UNIVERSITY POLITEHNICA OF BUCHAREST

RBM User Help

Regional Balance Mechanism (RBM) - Software Documentation

UNIVERSITY POLITEHNICA OF BUCHAREST

2012.

PROJECT

Grant Agreement No.	239453
Acronym	SEETSOC
Title	SOUTH-EAST EUROPEAN TSO CHALLENGES

Content

1. General SEETSOC Approach

Procedure to handle balancing energy bids

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.

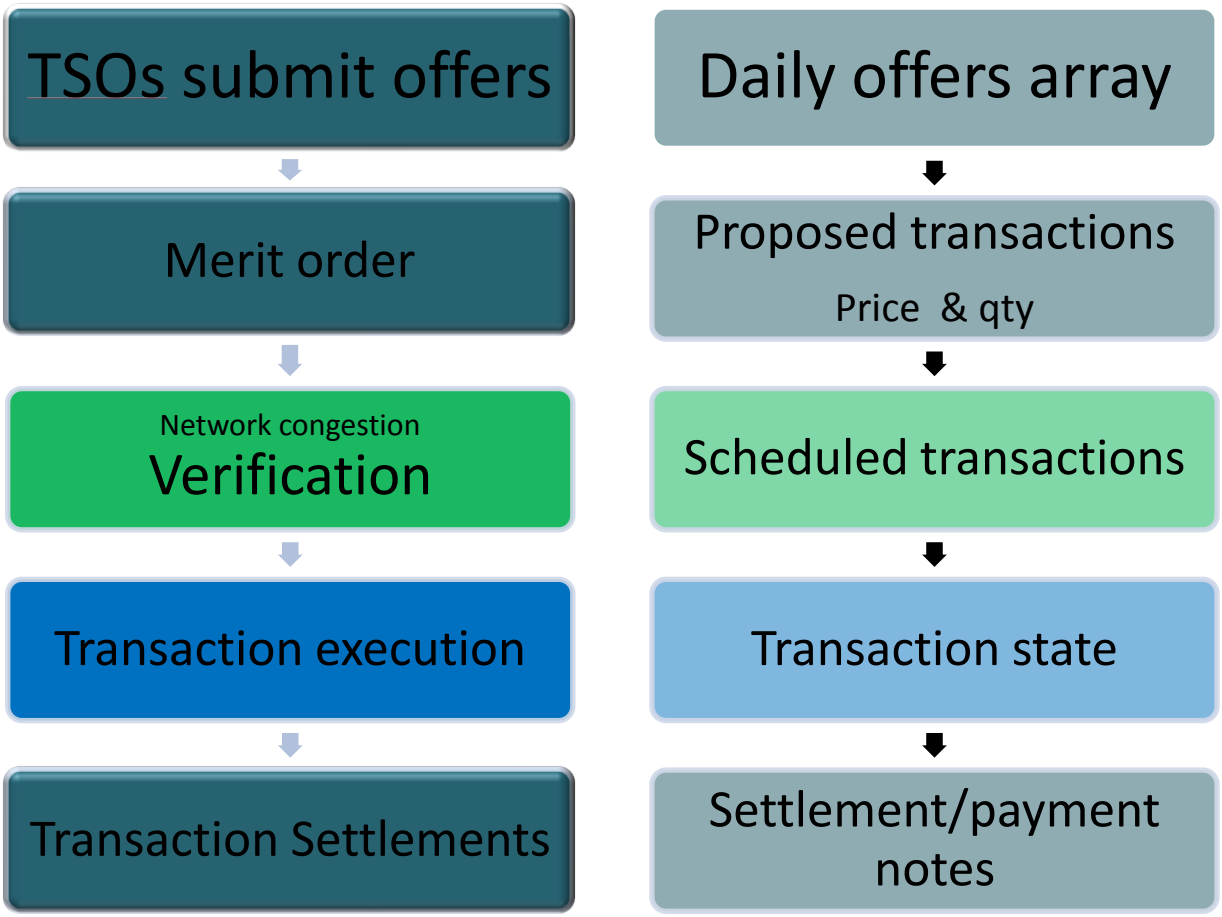

Figure 1. RBM processes and results.

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.

