

**THE HARMONIZED ROLE MODEL OF  
ELECTRICITY MARKET IN UKRAINE USING THE  
INTERNATIONAL SERIES OF STANDARDS  
IEC 62325 “FRAMEWORK FOR ENERGY MARKET  
COMMUNICATIONS”**

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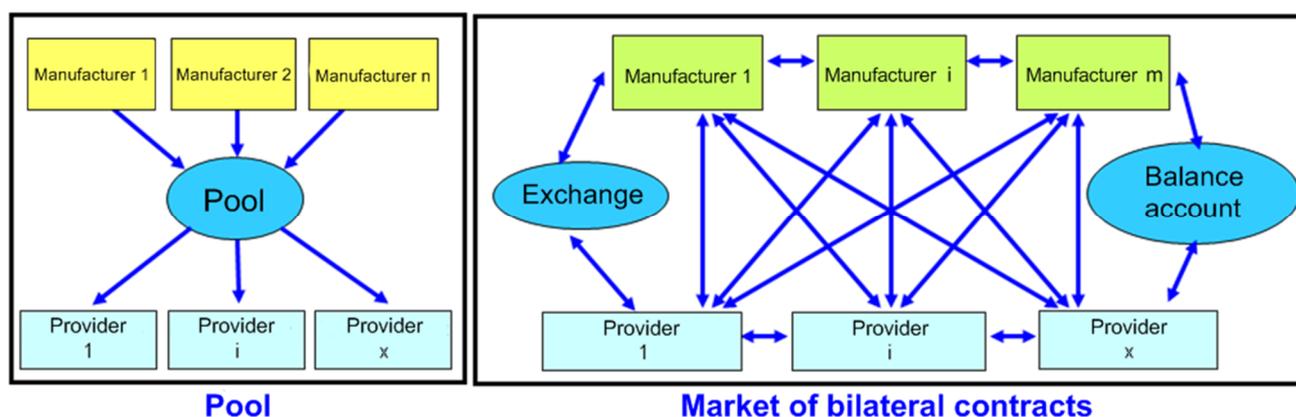
## OVERVIEW OF BILATERAL AND BALANCING ELECTRICITY MARKET IN UKRAINE

Wholesale Electricity Market (WEM) in Ukraine was established in 1996. Implementing WEM laid the basis for the introduction of market relations in the power industry which include: provide a framework for competition between manufacturers and suppliers of electricity, guaranteed energy consumers ensured form a single averaged the wholesale electricity prices, created conditions for equal access of market participants to the WEM of Ukraine worked out and implemented legal and regulatory and contractual basis for the functioning of the WEM, created prerequisites for attracting investment.

However, the shortcomings of the existing model of "Single buyer" acting in Ukraine today are: imperfect system of contractual relations; overpricing; administrative interference; unequal competitive conditions; insufficient transparency the export and import of electricity, and others.

Given the global experience of the wholesale electricity market, the rules of the European Energy Charter and the requirements of the European Directives, further development of WEM of Ukraine provides a transition from the current system through further liberalization of its models to full-scale competitive market – the market of bilateral contracts and balancing market (BCBM).

As seen in fig. 1 market model "Single buyer" is centralized in the aspect that the purchase and sale the all volume of electricity carried out through association (pool). The main feature of this model is the centralized scheduling of all participants, while all of electricity suppliers have to buy all the demand of electricity in the union, and all producers sell electricity to the pool.



**Fig. 1. Model of the pool and BCBM**

Unlike the pool on BCBM all market participants can enter into contracts with each other to supply electricity, and the contracts formed the basis for self-scheduling producers of electricity. BCBM gives possibility of realization overflows of electricity between any two market participants and, in fact, allows all market participants to act as traders. Model BCBM will provide a wide spectrum of tools to meet the needs of both consumers and producers of electricity, but the implementation of this model would require reorganization of relations between market participants. Model BCBM will include a number of different segments with corresponding features which will together form the basis of future BCBM Ukraine and ensuring a competitive relationship between its participants. The new model of the electricity market of Ukraine includes the following components: the market of bilateral contracts; "day ahead" market; balancing market; ancillary services market; the retail electricity market. Purchase and sale of electric energy on the electricity market made market of bilateral contracts, "day ahead" market, balancing market and retail market.

