

Annex 8 to the DAOA – Simulation Facility Services

Article 1 - PURPOSE OF THIS ANNEX

- 1.1. Pursuant to Article 10 of the DAOA, the Service Providers shall develop and operate a Simulation Facility and make it available to all Parties. Each Party wishing to use the Simulation Facility must subscribe to the service as described in this Annex.
- 1.2. This Annex sets forth the rights and obligations of the Service Providers and the Subscribers in respect of the operation and maintenance of the Simulation Facility and the provision of the Simulation Facility Services. It also describes how the costs related to the Simulation Facility are to be shared among the Parties.
- 1.3. This Annex consists of its main body and its Exhibits listed below:
 - Exhibit 1: Costs
 - Exhibit 2: Technical description of the Simulation Facility
 - Exhibit 3: Service Levels
 - Exhibit 4: List of Service Providers and Subscribers
- 1.4. Should differences and/or contradictions exist between the main body of this Annex and any of the Exhibits, the terms and conditions of the main body shall prevail.

The provisions of this Annex are subsidiary to the provisions of the DAOA generally and in particular to Article 10 of the DAOA. Should any differences and/or contradictions exist between this Annex and any of the provisions of the DAOA, the terms and conditions of the DAOA shall prevail.

Article 2 - DEFINITIONS AND INTERPRETATION

Capitalized terms and expressions used in this Annex shall have the meaning attributed to them in the DAOA Annex 1. The reference to "Exhibits" is to the exhibits of this Annex.

Article 3 - OBLIGATIONS OF THE SERVICE PROVIDERS

3.1. Services rendered by the Service Providers

The Service Providers shall provide the Simulation Facility Services to any Party, however, in order to gain access to the Simulation Facility each Party needs to subscribe to the Simulation Facility Services as described in this Annex.

The Simulation Facility Services consist of the following:

- i) putting at the disposal of each Subscriber the Simulation Facility which complies with the functionalities set forth in Exhibit 2. This includes:
 - providing each Subscriber with web-access to the Simulation Facility by granting the such Subscriber's nominated users with the necessary access codes and user names to enable them to log in to the Simulation Facility through the web interface and to perform simulations using Data;
 - providing each Subscriber with the reasonably necessary user documentation in pdf format;
- ii) providing services to support Subscribers in connection with access to and use of the Simulation Facility limited to login, creating of a simulation instance, importing User-defined Data, exporting Simulation Results, altering Data;
- iii) providing corrective maintenance of the Simulation Facility with the response times set forth in Exhibit 3; and
- iv) such other reasonable service that legitimately makes use of the Simulation Facility as may be agreed between a Subscriber and the Service Providers related to the Simulation Facility in consideration for the payment of a separate fee as set forth in Exhibit 1 (time and material basis).

3.2. Provision of Simulation Facility Services – Point of Contact

- 3.2.1 The Service Providers shall appoint one of them (the "**Functional Simulation Facility Operator**" or "**FSFO**") on a rotating basis for a period of 12 calendar months to provide the Simulation Facility Services and act as single point of contact of all Service Providers towards Subscribers.
- 3.2.2 As of the entry into force of the DAOA the Party who was appointed FSFO under the MRC DAOA shall continue as FSFO until the end of its term. Thereafter the Service Providers shall nominate each successive FSFO and inform the Subscribers thereof in writing before the expiry of the relevant 12 months term of such FSFO. Information regarding the change of FSFO shall be given to all Parties in writing.
- 3.2.3 Any request or enquiry from any Party regarding the Simulation Facility Services shall be forwarded to the FSFO in writing. The hours when the FSFO shall be reachable are stated in Exhibit 3.

3.2.4 The FSFO shall inform the relevant Subscriber and the other Service Providers in writing in the event of any difficulty arising in the course of the performance of its obligations under this Annex. Furthermore, the FSFO shall inform all Parties of any matter of relevance in the context of this Annex of which the FSFO becomes aware during the term of its appointment.

3.3. Service Levels – No Warranties

3.3.1 The Service Providers confirm that the Simulation Facility Services shall be performed in accordance with the service levels explicitly set forth in Exhibit 3, which correspond to the service levels agreed with the Software Provider. Should the arrangements with the Software Provider change, Exhibit 3 shall be adjusted accordingly, by a JSC decision.

3.3.2 In the event that the service levels in any calendar month are lower than the service levels set forth in Exhibit 3, [REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

3.3.3 The Service Providers commit to - on a best effort basis - make available a Simulation Facility which functions in compliance with the technical description set forth in Exhibit 2. No warranty (whether express or implied) with respect to the Simulation Facility is given by the Service Providers. The Service Providers shall have no responsibility or liability for how the Subscribers use the results of the simulations.

Article 4 - FUNCTIONALITIES OF THE SIMULATION FACILITY

4.1. Description of the Simulation Facility

The Simulation Facility is a web-based application in which the Algorithm is embedded, and which allows the simulation of market coupling scenarios based on Historical Data and/or User-defined Data, as well as the reporting on the

Simulation Results. The technical description of the Simulation Facility is set forth in Exhibit 2 hereto.

The Subscriber may select a date range over which he/she would like to run any simulation (and in respect of which obtain Simulation Results).

For the avoidance of doubt, the Simulation Facility does not (i) grant access to Historical Data (but only to the results of the simulations) or (ii) enable the Subscriber to identify any individual market participant or individual order.

Historical Data made available via the Simulation Facility Services is commercially sensitive information and is thus deemed Confidential Information.

The Simulation Facility Services shall take into account data from all Parties. All Parties undertake to provide free of charge their respective Historical Data to facilitate the Simulation Facility Services.

4.2. Simulation Facility Functionalities

The Simulation Facility shall, within the limitations regarding confidentiality, data publication and intellectual property rights set forth in the DAOA:

- i) enable the Subscriber to:
 - perform simulations on Historical Data and/or User-defined Data for analysis purposes;
 - download Simulation Results to perform operational and management reporting; and
 - create standard reports automatically.
- ii) provide a solution for hosting Data and Simulation Results.

However, it is understood that all Data attributable to Simulation Results and/or all User-defined Data shall be erased from the Simulation Facility every three months.