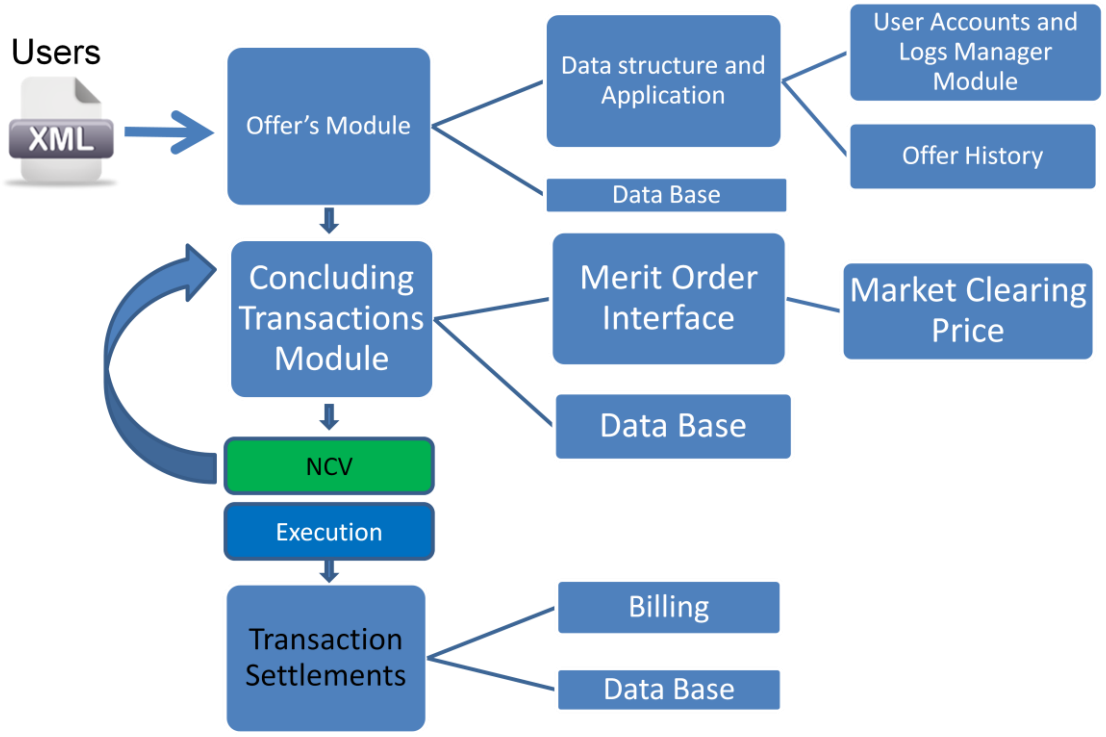

Figure 2. Regional Balancing Mechanism (RBM).

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:

1. *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.

2. *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.

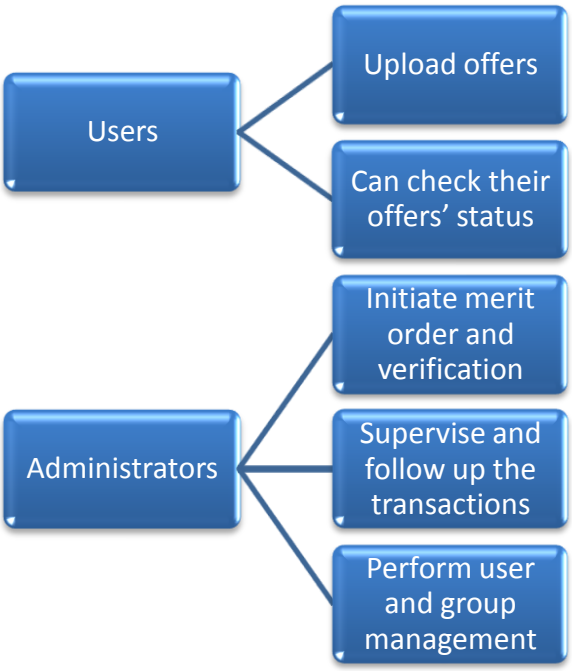

Figure 3. Actors implied in RBM.

3.1.1. RBM Operator

Actor Details	
Actor ID	ACTOR-1
Actor Name	RBM Operator of the SEE RBM trading platform (RBM-O)
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.

RBM-O Operator

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.

Regional TSOs

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.

RBM-S Operator

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.