## OVERVIEW OF IECTR 62325 SERIES

An integral part of the introduction of competitive market models is the development of rules and models of functioning, rules of interaction among their members in terms of data collection, transmission, processing information and more.

Until recently one of the major problems associated with the introduction BCBM in Ukraine was the lack of a formalized approach to the description of its operation model. This led to difficulties at formation of the final architectural market, the development of the final rules of the market, identifying technological and business processes as a whole or its individual segments. The analysis of principles of functioning of world markets electric power and international standards as well as common approaches to the construction of market models has confirmed that for model building electricity market it is necessary to use modern modeling methodology, based on information technology that simplifies the description of the organization and functioning of the control systems segment electricity market and the market in general.

Before the implementation of the control system of market segments and e-business in the electricity market should have a basic common understanding by all participants of the market, technical and information requirements, business rules and business processes. Description of business processes includes identifying and defining: roles of market participants, business areas and business processes within these areas, business interactions (logical combination of several transactions) and transactions (multilateral and bilateral). This common understanding is reflected in the business market model, using formalized methodology for modeling e-business, which should be independent of the virtually used communication technology e-business. According to the standards IEC 62325 series "Framework for energy market communications" to describe all processes on the electricity market it is appropriate to use the modeling methodology UMM (Unified Modeling Methodology). Methodology UMM is a modified specialized subgroup unified software development process called rational unified process (RUP), using unified modeling language (UML). Construction of role models that are based on the methodology of object-oriented modeling of UMM in accordance with international standards IEC62325 series, involves the development and use of a number of artifacts based on UML (Part 5.3. Standard IEC 62325-102):

- business operation maps;
- usecase diagram;
- activity diagram;
- sequence diagram;
- class diagram.

Thus, an object-oriented model of the electricity market is a formal description of the whole market using e-business modeling methodology UMM UN/CEFACT, which is based on UML modeling language for the four business processes with business modeling, formation requirements, analysis and design. The main stages of building object-oriented model include: analysis, design and construction of the model. Analysis and design phase aims at research of the subject area and finding logical solutions to implement role-model. In the process of object-oriented analysis and design main attention should be paid to the definition, classification and description of concepts (objects) role model and their entity in terms of subject area, creating a vocabulary role model and analysis requirements for interaction between concepts within a role model. In object-oriented design patterns BCBM decomposition is carried on roles and processes (segments, processes domains, processes etc.), defined logical relationships between roles and processes. This decomposition leads to the creation of hierarchies types of roles and processes. Also in object-oriented planning developed the previous conceptual diagram a role model, that is designed for a deeper understanding of concepts, precedents and relationships between them, followed by addition within each new development cycle detail or role model.

## **ENTSO-E HARMONIZED ELECTRICITY MARKET ROLE MODEL DESCRIPTION**

Before the implementation of information exchange, management of market areas and e-business in the electricity market should have a basic common understanding by all participants of the market, technical and information requirements, business rules and business processes. For understanding and practical implementation of all processes in the BCBM model in Ukraine it is necessary to define and to describe roles and functions of different participants and to construct the role model of BCBM and of its areas. Main principles and examples of construction of models of the electricity market are defined in the series of international standards IEC 62325 "Framework for

energy market communications”. These principles are widely used in the power industry and by software developers. The generalized experience of construction and use of role models in the European countries is the basis for developed ENTSO-E "Harmonized role model of electricity market" [3] and of models of separate areas of electricity market. The role model is a variety of object-oriented model which constructs with use of UMM.

The development of the role model of Ukrainian BCBM may base on the models of whole sale electricity markets which functioning in other counties and have an analogic market areas and similar roles of participants. However, the role model of specific electricity market cannot fully replicate any other role model. That is why it is reasonable to harmonize and adapt the existing ENTSO-E model taking into account the features and roles of area of Ukrainian electricity markets.