Article 5 - OBLIGATIONS OF SUBSCRIBERS

Each Subscriber shall:

- i) ensure that any access credentials, such as access code and user name granted to it, as well as any password, are kept confidential and not disclosed to any other person than the named user;
- ii) not use the Simulation Facility (including the Historical Data and tool available through it or contained in it) for any other purpose than (a) simulations, and (b) any other purpose described in this Annex;

- iii) not attempt to download Historical Data or decompile or reverse engineer any Simulation Results in order to reconstruct the Historical Data or so as to be able to discern the identity of, or trading pattern of, any individual market participant (unless permitted under mandatory law). In the event that any such Historical Data, for any reason or by error, should become available to a Subscriber, the Subscriber shall not use such Historical Data and shall inform the Service Providers of such occurrence without delay and immediately destroy such data;
- iv) not modify or damage the Simulation Facility in any way;
- v) take appropriate precautions against the possibility that the Simulation Facility does not function properly by, for example, performing data back-up. The Service Providers shall have no liability for any lost Data; and
- vi) pay the costs and fees related to the Simulation Facility Services in accordance with DAOA.

For the avoidance of doubt, the Simulation Results may be freely used by the TSOs in their TSO business and be published by any Party.

Article 6 - **DATA PROCESSING**

The Service Providers and the Subscribers shall comply with their respective obligations under the law of their respective country of incorporation as well as all applicable data protection and privacy laws. Should any personal data be acquired by the Subscribers, it shall only be used for the purposes of this Annex and shall not be further processed or disclosed without the consent of the relevant Subscriber.

The Subscribers accept and agree that certain personal data may be processed by the Service Providers and/or subcontractors whom the Service Providers may appoint within the European Economic Area. The Service Providers will safeguard and protect the relevant personal data against unauthorised access, accidental loss, improper use and unlawful disclosure, as required by applicable laws.

Article 7 - **COSTS RELATED TO SIMULATION FACILITY**

7.1. All costs related to the Simulation Facility and the provision of Simulation Facility Services shall be considered SDAC Joint NEMOs and TSOs Common Costs and be shared among the Parties in accordance with the DAOA and in particular Annex 6. Additional services provided in accordance with article 3.1 (iv) shall be invoiced separately to the relevant Party.

- 7.2. The costs related to the Simulation Facility Services are set forth in Exhibit 1 hereto. Exhibit 1 reflects the costs accrued by the Service Providers and shall be amended by a JSC decision, as need be.
- 7.3. Any fees and costs described in Exhibit 1 shall be invoiced by the Financial SPOC to the Central Settlement Entity. As of the entry into force of the DAOA [REDACTED] shall act as Financial SPOC. Should another Service Provider or entity be appointed as Financial SPOC, the Central Settlement Entity and the Parties shall be notified of such change in writing by the FSFO.
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- 7.4. The Financial SPOC shall invoice the relevant fees and costs taking into consideration any such proper reduction in fees as may be due to reduced service levels and provided that any such reduction in fees shall be taken into account only in connection with the invoice covering the calendar quarter after such reduced service levels occurred in accordance with Annex 6.
- 7.5. Without prejudice to article 7.4, the FSFO shall invoice to the Central Settlement Entity the costs related to the FSFO services as described under Exhibit 1, under the same conditions as described in articles 7.5 and 7.6.

Article 8 - **DURATION OF THE SERVICES**

The Simulation Facility Services shall be made available to each Subscriber as of the Effective Date of such subscription and shall remain available until a subscription is terminated, as provided in article 10. For the sake of clarity, the subscription acquired by a Subscriber prior to entry into force of the DAOA, shall continue on the terms and conditions of this Annex.

Article 9 - **ENTRY INTO FORCE; NEW SERVICE PROVIDERS; NEW SUBSCRIBERS**

- 9.1 This Annex shall enter into force on the date the DAOA enters into force for those parties (both Service Providers and Subscribers) listed in Exhibit 4. The JSC will update Exhibit 4 when necessary to reflect any change in the Service Providers and/or Subscribers.

- 9.2 In the event that any Party to the DAOA wishes to become a Subscriber to the Simulation Facility Services, the applicant shall send to the JSC a written request stating its wish to become a Subscriber.
- 9.3 The JSC shall approve the request of the applicant by a JSC decision.
- 9.4 Should a NEMO wish to become a Service Provider, the applicant shall send to the JSC a written request stating its wish to become a Service Provider. The JSC's approval of its application and its enduring status as Service Provider is subject to its entering into:
- i) the ANDOA and the PCR Co-ownership Agreement, both as further amended and supplemented from time to time; and
 - ii) any further separate agreement concerning the Simulation Facility in force between all Service Providers.
- 9.5 As of the JSC positive decision related to a request to become a Service Provider and/or Subscriber to the Simulation Facility Services, the applicant will be bound by all the terms and conditions of this Annex.

Article 10 - **TERMINATION OF SIMULATION FACILITY SERVICES**

- 10.1. The Simulation Facility Services shall terminate automatically in the event that the DAOA is terminated.
- 10.2. A Subscriber may at any time suspend or terminate its subscription to the Simulation Facility Services, without court intervention and any indemnity being due, by sending a written notice to the FSFO stating its wish to suspend or terminate the subscription. The FSFO shall ensure that the access credentials of the Subscriber are suspended or terminated, as the case may be, as soon as practically possible after the receipt of the notice.

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Exhibit 1: Costs

The costs for the Simulation Facility Services shall be covered by the Parties on an “at cost” basis covering the items mentioned below. The actual invoices shall reflect the actual costs.