RS-O Operator

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. User Accounts and Logs Manager Module

4.1. User's Offer interface

The interface has the sections:

- User login
- Offer upload

4.1.1. User 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.

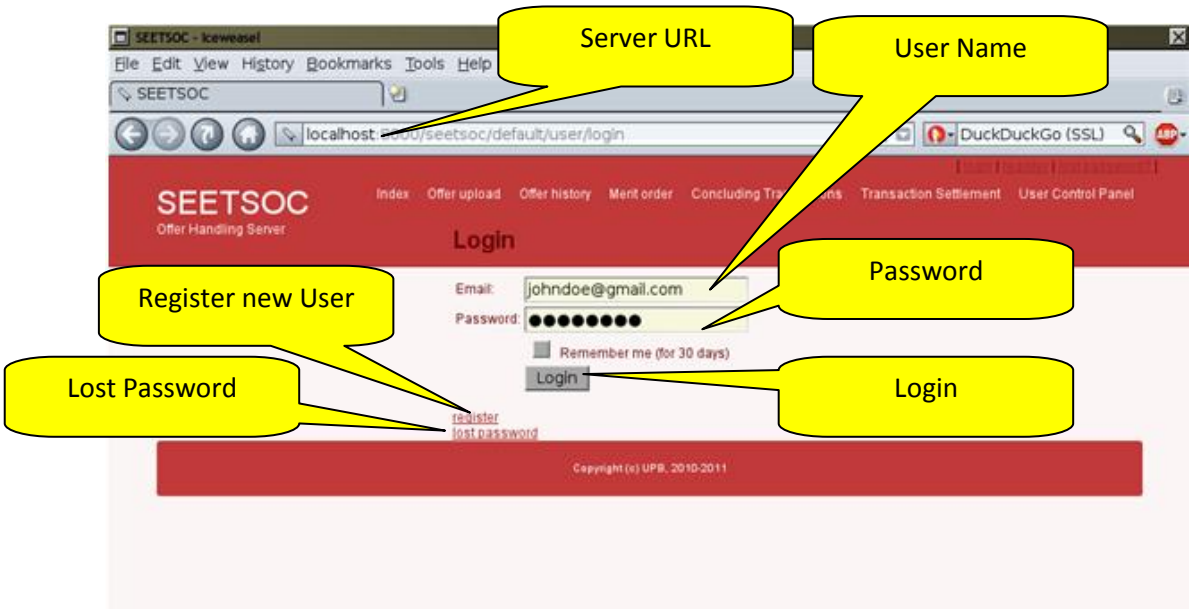

Figure 4. Login for User.

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

i. *Login* - allows the user to login into the application using *User name (Registered ID)* and *Password*
ii. For New Users: *Register*
iii. *Lost Password*

4.1.2. Offer format

At the first login, the user downloads and installs an application for generation of XML formatted offers. At subsequent logins the installed application will automatically download from the server the last actual updates of the application. The client-side application can be used to generate offer files, but uploading them in order to be involved in the market requires a connection to the server.

The sequence of application functions is as follows:

Figure 5. The sequence of application functions.