*A role* represents the external intended behavior of a party. Parties cannot share a role. Businesses carry out their activities by performing roles, e.g. system operator, trader. Roles describe external business interactions with other parties in relation to the goal of a given business transaction.

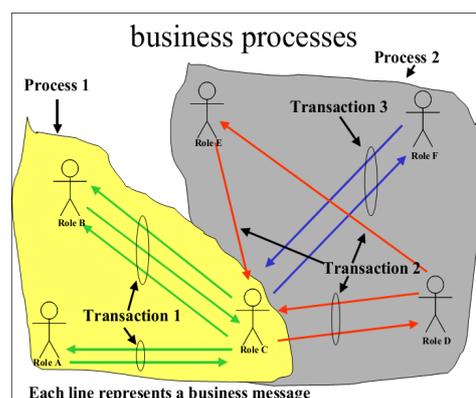
*A domain* represents a delimited area that is uniquely identified for a specific purpose and where energy consumption, production or trade may be determined.

*A party* represents an organization or a part of an organization that participates in a business transaction. Within a given business transaction a party assumes a specific role or a set of roles. The objective therefore of decomposing the electricity industry into a set of autonomous roles is to enable the construction of business processes where the relevant role participates to satisfy a specific business transaction.

*A business process* may be defined as a formal specification of a set of business transactions having the same business goal. For example, the day ahead schedule business process.

*A business transaction* may be defined as a predefined set of activities that are initiated by a role to accomplish an explicitly shared business goal and terminated upon recognition of one of the agreed conclusions by all the involved roles.

The diagram in fig. 2 (The Harmonized Electricity Market Role Model, 2009) provides an example of the different relationships that can appear in a role model. The diagram shows two business processes, three business transactions, six roles and a number of business messages. It can be seen that role C participates in both processes, and in all transactions. It is not the intent of the role model to define the business processes or the business transactions themselves. The role model will only provide the principal business messages that are exchanged between two roles. The business messages, which could be paper or electronic, provide the main justification for the roles presence in the role model. The business process and business transactions that are derived from the role model will be completely defined in an implementation guide. A party may play one or multiple roles within a given business process. For example in business process 2 in fig. 2 a single party could play role D, role E and role F. It is therefore essential that when designing a business process composed of one or more business transactions, the constraints on each business message of a business transaction are defined exclusively in relation to the role and the part the role plays in the business transaction. Thus a party who plays only one role may participate in the business process just as actively as a party who plays several.



**Fig. 2. Business processes, transactions and messages**





transmission and distribution network. System operation guarantees in this phase that generation meets consumption in real-time (balancing) and that the system is reliable. Many services are needed to support the core processes. In the settlement phase, for example, the settlement service provides the means to bill consumption and imbalances. Any imbalance of operation (difference between schedules and metered generation and consumption) is in the financial responsibility of the Balance-Responsible Parties (traders and others).

However, on BCBM of Ukraine there are some differences between process domains and roles which described in the standards IEC 62325-101 [1] and 62325-102 [2] and in the harmonized electricity market role model [3].

The list of domains in the role model of BCBM of Ukraine is shown in the Table 1. The domains are organized by names and by their main functions with European harmonized electricity market role model.

TABLE 1.

<b>The harmonized electricity market role model</b>	<b>General role model of electricity market in Ukraine</b>	<b>The differences between models</b>
Accounting Point	Accounting Point	Identical
Allocated Capacity Area	Allocated Capacity and Market Area	In Ukraine Allocated Capacity and Common Capacity are a part of Capacity Market Area
Capacity Market Area		
Common Capacity Area		
Balance Group	Balance Group	Identical
Control Area/Control Block/Coordination Center Zone	Control Area	In Ukraine 3 domains are united in one domain
Functional Group	Functional Group	The domain is absent
Market Area/Local Market Area	Market Area	In Ukraine there is not division to Local Market Area, this terms are identical
Market Balance Area	Market Balance Area	Identical
Meter	Meter	Identical
Metering Grid Area	Metering Grid Area	Identical
Metering point	Metering point	Identical
Register	Register	Identical
Reserve Object	Ancillary Service Object	This object is identical to object which provide the ancillary services

The list of roles in the role model of BCBM of Ukraine is shown in the Table 2. The roles are organized by names and by their main functions with European harmonized electricity market role model. The description of given roles (Table 2) and domains (Table 1) is given in [3].