- a. The maintenance costs of the Simulation Facility;
- b. The hosting of the Simulation Facility including [REDACTED]; and
- c. FSFO operational costs

Three separate costs are contemplated:

- One-off set-up and commissioning costs (to be invoiced after the Effective Date):
[REDACTED]
- Yearly costs of maintenance and service described in the contract with the Software Provider:
[REDACTED]
- In case of additional services, for instance development of new functionalities (time and material): [REDACTED]

Exhibit 2 – Description of Simulation Facility



Price Coupling of Regions Simulation

PCR Simulation Tool Requirements

Date	2014-02-17
Author	EPEX, NPS, ,OMIE
Topic	PCR Simulation Tool – General requirements
Summary	This document lists the required functionalities of the simulation facility of the PCR market coupling project which allows to simulate various market coupling scenarios.
Version	0005

Nr	References	Version	Date
1	Euphemia Public Description	0.6	02/10/2013
2	PCR Matcher Algorithm Interface Specifications	2.0.13	8/11/2012
3	Functional Specifications – CWE Simulation Facility Release 2	2.0	28/9/2009
4	Design Document – CWE SF	1.0	8 June 2009
5	File Interface Specification – CWE SF Files (Import/Export)	01.00	May 2009
6	Database Design – CWE SF (Draft)	1.0	26 Feb 2009
7	Architecture Document – CWE SF	1.10	10 Sep 2009
8	PCR Matcher Algorithm Interface Specifications	2.0.13	8/11/2012

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1 Scope, context and generalities

In the framework of the PCR Market Coupling project, some project parties are requiring a Simulation Facility (SF). The aim of this document is to describe the high-level functional requirements related to this software tool.

All users will have individual access to this facility, which is a web-based secured application. The application may either be hosted centrally or locally by each Power Exchange that would demand this. These technical aspects are however not yet considered in this document.

Section 2 describes the market coupling concept.

Section 3 describes the Simulation Facility.

Section 4 describes the “batch” concept and explains how to set up simulations.

Section 5 deals with the execution of the algorithm from the SF to run the batches.

Section 6 describes the possibilities facility should have in terms of analysis and reporting.

Section 7 discusses the general principle of data handling and users’ restrictions

Section 8 proposes a basic functional architecture.

Section 9 contains a short description of future requirements.

Section 10 gives definitions of expressions and acronyms that are used throughout the document.

2 The market coupling concept

2.1 Introduction

The Simulation Facility will be used to simulate one or more market coupling runs. This chapter explains the concept of market coupling as it currently is applied in the Central Western Europe region and is being extended to the Nordic-Baltic area, Great-Britain, the Iberian peninsula and, ultimately, the whole of Europe.

2.2 The players and the context

Market coupling involves contributions from Power Exchanges (PXs) and Transmission System Operators (TSOs). It regards coupling of the wholesale electricity markets for day-ahead delivery of the participating PXs. These markets are run in the form of mid-day auctions involving a central counterparty on every day of the year.

The geographical area coupled is divided into several bidding areas or market areas, which each are run by one of the PXs. This means that the market participants of the PXs submit day-ahead electricity orders (for one or more hours out of the 24 in the next day) to a market area and the PX sees to the matching of these supply and demand orders to the extent possible. The orders may be either simple hourly ('limit') orders, or complex multi-hour ('block') orders.

The TSOs involved are responsible for security of the power supply in these areas. They own the interconnectors (i.e. electricity cables) between these areas and decide on the hourly transmission capacity on each of these interconnectors that will be released for day-ahead market coupling on every day of the year.

Because of the market model chosen, market participants always trade with their central counterparty, which is the clearing house employed by the PX. The effect of market coupling is that there also are clearing-house trades between adjacent market areas, potentially across a national border. This allows supply in one country to be matched by demand in another country.

The central software system involved is the matching algorithm, which is called Euphemia. Next to that, many other software systems are used both by PXs and by TSOs to take care of the various input and output data flows.

2.3 Data flows

Typically, a market coupling run goes as follows.

1. TSOs submit hourly or daily network constraints for all interconnectors in the coupled region. These constraints include the available transmission capacities (ATCs) on these interconnectors for the 24 hours in the following day.
2. PXs submit anonymized order books comprising the hourly orders and the block orders for all market areas in the coupled region over the 24 hours in the following day.
3. The central coupling algorithm calculates the optimal matching of the orders taking into account the constraints within 10 minutes calculation time. The market coupling results comprise: (a) the market clearing price per hour per market area, which determines the local matching of the hourly orders, (b) the list of matched block orders per market area, (c) the hourly net (import/export) position for each market area, and (d) the hourly interconnector flows.
4. Both PXs and TSOs validate the market results, which thereby become firm.

2.4 Static data

The following data (that does not change on a daily basis) is also input for the market coupling run.

1. The network topology, i.e. the set of market areas that compose the coupled region and the set of their interconnectors, each with their relevant attributes (like type, owner etc.)
2. The algorithm configuration parameters used

3 The Simulation Facility

3.1 Simulation Facility

The Simulation Facility (SF) is a tool that allows simulating market coupling runs based either on one's own input and configuration data or on historical data, which may or may not be altered. It can be used to simulate the impact of, for instance, extension of the region, introduction of new PX products, moving from ATC-based coupling to flow-based coupling, for performing resilience analyses and for many other purposes.

3.2 Input and output data formats

Input and output data formats are specified in File Interface Specification.

Note that these are the format which apply to the in- and export of (csv) files. The majority of the input data is expected to be the database containing the historical data.

3.3 Simulation Facility features

The Simulation Facility is expected to provide the following functions:

3.3.1.1 Requirement – User management

User management shall be implemented, making as a minimum a separation between a functional administrator and a user. Users can perform simulations and inspect results, but not (necessarily) inspect input data. The administrator manages users and also manages priorities across pending simulation requests if applicable.

3.3.1.2 Requirement – Run single-day simulations

The option to run single-day simulations shall be implemented.

3.3.1.3 Requirement –Run batches

The option to run a batch containing any number of days (e.g. full years) shall be implemented.

3.3.1.4 Requirement – Run historical input data

The option to run on historical input data (see section 4.7) shall be implemented.

3.3.1.5 Requirement – Run artificial data

The option to run on artificial input data shall be implemented.

3.3.1.6 Requirement – Run historical and artificial input data

The option to run on any mix of the two historical and artificial data shall be implemented.

3.3.1.7 Requirement – Manipulate historical input data

The option to easily manipulate historical input data before running a simulation shall be implemented. This includes data whose direct access is not allowed to the user, both market and network data (for example, doubling the capacities on a specific ATC and increasing all block volume).