Offer configuration window – generating message header

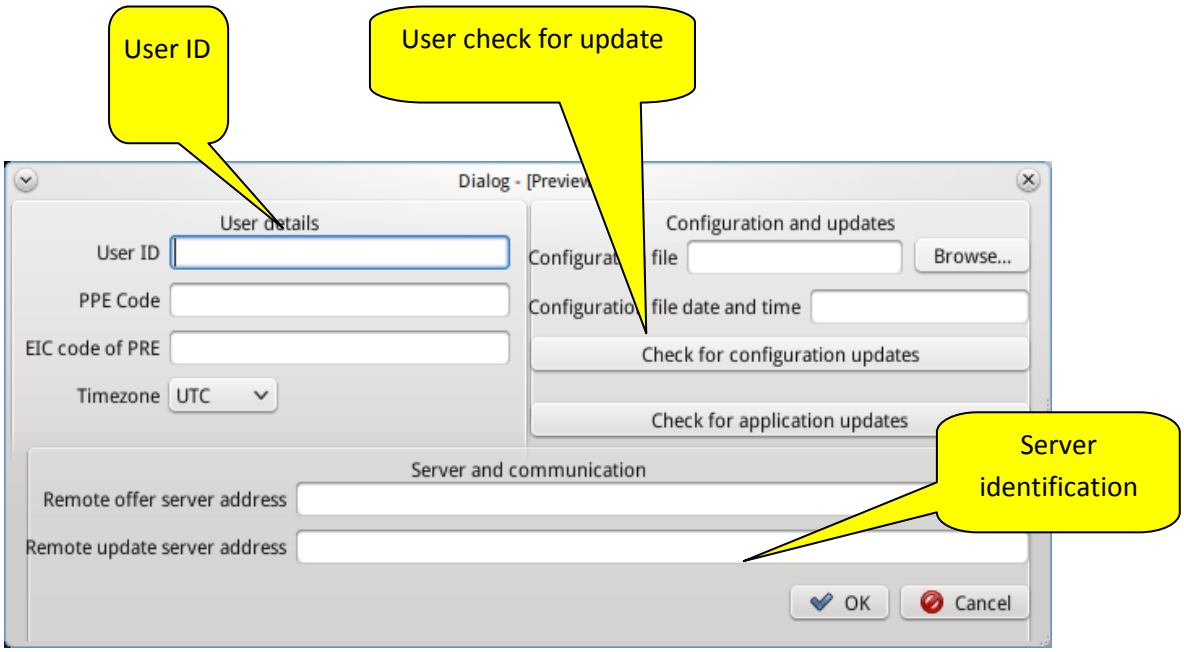

Figure 6. Offer configuration window.

Selling offer window

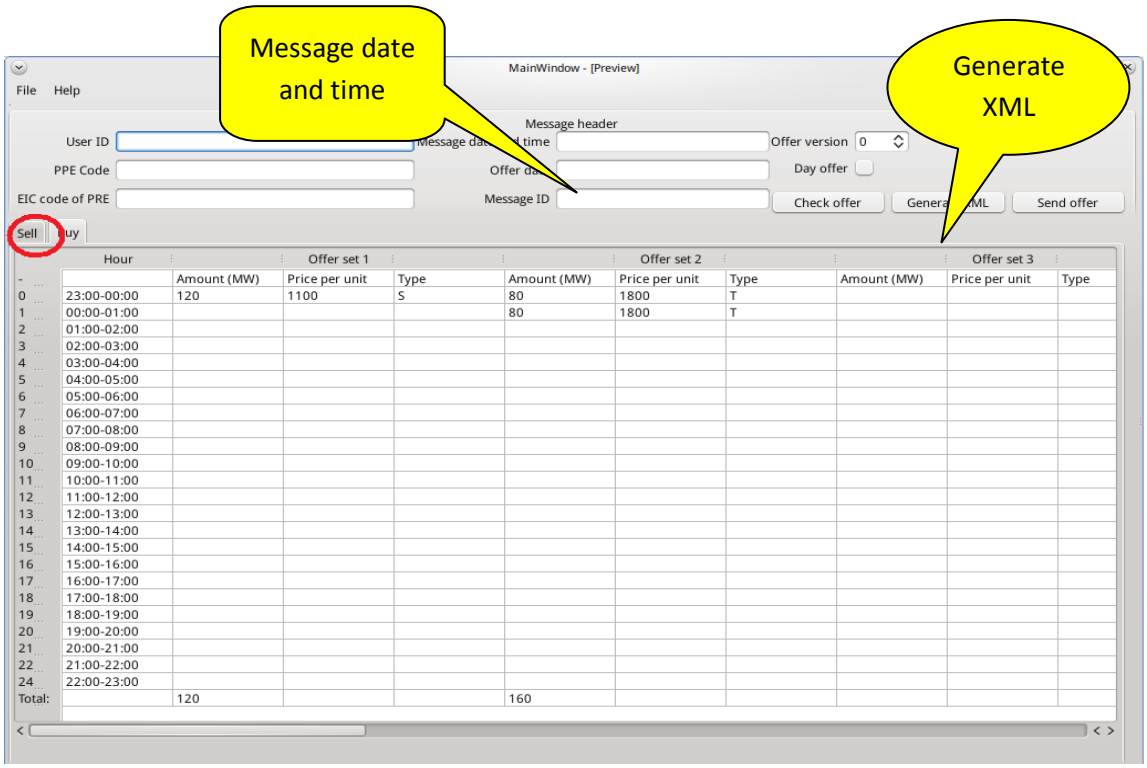

Figure 7. Selling offer table.

