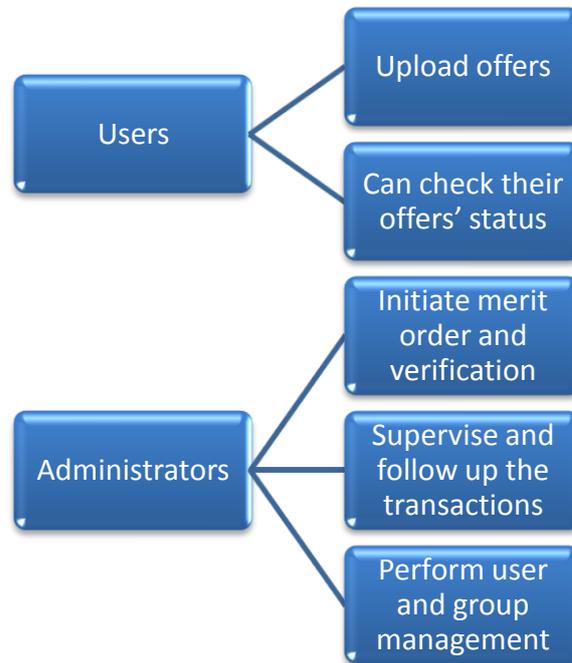

Figure 3. Actors implied in RBM.

3.1.1. RBM Operator

Actor Details		
Actor ID	ACTOR-1	
Actor Name	RBM Operator of the SEE RBM trading platform (RBM-O)	**RBM-O Operator**
Brief Description	This actor represents a user that operates and has administrative access to the RBM system.	
Responsibilities	The RBM-O is responsible for running the RBM system, namely: They receive orders for (intermediating) RMBE transactions of Day – ahead energy balancing and Intraday energy balancing They serve the function of clearing balance energy. They facilitate settlement for transactions on the RMBE.	

3.1.2. Regional TSOs

Actor Details	
Actor ID	ACTOR-2
Actor Name	Regional TSOs
Brief Description	These actors represent users that (a) play on the RMBE market and (b) execute the RMBE transactions.
Responsibilities	Regional TSOs are responsible for: • Placing orders (making offers) for RBM transactions of Day – ahead energy balancing and Intraday energy balancing. • Using the balance energy. • Payments for transactions on the RMBE. • Confirming and executing the RMBE transactions.

3.1.3. Settlement operator of the SEE – RBM

Actor Details	
Actor ID	ACTOR-3
Actor Name	Settlement Operator of the SEE – RBM (RBM-S)
Brief Description	This actor represents a user who ensures settlement and payments for the RMBE transactions.
Responsibilities	The RBM-S is responsible for: • Contracting with participating TSOs for all transactions concluded in the RMBE. • Carrying out the Settlement Notes. • Ensuring payments for transactions on the RMBE.

3.1.4. Regional scheduling operator (optional)

Actor Details	
Actor ID	ACTOR-4
Actor Name	Regional Scheduling Operator (RS-O)
Brief Description	This actor represents a user that could facilitate access to the RMBE resources by regional TSOs.
Responsibilities	The RS-O is responsible for: • Checking up for congestion on the regional interconnections in day- ahead scheduling of CB exchanges. • Assistance to the regional TSOs for removing congestions on the interconnectors.

3.2. Data structure for offers

Column	*Description*	*Values*
Sender ID	User ID of the offer sender	character
Message creation time	Time when XML message was generated	date
Offer date	Date for which the offer is made	date
Offer ID	A unique ID for an offer, automatically generated based on sender ID and message creation time	character
Selling offers	Table	
Buying offers	Table	

Buying Offer Table

Column	Description	Values
Interval	Interval for which the offer is being made	integer
Offer date	Date for which the offer is being made	date
UTC	User's time zone	integer
Local time	User's local time for the interval	date
Power qty.	Quantity of power to be bought	real
Price	Price (per unit) at which the power is to be bought	real
Power type	Type of power to be bought	string

For each interval, several quantity-price-type triads can be specified. The maximum number of triads is a database parameter.

Selling Offer Table

Column	Description	Values
Interval	Interval for which the offer is being made	integer
Offer date	Date for which the offer is being made	date
UTC	User's time zone	integer
Local time	User's local time for the interval	date
Power qty.	Quantity of power to be sold	real
Price	Price (per unit) at which the power is to be sold	real
Power type	Type of power to be sold	string

4. The Administrator's interface

Administrator is the RBM operator of the SEE RBM trading platform (RBM – O)

The interface has the sections:

- Administrator login
- Server-side interface
- LOGS / ACK / Download interface

4.1. Administrator Login

The user login is the first step of authentication. This opened way will be used in all transactions of the certified user as shown by the Figure 4 below.
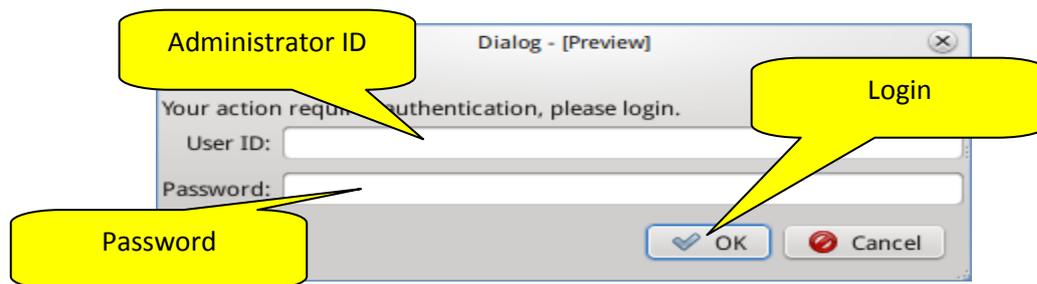
Figure 4. Login form/"Login"

The menu " User Login" consists of the following functions and commands:

      i. Login - allows the user to login into the application,

      ii. Logout (Cancel)

For "Login" user must specify the registered user ID and password.

Server-side interface

The server-side RMB software is implemented as a web application on web2py backend, allowing for a clean and slim implementation and a simple, consistent user interface. It is is written in a Model-View-Controller paradigm; the following controllers are defined:

1. *Appadmin:* Administrative interface for webmaster

2. *Default*: Default controller (i.e. index page)

3. *History*: XML offers history page

4. *Merit*: Merit-order related calculation and verifications

5. *Upload*: Offer uploading

4.2. The User Control Panel (UCP)

4.2.1. UCP Overview

When accessing the UCP (see figure 5), the main view that is presented should look roughly like in the figure below. The following actions can be performed:

- Clicking "Add new user" will lead to a new screen, where users can be added manually by the adminsitrator. This method of adding users is *not* recommended for deployment.

- Clicking "Add new TSO" will lead to a new screen, where new TSOs can be added by the adminsitrator.

- Clicking "Edit default membership" will allow the administrator to choose the initial group for new registered users.

- Clicking the red X sign near an user's ID will delete that user

- Clicking the red X sign near an user's group (User or Administrator) will remove the user from that group

- Clicking "Make participant" will add the user to the User group. Analogously, clicking on "Make administrator" will add the user to the Administrator group.

- Clicking the red X near a TSO name will remove that TSO from the system. Note that all the bids, offers and users are otherwise kept for future reference and/or settlement.

User Control Panel

System actions

Add new user Add new TSO Edit default memberships

User list

ID	Name	E-Mail	Groups
1 ✖	John Doe	johndoe@gmail.com	User ✖ Make administrator Make participant
2 ✖	admin admin	admin@seetsoc.eu	Administrator ✖ User ✖ Make administrator Make participant
4 ✖	Representative User 2	user2@tso2.eu	User ✖ Make administrator Make participant
3 ✖	Representative User	user@tso.eu	User ✖ Administrator ✖ Make administrator Make participant
5 ✖	Admin Test	admin1@seetsoc.eu	user_5 ✖ Administrator ✖ Make administrator Make participant
7 ✖	Another User	another@test.com	User ✖ Make administrator Make participant

TSO List

ID	Name	Timezone
1 ✖	TSO 1	1
2 ✖	TSO 2	0
3 ✖	New TSO	2

Figure 5. User Control panel.

4.2.2. Deployment: setting up users and TSO accounts

Broadly speaking, the procedure of setting up the user and TSO accounts should proceed as follows:

- The administrator creates the TSO accounts. The RBM will assign each TSO an unique ID.

- The administrator then distributes to each TSO the unique ID generated by the system.

- Each TSO registers its representatives and notifies the administrators about the

accounts it created. Registration can be done simply by clicking the "register" link the upper-right corner of the application's page

- The administrator assigns correct group membership (User/Participant or Administrator) to the new user.