3.3.1.8 Requirement – Set configuration settings

The option to set the relevant configuration settings for any run shall be implemented. The relevant parameters are:

- algorithm parameters
- network topologies
- Network model

3.3.1.9 Requirement – Submit recurring batches

The option to submit recurring batches shall be implemented. Recurring can for example be daily computation of the resilience on the daily results.

3.3.1.10 Requirement – Run pre-defined or ad-hoc reports

The option to run pre-defined or ad-hoc reports on simulation results and production results (market and operational results) [REDACTED] shall be implemented.

4 Specifying a batch of simulations

4.1 Introduction

The basic operation with the SF application will consist of a user creating its own batches (mainly based on historical input data with some alterations), giving the batch to the SF tool to be run by the algorithm, and getting the results afterwards.

This process will be based on the concept of batch. Generally speaking, we call batch an object that specifies a set of similar sessions, and market results the output of a batch as computed by the algorithm

4.2 Batches

A batch essentially points to a set of other objects.

- Either one time period defined by a start date and an end date or a set of dates
- One set of algorithmic parameters
- One network configuration (topology)
- A set of network data (historical or newly uploaded, original or modified) matching the time period and the topology
- A set of market data (historical or newly uploaded, original or modified) matching the time period and the topology

A batch also contains its own attributes:

- Identification code.
- User name (owner)
- Priority
- Frequency of execution (values: *one-shot*, *daily at 12:00*, *Mondays at 18:00*, etc...).
- Privacy (*private* or *shared*)
- Status
 - *unfinished*: the batch is under construction.
 - *pending*: the batch is in the queue and is awaiting execution.
 - *cancelled*: the user cancelled the batch during execution.
 - *running*: execution is on-going.
 - *finished*: execution terminated normally.
 - *failed*: execution terminated abnormally (for instance: algorithm could not find a valid solution or a technical problem was encountered during execution)
 - *paused*: execution is paused
 - *stopped* : execution is stopped by the user.

- In the case of a recurring batch: time and date at which the next execution is supposed to happen.

4.2.1.1 Requirement – Create batches

Batches will be created by users and sent to the SF tool to be run using the PCR algorithm. Pending batches will be managed by the SF in a list according to their priority attribute (absolute, high, normal and low). Batches of the same priority will be managed as a FIFO list.

4.2.1.2 Requirement – Give batches priorities

Priorities will be given automatically by the SF according to some rules (e.g. yearly batches will be catalogued as low priority). However this priority could be changed by authorized users (administrator).

4.2.1.3 Requirement – Time period

The user of the simulation facility shall be able to choose the days for a batch (either by giving a start and end day or by importing a set of individual days one by one).

4.2.1.4 Requirement – Allow flexible start and end data handling

The user shall be able to choose for a batch the time period by selecting set of non- consecutive days one by one

4.2.1.5 Requirement - Algorithmic parameters, default mode

Pre-defined default algorithm parameters shall be used when running in default mode (batches run by superusers not authorized to change algorithm parameters, see section7.2)

4.2.1.6 Requirement - Algorithmic parameters, alternative parameters

Only authorized users (see section 7.2) will be allowed to use alternative parameters than the default mode. If this is the case, the SF will provide the user with this possibility. In all other cases, the default parameters are applied (default mode).

4.2.1.7 Requirement – Create a batch

The batch data shall be initialized by default to historical data.

4.2.1.8 Requirement – Duplicate a batch

The user shall be able to create a new batch by “copy/paste” an existing batch, and afterward change/apply queries on input data to modify the new batch.

4.2.1.9 Requirement – Modify batch

The user shall be able to modify his batch definition (session type, parameters, topology and all the corresponding hourly data) as long as the batch has not been run.

4.2.1.10 Requirement – Filter batch list

In the tabs where the batches are listed, the user shall be able to filter the batch list according to all column values. For example, in the batch results tab, he shall be able to filter batches with one session, a finished status and recurring he created.

4.2.1.11 Requirement – Change batch data

The user can change input data by applying queries. There shall be a functionality to run these queries (refer to sections 4.4-4.6).

4.2.1.12 Requirement – Set batch priority

The system follows rules to prioritize batches. For instance, single-day batches have high priority because they run very quickly.

These rules cannot be defined by users, but administrators can override them by giving a different priority to a batch.

4.3 Network topology

A network configuration, which is a set of configuration settings, can be labelled as a network configuration object.

Examples of Network configuration objects

- "PCR_ATC"
- "OMIE_ONLY_ATC"
- "CWE in FB"

4.3.1.1 Requirement – Save network configuration (topology)

The SF shall have the functionality to save several different network configurations.

4.3.1.2 Requirement – Upload network configuration (topology)

The SF shall have the functionality to upload network configurations.

4.4 Queries

A query is an alteration that can be applied on the input data. It can be applied when defining a batch or before exporting input data. Queries can be combined, which means they will be applied sequentially, one after the other.

The word query should be understood as a general term and does not necessarily refer to SQL –like queries.

4.5 Network data series and queries

Network data series are typically network historical data spanning the batch period¹.

Because simulations typically aim at altering some data to analyze its effects, the user will be able to modify the network data series by means of network queries. A network query allows changing a network data series in several ways. For instance, queries can be used to reduce or increase the available capacity by a given percentage.

Queries can be created, modified, saved, and deleted.

4.5.1.1 Requirement – Network data queries

The SF tool will allow users to alter the network data series included in their batches by using queries (including but not limited to): modify ATC values (add a number, multiply by a number, set to a number), alter PTDF matrices (multiply by some matrix). It is possible to

filter to a subset of hours and/or by ATC direction (up or down). Several queries can be defined per ATC line.

See more on queries in *Functional Specifications*.

¹ Although this is the usual case, they can also be composed by new data included by the user.

4.6 Market data series and queries

Just like network data, market data (order books) can be retrieved and modified via queries by the users. The essential features of network queries and market queries will be identical, but the functionalities will be obviously different.