Buying offer window

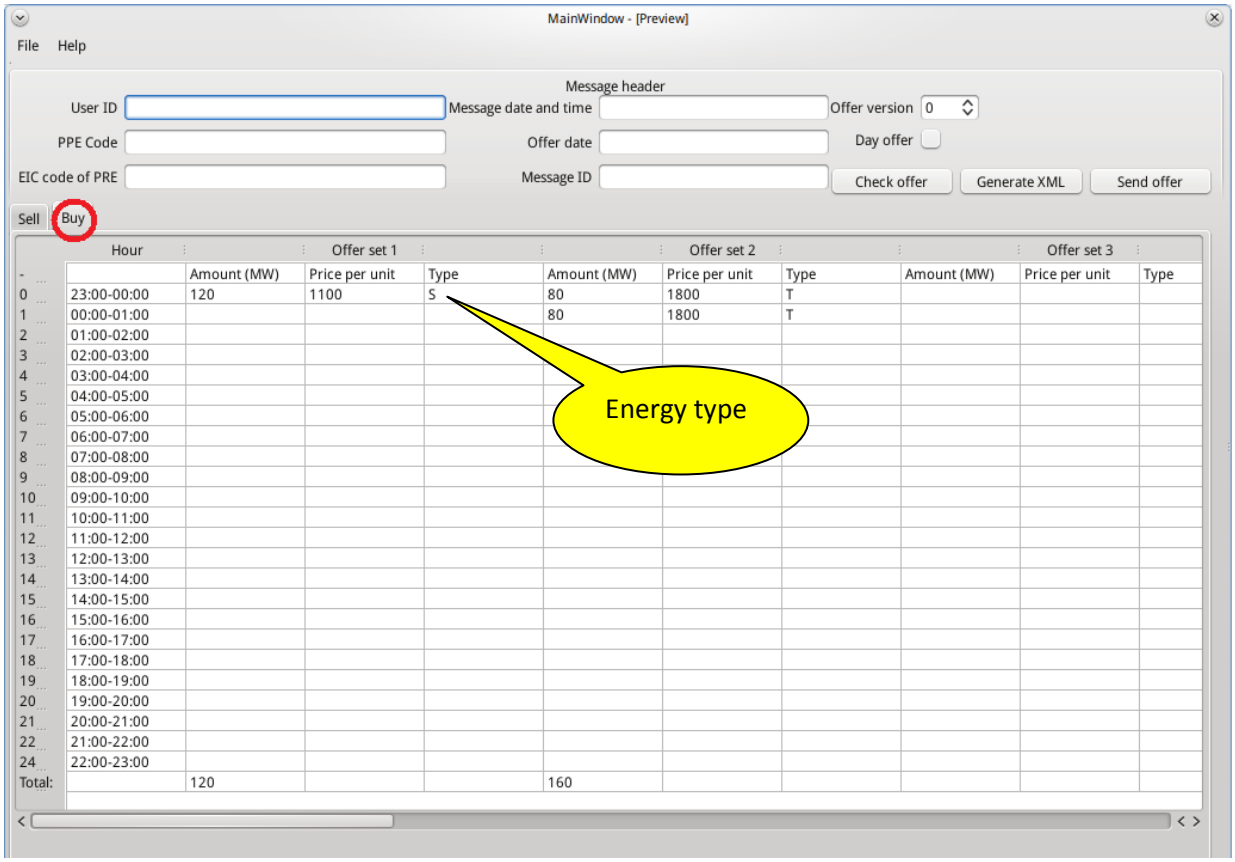

Figure 8. Buying offer table.

The Generate XML is used to create the XML offer file and save it locally, on the user's hard drive (e.g. for later review or reference). The Send Offer button also sends the offer to the remote server; in terms of end result, there is no difference between doing this and using the web-based upload interface.

The message header area includes the fields of the XML message header. Most of them are either automatically-generated (e.g. message ID) or are the same for every message from the same TSO, so they can be saved in an user configuration file and loaded automatically. The offer details area allows the user enter the offer details for every interval (amount of energy, price per MW, balance energy type – Figure 8).

Offer XML file Upload

The user selects a file to upload (optionally adding whether or not this is a new version of a previous offer) and clicks submit. The program proceeds as follows:

The offer is checked for identity validity i.e. it ensures that the user is placing an offer for his own PRE.

The offer is checked for structural validity i.e. it ensures that the offer is not placed too early, that the granularity is respected, that the maximum number of offers per interval is respected and that the quantities and prices are valid. These checks are made as a preamble of the parse_uploaded_xml() function.