4.2.3. Setting up TSO accounts

To create the TSO accounts, go to the User Control Panel (UCP) and click "Add New TSO" under "System actions". This will pop up a new form, asking to enter the name and the timezone of the new TSO (figure 6).
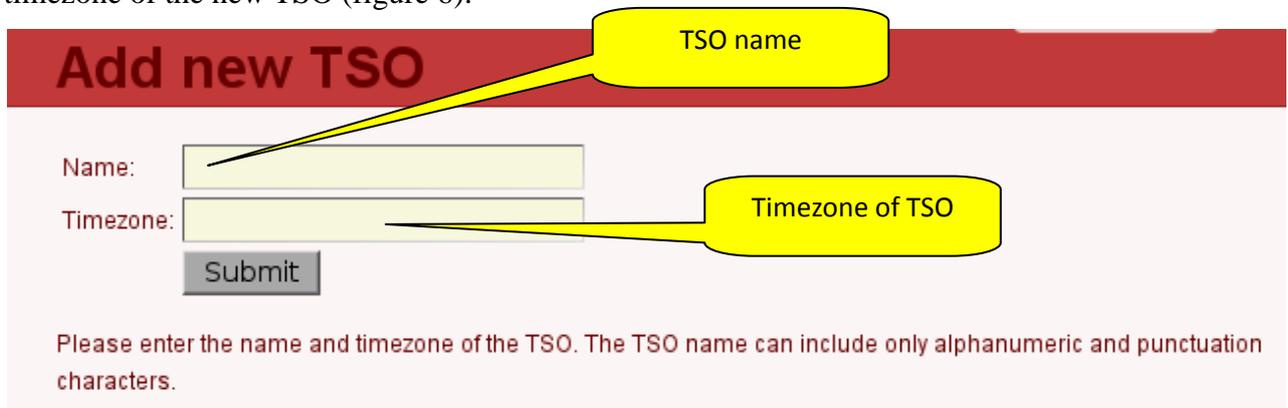
Figure 6. Add new TSO Account.

You can create all the TSO accounts in a batch and return to the UCP when you have finished creating all the accounts.

4.2.4. Setting correct group membership

Immediately after a user has been created, TSO cannot access any section of the website. This is done in order to prevent a future administrator from seeing or uploading any offers before being set up as an administrator, or a future user from being able to take administrative actions. The administrator must assign the initial membership.

In order to do so, go to the UCP and click "Edit default memberships". This will open a simple form, where you can pick the user and the innitial group to which you want TSO assigned (figure 7)

Figure 7. Edit default membership.

4.3. Miscellaneous actions

4.3.1. Manually adding new users

It is possible to add users manually, rather than by registering them, but this method is more tedious and gives the administrators initial access to the users' accounts, as they have to enter a password. In order to do so, click **Add new user** in the UCP page (figure 8).

Figure 8. Add manually new User.

This will open a new screen, asking for the first and last name of the user, the email address, the TSO ID and the password.

4.3.2. CRUD database access

Administrators have full access to the database through a CRUD interface through the **appadmin** controller. It can be accessed by appending /appadmin/index to the root address of the SEETSOC application.

We chose to keep this available for debugging and emergency, but we advise extreme care. There are no validations in place other than those required for SQL security, nor any safety locks.

4.4. Administration-Merit order

The Merit Order controller provides an interface to the Merit algorithms, allowing the user to build Merit Orders for selected days. The user is subsequently presented with a set of statistics and can commit the programmed transactions to the database, in order for them to be used in the Transaction Conclusion and Transaction Settlement procedures.

Step 1: The user selects the date and regulation type for merit order procedure – Figure 9.
Step 2: The user is displayed with a set of statistics. Note that one of the bids has been only partially selected in offer to meet the requested limit. The user can now commit the order to the database – Figure 10

Figure 9. Step 1: The user selects the date and regulation type.

a)

b)

Figure 10. Step 2: The user is displayed with a set of statistics.

Figure 11. Transaction conclusion can be done from the homonymous page.

4.5. Transaction Conclusion Controller

The Transaction Conclusion controller is used to settle transactions. An administrator inputs the final transactioned values, as described in D 5.1.2. These values will later be used in the

Figure 12. The user selects the date for which he wishes to carry out the conclusion procedure.

Transaction Settlement process.

Each offer is marked as transitioned as it is completed, and you can change all of their parameters at will (figure 13).

At the end of transactions, you can generate the required transaction settlement notes from the Transaction Settlement page.

Figure 13. The user carries out the changes and commits them to the database.

Figure 14. The user is presented with a list of scheduled transactions and
can choose to edit any of them.

The ID is the the ID of the transaction that is going to be performed (each transaction that is to be performed is stored separately in a table)

The Bid ID is effectively the ID of the price-quantity pair that is going to be transactioned. The Offer ID is the ID of the offer to which the ID belongs.

4.6. Transaction Settlement (TS) Module

A purchasing TSO pays for the Surplus (Negative) Imbalance (SI) or Deficit (Positive) Imbalance (DI) at imbalance price for the corresponding balancing interval.
TSO / control area Imbalance is the sum of the Net Contractual Position and the Net Metered Position. That is, for each balancing interval, the Imbalance is energy difference between all metered exchange schedules, on the one side, and all exchange schedule nominations, on the other side, dismissed by the inadvertent exchanges and UCTE compensation programs.

For each balancing interval, calculated BE value corresponding to final dispatch order. The imbalance price is determined so that the BE value equals the total payment for energy imbalance.

Figure 15. Transaction settlement.