4.6.1.1 Requirement – Market data queries

The possible market data queries per market are among others:

- Hourly orders (aggregated curves)
 - Modify quantities (add a number, multiply by a number)
 - Modify prices (add a number, multiply by a number),
It is possible to combine both alterations in a query and to filter to a subset of hours and/or by order sense (supply or demand).
It is possible to define queries cumulatively
- Block orders
 - Modify quantities (add a number, multiply by a number, set to a number),
 - Modify prices (add a number, multiply by a number)
 - Set the minimum acceptance ratio to a number.

It is possible to combine all alterations in a query and to filter to a subset of hours or by order sense (supply or demand) or order volume or order price limit or order type (profile, linked, exclusive, flexible).

It is possible to define several queries per market.

4.7 Historical input data

The SF will, have access to MRC and 4MMC historical data copied from the production database (including the historical market results). [REDACTED]

4.8 Fresh input data

It is also possible to submit (i.e. upload) fresh data to the SF. Fresh data can be used in simulations in replacement of historical data or in addition to it. The SF will allow this functionality to the users.

Whether fresh data is based on historical data or created by any other means remains unknown for the system, the only requirement being that this new data satisfy a particular format. Fresh input data will be stored within the simulation facility system (after verification of the input format and consistency), allowing to apply queries on this fresh data in exactly the same way as on the historical data.

When importing fresh input data, the user has to define the level of access right for the data (see section 7.2).

4.8.1.1 Requirement- Support different fresh data types

Handling of the following fresh data types shall be supported:

- Algorithm parameter data
- Network configuration data
- Network data series
- Market data series

4.8.1.2 Requirement- Upload and add fresh data to the SF

Implement a user-friendly method to upload fresh data to the SF, and then allow the user to add it in a new batch.

Example

If I have fresh data for "Line A" capacities which I want to use instead of the historical data, the user first uploads these new capacities and give it a name.

Next, when creating a batch, he opts for a (default) network topology, and in the next step the user is asked to provide the correct hourly information for all the defined bidding areas (curve and block) and capacity information for all the lines.

In this step he will change the "Line A capacity" entry from the default (historical) to fresh data with the name of the input he provided earlier.

4.8.1.3 Requirement- Verify the consistency of the uploaded fresh data

Controls to verify the input format and consistency of the uploaded data shall be implemented.

[Redacted]

[Redacted]

5 Execution of the algorithm

5.1 Introduction

Once a user has created a batch, the batch is added to the list of pending batches managed by the SF tool. This list may have various entries (one per pending batch) belonging to different users. The list is ordered by priority. The first batch in the list is the first one to be given to the algorithm for execution.

5.2 Algorithm call

The SF will be able to create input data in the database schema used by the algorithm and call the algorithm executable.

The SF will launch the algorithm execution for the first pending session of the first batch in the list of pending batches. The SF tool runs sessions corresponding to batches in a sequential way (one by one).

5.3 Calculation management

In a first step, the application will run sessions corresponding to batches in a sequential way (one by one). The architecture of the application should be sufficiently flexible to change easily the sequential calculation by a parallel calculation (running several instances of the algorithm in parallel).

5.4 Pending batches list management

5.3.1.1 Requirement – Manage batches

Pending batches will be managed by the SF in a list according to their priority attribute (assigned by the SF according to the number of sessions in the batch). Batches of the same priority will be managed as a FIFO list.

5.3.1.2 Requirement – Manage multiple batch sessions

As batches can have multiple sessions, it can happen that a low priority batch is running a session (using the algorithm) and in the middle of this execution a new batch is entered into the list with higher priority. In this case, the former batch shall stop its execution after the current session is finished, and the new batch will start running its sessions. Once the new batch ends, the first batch will continue its execution from the first still not run session.

5.3.1.3 Requirement – Manage batch priorities automatically

Priorities for batches will be given automatically by the SF depending on the number of sessions included in the batch (more sessions imply less priority).

5.3.1.4 Requirement – Manage recurring batches

Recurring batches (e.g. daily at 12:00, Mondays at 18:00, etc...) shall be added to the list periodically by the SF tool, in line with the specified frequency. These batches will usually be one-session data and will have high priority.

5.3.1.5 Requirement – Manage batch priorities

Priority can only be changed by authorized users (administrator).

6 Using simulation results

6.1 Introduction

In chapter 4, we described how the users will be able to specify a batch of simulation in the SF tool, that is, how to specify what the user wants to simulate. This chapter describes the usage of the simulation results.

Apart from the results coming from the simulations, historical results as automatically uploaded from the production environment² will be available in the Simulation Facility and treated in the same way as simulation results (i.e. as the results of a batch). This will allow using the same reporting tools to analyse historical and simulation results and do comparisons.

6.2 Downloading or exporting raw results

As part of the SF tool functionalities, all the raw results from the algorithm can either be downloaded individually via files (csv or csv-like format) or exported to an FTP server. Access to the input data is managed per data type and per data series (restricted access depending on user rights).

6.3 Creating reports

Output data will also be provided by the SF tool in various types of reports, including tables or graphics. A user will not be able to generate a batch report containing data he is not permitted to “see” (see section 7.2).

Historical results are part of the accessible data, meaning that all the processing of simulated data into reports can be also used for historical data and vice-versa.

The SF tool will provide the user with the possibility of using pre-created reports (to be defined). The format of these reports (xlsx-like vs pdf-like) is not yet settled.

² Not to be done by the Simulation Facility provider

6.3.1.1 Requirement – Run pre-defined and ad-hoc reports

The option to run pre-defined or ad-hoc reports [REDACTED]
[REDACTED] shall be implemented [REDACTED]

7 Data handling and user restrictions

7.1 Introduction

This section describes all the functionalities linked to management of data and of access restriction.

7.2 Users

7.2.1.1 Requirement – Use roles

The usage of the simulation tool will require login with a user ID. The accessibility to each feature of the simulation tool can be restricted by user or by group of users using roles.

7.2.1.2 Requirement – Administer access rights

The usage of the simulation tool will require login with a user-ID. The accessibility to each feature of the simulation tool is managed by user role [REDACTED]

[REDACTED]

7.2.1.3 Requirement – Link users to user groups and bidding areas

Next to the defined roles there is another distinction for the superusers: user groups. Each user is linked to a defined group (usually a company). In turn a group is linked to bidding areas owned by the group. While a user has to be linked to a group this obligation does not exist for groups being linked to bidding areas. This allows the existence of TSO groups which are not linked to any bidding areas and thus have no access to any market data.