The information is subsequently parsed and uploaded to the database and information is appended to the user's history.

Figure 9. Upload Interface for XML Offer.

Actions of the user:

- In this section, the user will be allowed to upload its offers, only.
- By pressing the “Browse” button, the user will be asked to select the XML file for upload.
- Each received (uploaded) offer will be assigned a time stamp that corresponds to the time when the offer (the XML file) was uploaded.

- Each ACK will be assigned a time stamp that corresponds to the time transmission of the ACK from the server.
- Repeat (add a couple of offers to ensure that there is a representative data set).
- At any point in time, you can view all your history in the "Offer history" page. Please note that some of the offers you see there may have actually been removed from the database. This is because the system only keeps the latest version. However, *all* the XML files, even the ones that have been rejected, are kept or reference and can be viewed at any time.

Figure 10. Offer History Interface.

LOGS / ACK / Download interface

In this interface, the user will be able to:

a) Visualize all logs, i.e. the messages resulted after XML upload and the result of XML formal check
b) Visualize the acknowledgements, i.e. the results of offer parameters compliance
c) Download submitted offers in XML format.

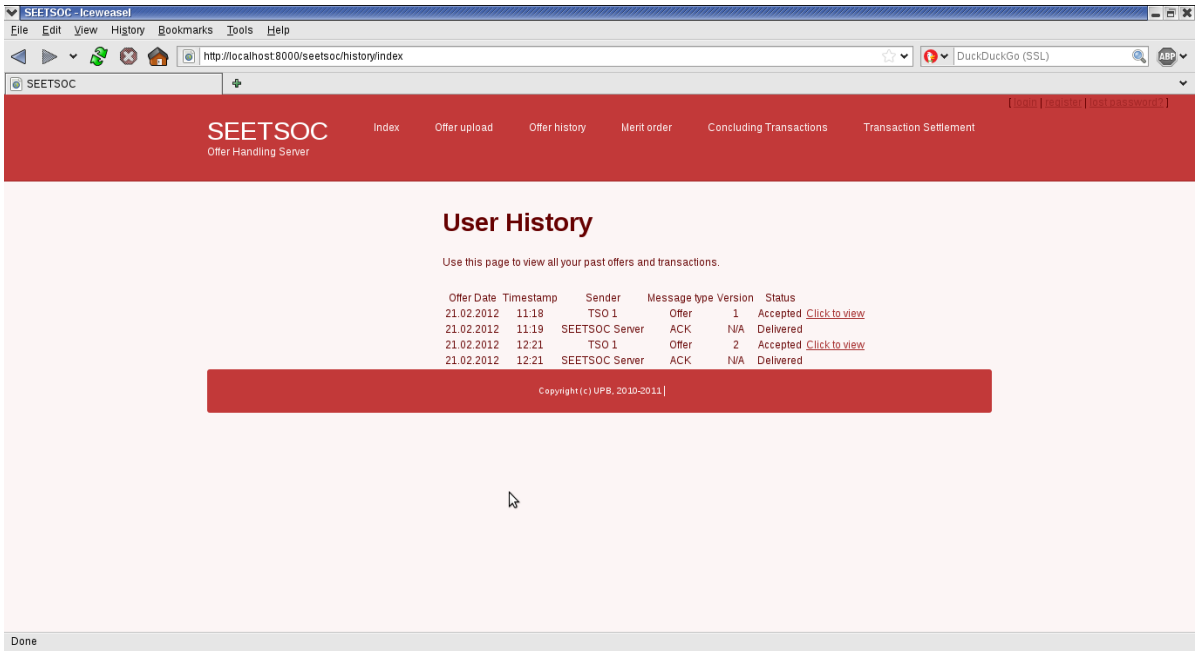

Figure 11. Logs / ACK / Downloads interface.

Logs interface items are composed of:

- Filters interface
- Items.

In the filters interface, the user can choose from the following options:

a) *Market day* (date type): the market date for which the items (ACK, offer) can be visualized /downloaded

b) *Time stamp* (time *format – hh:mm:ss*)**:** server time stamp of the message.

c) *Sender* (TSO name – text type): list of the sending TSO for the chosen market day (this filter will be available only for the administrator user type).

d) *Message type* (displays the messages to be shown (ACK, Offer) – text type): this filter offers the possibility to choose between ACK message type and offer message type. ACK message type will display only ACK messages, Offer Message type will display all (both accepted and rejected) submitted offers.

e) *Version* (integer type): will display the offer version in case of that message type will be set on offer or all

f) *Status* (offer status – text type): will display the offer status (Accepted or Rejected).

Notes:

- The DB will contain a *full* history of the sent offers along with the receiving time. In this way, the user (Administrator or Participant) will be able to consult in each moment the full history of sent offers (on a chosen market day by status, version etc).
- When the user submits update of an offer he/she provides offer's ID, and the system increase the version number accordingly.

4.1.3. Typical Errors for XML file offer

Local offer checking involves the following checks:

- Temporal validity
- Logical validity
- Constraint validity.

The offer is considered accepted if all checks have passed and the offer has been uploaded to the database. The user is subsequently notified by e-mail, as well as in the status bar of the application.

Any error in the XML file causes all errors to be automatically discarded and the user is notified as such. Files are still stored for a certain duration, in case any verification is needed later, should any doubts arise whether or not the invalidity was in fact intentional, as part of an attack.

There are five general reasons for an upload failure, namely:

- *Syntactic errors*: the user did not upload a valid XML file, or the file had syntax errors.
- *Structural mistakes*: the offer was not structurally valid – it did not contain any XML errors, but some information was missing (e.g. an offer did not have an associated price).
- *Content errors*: the offer was structurally valid but some of the information it contained was wrong or meaningless (e.g. a non-existing EIC code, negative price etc).

- *Identity errors*: the offer was structurally valid and the content was correct, but the user submitting it was not authorized to do so (e.g. he was attempting to place an offer in the name of a PRE other than his own).
- *System errors*: unexpected errors were encountered. The admission process is halted, but the administrator is notified and he has the option of adding the data manually later, once the system error is resolved. This can be due to a hardware failure, an unhandled error in the XML file etc.

4.1.4. Offer verification

When uploading an offer, the following verifications are performed:

1. *Syntactic verifications*: The server verifies that all offers are syntactically correct (i.e. they are valid XML files)
2. *File validity verifications*: The server verifies that the offer is structurally valid (i.e. it contains all the required user information, that the bids contain all the required information etc.
3. *Offer content verifications*: The server ensures that the offer is correct from a content point of view – that there are no physically meaningless values (e.g. prices below zero) or that the limits placed by the administrators have not been stepped out of.
4. *User and session verifications*: The server ensures that the offer is being placed by a validly logged-in user, that the offer belongs to the user submitting it (i.e. the user does not attempt to place an offer for someone else) and that all the information required to identify the submitter of the offer exists and is written in a valid format.

- If a file does not pass all the verifications, it is immediately discarded (Figure 15).
- A copy of the file is kept on the server for reference, but it is not displayed on the user's history page so as not to clutter it with invalid files.
- Even files that have been judged to be syntactically invalid are kept for a certain amount of time, should there arise the suspicion that they contain malicious data that might have been used for potential attacks.The files can be cleared via a set of cron scripts, but we do not anticipate this to be a stern problem due to the low usage rate.