7.2.1.4 Requirement – Set group access

Besides the access to market data (curve and block orders), groups also define the access with regards to either fresh data which is uploaded as 'private' or a batch which is created with the 'private' setting. The access rights are always considered at a group level. Hence each user of the owners group has identical access to either the fresh data or the batch results.

7.2.1.5 Requirement – Create a User

Implement functionality to create users. A user must belong to at least one group

7.2.1.6 Requirement – Edit a User

Implement functionality to edit users.

7.2.1.7 Requirement – Create a Group

Implement functionality to create groups.

7.2.1.8 Requirement – Edit a Group

Implement functionality to edit groups.

7.2.1.9 Requirement – Set Group rights, roles

Implement functionality to set group rights and roles.

7.3 Data access rights

7.3.1.1 Requirement - Access to data

The accessibility to data shall be identified by user group. There shall be 3 access types. Data owned by a user group have either:

- A private access: only users belonging to the group can view (download as such or after alteration with a query) and use the data (in a batch as such or after alteration with a query).
- A protected access:
 - o all users (belonging to any group) can use the data (in a batch as such or after alteration with a query)
 - o only users belonging to the group can view (download the data)
- A shared access: all users of any group can view (download as such or after alteration with a query) and use the data (in a batch as such or after alteration with a query)

7.3.1.2 Requirement - Access to historical data

There shall be a functionality to configure access rights to different type of data.

For example historical data:

- Market data is owned by the group to which the corresponding bidding area is linked
- Network data is considered unrestricted and (fully) accessible by all groups/users.
- Historical data cannot be removed/modified (read and use access only)

Example, fresh data:

- Market and network data imported by a user is owned by the user group and can have a private or protected or shared access.
- Algorithm parameter and network configuration data imported by a user is owned by the user group and can have a private or shared access.
- Fresh data can be removed by any user of the group the data belong to.

A batch is owned by the group of the user who defined the batch. Batch results can have 2 access types defined by the user:

- Private access: only users belonging to the group can view the batch and download the data results the group has access to
- shared access:
 - o only users belonging to the group can view the batch
 - o any user (of any group) can download the results

Recap tables

Input data	Input data type	Imp	Exp	Use
Fresh market or network data (Same)	Private /protected/shared	Yes	Yes	Yes
Fresh market or network data (Other group)	Private	NA	No	No
	Protected	NA	No	Yes
	Shared	NA	Yes	Yes
Historical market data (protected) (OMIE user)	OMIE -ES/PT/MO	NA	Yes	Yes
	EPEX Spot - DE/AT/FR/BE/NL/GB2	NA	No	Yes
Historical market data (protected) (EPEX user)	OMIE -ES/PT/MO	NA	No	Yes
	EPEX Spot - DE/AT/FR/BE/NL/GB2	NA	Yes	Yes
Historical Network data		NA	Yes	Yes
Algorithm parameters or Network configuration (same group)	Private	Yes	Yes	Yes
	Shared	Yes	Yes	Yes
Algorithm parameters or Network configuration (other group)	Private	NA	No	No
	Shared	NA	Yes	Yes

	Batch access	View Batch description	Export batch input data	View/export batch results
Batch (same group)	Private or shared	Yes	Owned and shared input data only	Yes except block order results of the not owned and protected block orders used in the batch.
	Private	No	No	No
Batch (other group)	Shared	No	Owned and shared input data only	Yes, except block order results of the not owned and protected block orders used in the batch

The above shows that access to private data will be granted only to its owner.

7.4 Historical and fresh data import

Historical and fresh input data will be subject to user access rights (see section 7.2)

7.4.1.1 Requirement - Data import

It will be possible to choose for all individual data series which user can create queries using this data or not:

- PX Historical data is protected and TSO historical data is shared.
- Fresh data can be shared, protected or private.
- Once data has been defined as private, protected or shared, its access right cannot be changed.

7.5 Network and market queries

7.5.1.1 Requirement - Network and market queries

Network and market data queries can be created by all users. Users can apply network queries or market queries only on shared data, or protected data or their own private data. In other words, the only restriction is on private data from other groups specific data series (see previous section).

7.6 Download input data

7.6.1.1 Requirement - Download input data

Using the SF tool, input network and market data can be downloaded from the historical database (depending on the rights of the user), in individual files in a csv or csv-like format.

This file format is the same as the “Fresh input data” format. This is particularly convenient in case queries are not sufficient: the user will be then able to download the data, perform whichever change he needs (manual, scripts ...) and upload the modified files.

To perform downloading, the user has to provide a time period object, to specify the range to download. A user can only download data he has the right to see.

7.6.1.2 Requirement - Apply a query on input data before download

It is possible to apply a query on input data before downloading it. The input data of a batch can be downloaded once it has run.

7.7 Algorithm parameters

7.7.1.1 Requirement - Administer algorithm parameters

The Simulation facility comes with default values for the algorithm parameters. Every authorized user (see section 7.2) may create a new set of values for a specific batch by importing it as a csv file.

7.8 Network configurations

7.8.1.1 Requirement - Select network configurations

A user can select a network configuration from a list of previously uploaded network configurations.