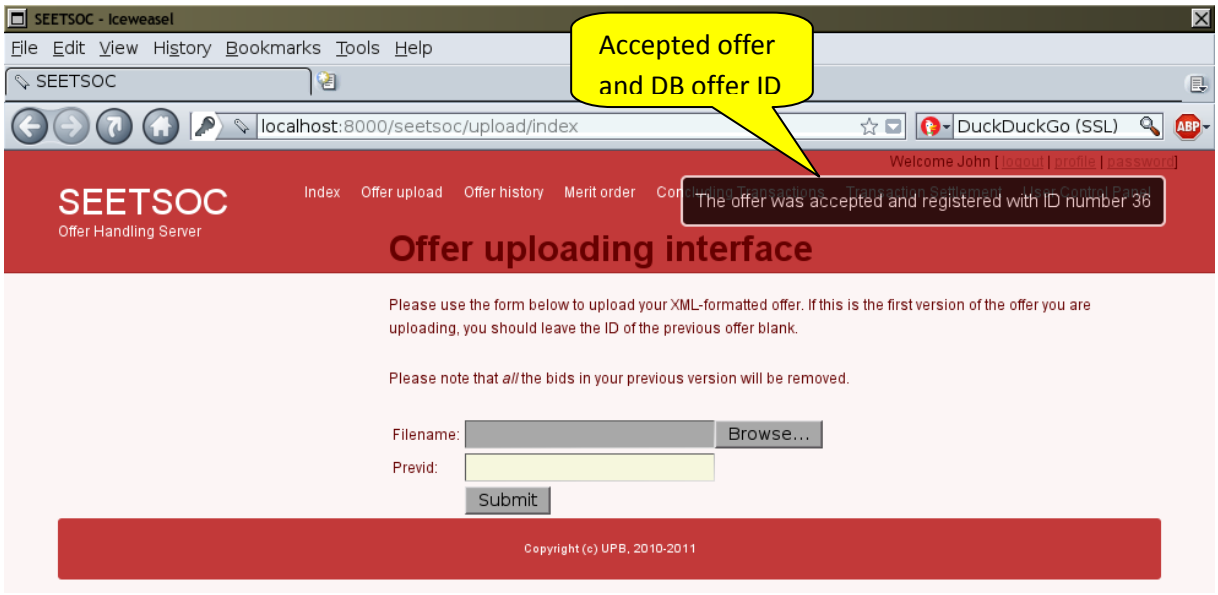

Figure 12. Accepted offer with Data base ID number.

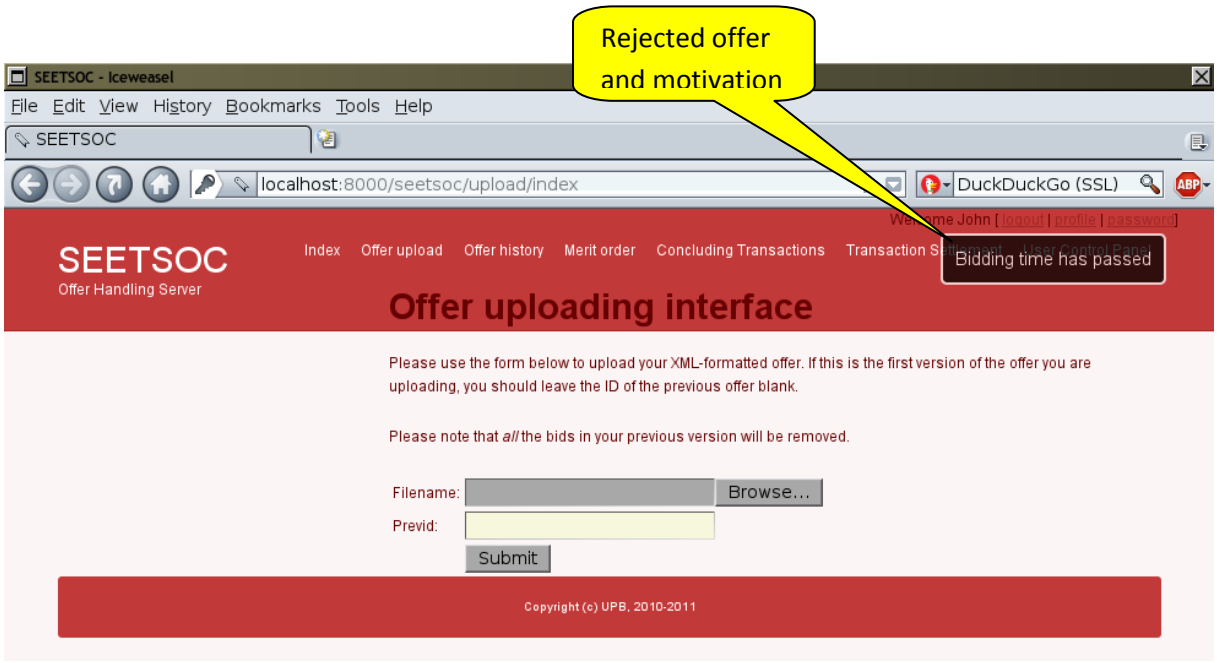

Figure 13. Error notification – the user attempted to upload an offer for an invalid date and it was rejected.

The insertion of data itself is based on a comprehensive set of input sanitizing and data parsing which provides excellent protection against database attacks. The user never supplies data for the database directly; the required information is extracted from the XML file and the

web2py database abstraction layer performs an extensive set of validation and filtering to ensure a good protection against attacks with malicious data.

If the offer file is invalid, the user is notified in the status bar and can re-upload the file after making the required corrections.