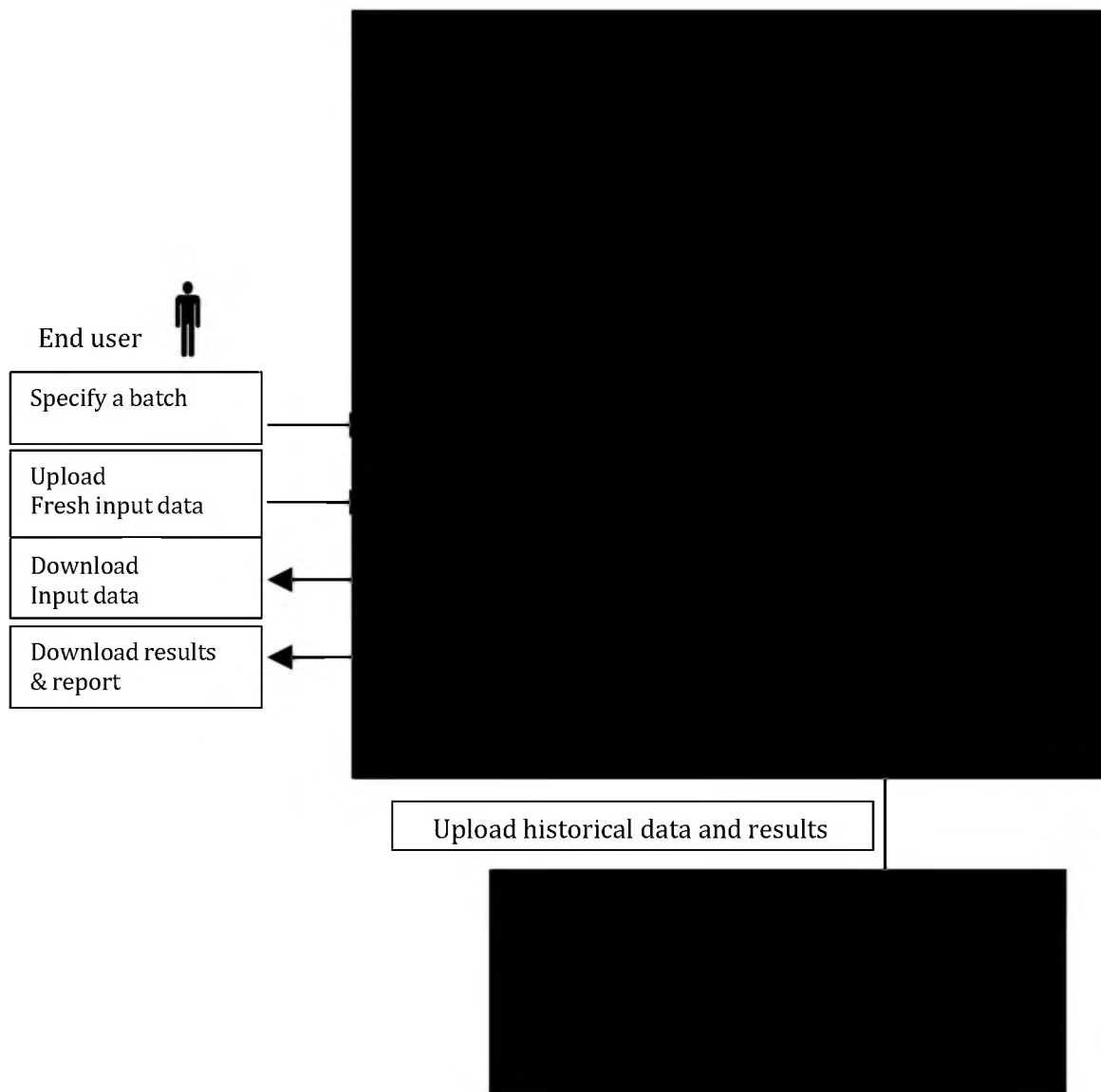
Only users authorized to change network configurations (see section 7.2) are allowed to create new network configurations.

8 Technicalities and IT issues

8.1 Functional architecture

The scheme hereunder shows the logical simulation facility components and its external interactions.

Internal interactions are shown for clarity purpose, but as they require a technical analysis of the requirements, their design will be specified in a later stage.





8.1.1.1 Requirement - Simulation facility interactions

The simulation facility can interact with

- End users who can
 - Specify a simulation
 - Upload input data
 - Download output results (raw data or report)

- An FTP server on which it can upload automatically output results
- Administrator who administrate the application
 - Not shown in this scheme

8.2 DB sizing and maintainability and simulation audit

8.2.1.1 Requirement - Maintain DB

DB can grow up to the point of possibly reaching technical limits or reducing its efficiency.

The SF will envisage some kind of approach to avoid this kind of problems. Several solutions can be proposed, including but not limited to:

- Possibility to purge the oldest simulation results and fresh input data (keeping input and batch data would allow recreating the results anyway).
- Advanced DB archiving methods.
- Storage in files, complementing the DB.

8.3 System requirements

8.3.1.1 Requirement - Web application

The simulation Facility should consist in a web application.³

8.3.1.2 Requirement - Use software environments

The facility should be accessible for external parties involved in the project; hence attention should be paid to be highly compatible with most secured IT infrastructures.

³ The existing Simulation Facility is already a web application.

[Redacted]

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10 Definitions

AC-connection	Alternating Current Connection
Agent	The Agents are the entities – mostly humans – that interact with the Broker, Matcher or Helper in order to fulfil their goals.
Algorithm	The PCR Algorithm System is the actual algorithm that does the matching calculation. It produces the prices, matched energies, accepted and rejected bids, and net area/flows between all PCR price areas.
Algorithm Session	For the Algorithm, a session is a run. If the calculation is restarted, a new session of the Algorithm is started. We are not completely sure yet how a new Algorithm session is created from existing data, but we do require this option. This also is true for receiving a second version of only one order book: this triggers a new Algorithm Session.. See also Market Coupling Session.
ATC/DC line	ATC/DC line consists of a virtual trade interconnection between two bidding areas. This should not be confused with the physical lines crossing the border. In theory, an ATC/DC line could be defined between two non-adjacent bidding areas. In practice, ATD/DC lines are defined only between adjacent bidding areas. It can also happen that two adjacent bidding areas are not linked with any ATC/DC line.
Area price	Market Clearing Price valid for a Bid Area . Settlement of participants physical buying and selling is based on this price. If no transmission constraints occur, the area prices for all areas will be equal. If need for transmission exceeds the available transmission capacity, the prices are lowered in Surplus areas and raised in Deficit areas , thus resulting in different area prices.
Auction-based trading	A way of trading where all bids are gathered at the same time into the price calculation (bid matching), and for each bid period, a single price for all transactions is established. See also Continuous trading .
Balancing Area	Subset of bidding areas for which the sum of the AC net positions should be zero.
Bid	Discloses a participant's request to sell or buy energy. Different bid types can exist (block, profile, hourly, etc...)

Bid area	A geographical area spanning an electrically unbroken part of the grid in the actual Market area . The bid area borders normally reflect locations in the grid where Transmission constraints may occur.
Bid period	The duration of the time period that bids are related to. Normally, hourly periods are used
Block	A sequence of consecutive hours. The blocks can be defined by the Power Exchange or by members.
Block bid	A Bid with a fixed price and quantity valid for a Block . Both sale and purchase block bids are allowed. The quantity is either fully accepted or completely rejected, depending on the average price of the hours within the actual block. Sale block bids are accepted if the bid price is <i>lower</i> than the average price. Purchase block bids are accepted if the bid price is <i>higher</i> than the average price. Tradable volumes over the block is typically constant, but can also vary for each Bid Period (in which case it is called a profile Block Bid)
Broker	The PCR Broker is an application running at the PX's installations that provide the necessary control and data interchange functionalities to make the PCR run. The PCR Broker is connected to the PCR Matcher, to the PX Information & Trading Systems, and to the other PCR Brokers.
Broker Cloud	Broker Cloud is the description of the set of all Brokers active or expected to be active at a certain point in time after the first launch of a regional PCR implementation. If a message is sent to the Broker Cloud, this means that it is sent to all Brokers that are part of the Broker Cloud individually. The Broker Cloud does not have data storage of its own; it is only another way of referring to "all Brokers".
Clock	The Clock is the virtual agent that triggers actions that will be performed periodically.
Cloud computing	Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories: Infrastructure –as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams.
Congestion management	Techniques and methods for managing Transmission constraints . Several methods may be applied.

Continuous trading	A way of trading where matching of bids are done continuously, where each match of sale and purchase result in a specific price, valid for that particular transaction only. See also Auction-based trading.
Coordinator	Party coordinating and supervising the operation of PCR Market Coupling
Deficit area	An area where, given a specific price, the aggregated sale is <i>lower</i> than the aggregated purchase. See also Surplus area .
External area	A Bidding Area that only can influence a given reference price up to the given capacity to/from this external area to the internal areas. See also internal areas .
Flexible bid	A Bid with a fixed price and quantity with the duration of one hour. The participants do not state a specific hour themselves. The bids are automatically placed in the most favourable hour(s), i.e. the hour with the highest price, given that the bid price is <i>lower</i> than the highest hourly price.
Full decoupling	Full suspension of PCR market coupling for the duration of at least one day.
Functional Administrator	The Functional Administrator administers user rights and can end user sessions. This typically is either an operations supervisor or an application manager.
HVDC-connection	High Voltage Direct Current Connection HVDC or high-voltage, direct current electric power transmission systems contrast with the more common alternating-current systems as a means for the bulk transmission of electrical power.
Impedance	Total resistance of the electric circuit to the flow of alternating current.
Market area	A geographical area where a Power Exchange (also called a Market Operator) runs an electricity market. One or more Transmission System Operators (TSO) operates the electrical grid within the Market area.
Market-Clearing Price (MCP)	A common reference price for the whole Market area , when not considering transmission constraints. See also Area price and System Price .
Market coupling	A coordinated day-ahead electricity implicit auction mechanism, performing the matching of the supply and demand curves of different PXs, taking into account the cross border capacity made available by the TSO's, using a software application embedding a matching algorithm
Market Coupling Session	A Market Coupling Session is the market coupling run for a certain flow date. We stay within the same session in case we

	need to go back to earlier steps of UC1, restart the Algorithm, have resending of data etc, Can we also resume a session after a Broker crash? Yes, we can, but not all parties trust such functionality. See also Algorithm Session.
Market splitting	A common word for the process of separating the Market area in multiple Price areas due to Congestion management .
Matcher	The PCR Matcher is an application intermediary between the Broker and the Algorithm. It obtains from the PCR Cloud the input information for the algorithm and stores it in the common database. Once the algorithm has finished, it download the results and passes them to the PCR Cloud.
Operator	The Operator monitors and operates the regular market coupling business process and takes action if things go wrong. This typically is a market operator
Partial decoupling	Temporary non-participation in PCR Market Coupling one or more bidding areas, while the remaining bidding areas still participate in PCR market coupling
PCR	Price Coupling of Regions (PCR) is a distributed approach to price coupling between different bidding areas managed by several PXS
PTDF	Power Transfer Distribution Factors, commonly referred to as PTDFs, express the percentage of a power transfer that flows on a transmission facility.
Price area	A part of the total Market area having equal price. A price area may consist of a single bid area or, more often, by two or more bid areas.
Price-independent bid or price taking bid	A Single bid with only two price/quantity pairs, namely at the minimum and maximum price limits. At both prices, the quantity is the same. This will result in the participant getting this quantity no matter what the market price will be within the price area.
PX	Power Exchange, a company that organizes directly, or through services of a third party, wholesale trade of electricity to be delivered in a certain Bidding Area or of electricity related products
PX IT System	Any local PX system that, either directly or indirectly, communicates with the Broker, including, but not limited to, the trading system.
PX Trading System	The trading system existing on each PX. In PCR it interacts with the Broker providing and receiving information
Ramping	Maximum change per area and/from interconnection from one hour to the next hour of trading (transmission) flow.

Single hourly bid	A Bid consisting of a sequence of price/quantity pairs valid for a single Bid period . The price/quantity pairs are regarded as points on a piecewise linear curve and indicate a request to sell or buy various amounts of energy at different prices.
Surplus area	An area where, given a specific price, the aggregated sale is <i>higher</i> than the aggregated purchase. See also Deficit area .
Technical Administrator	The Technical Administrator ensures that the system is in good working order for the other actors and has direct access to the innards of the system, in particular the database and the file system
Transmission capacity	The capacity for transport of energy from one Bid area to another. The capacity values are set per Bid period by the TSOs.
Transmission constraint	A situation where the need for transmission exceeds the available transmission capacity across a section of the grid. Such situations are handled by Congestion management methods.
TSO	Transmission system operator
TSO IT Systems	IT systems existing on the related TSOs which provide information for PCR (capacities) and potentially receives the PCR results for validation
Watcher	A Watcher can view the progress of the market coupling process and the results, but not influence it (a system watcher is a 'read-only' operator).