The main differences between BCBM model of Ukraine and European harmonized electricity market role model are in more broad functions of system operator in Ukraine, and especially market laws and rules which provided the union of several roles in one role.

TABLE 2.

<b>The harmonized electricity market role model</b>	<b>General role model of electricity market in Ukraine</b>	<b>The differences between models</b>
Balance/ Production/ Consumption Responsible Party	Balance Responsible Party	Three roles are united into one
Balance Supplier	Market participant	Only the name differs
Billing Agent	Market Operator	As a part of Market Operator
Capacity Coordinator	System Operator	As a part of System Operator
Capacity Trader	Capacity Trader	Identical
Consumer	Consumer	Identical
Control Area / Block Operator Coordination Center Operator	Control Area Operator	Three roles are united into one
Data Provider	---	The role is absent
Grid Access Provider	Grid Access Provider	Identical

Grid Operator	Grid Operator	Identical
Imbalance Settlement Responsible	Imbalance Settlement Responsible	Identical
Interconnection Trade Responsible	Interconnection Trade Responsible	As a part of System Operator
Market Information Aggregator	Market Operator	Two roles are united into one
Market Operator		
Meter Administrator	Meter Administrator	Identical
Meter Operator	Meter Operator	Identical
Metered Data Collector	Metered Data Collector	Identical
Metered Data Responsible	Metered Data Responsible	Identical
Metered Data Aggregator	Metered Data Aggregator	Identical
Metering Point Administrator	Metering Point Administrator	Identical
MOL Responsible	---	The role is absent
Nomination Validator	System Operator	As a part of System Operator
Party Connected to the Grid	Party Connected to the Grid	Identical
Producer/ Block Energy Trader	Producer	Identical
Reconciliation Accountable	Balance Responsible Party	Two roles are united into one
Reconciliation Responsible		
Reserve Allocator	Ancillary Service Provider	Two roles are united into one
Resource Provider		
Scheduling Coordinator	---	The role is absent
System Operator	System Operator	Identical
Trade Responsible Party	Trade Responsible Party	Identical
Transmission Capacity Allocator	Transmission Capacity Allocator	As a part of System Operator

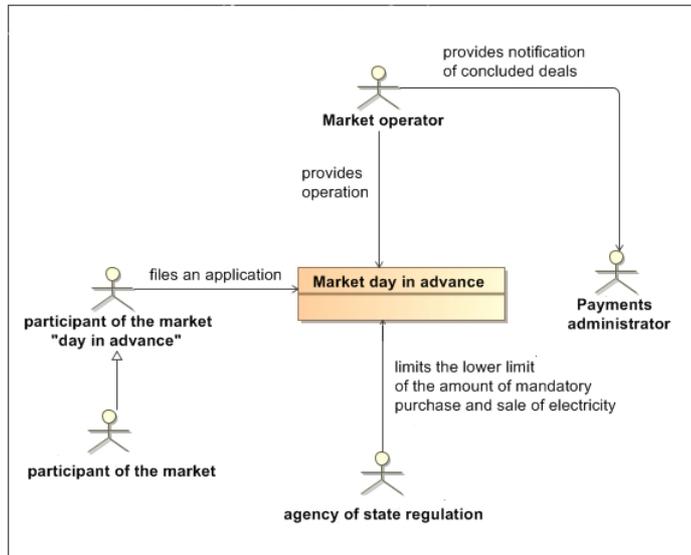
### **EXAMPLE OF CONSTRUCTION OF ROLE MODEL FOR POWER EXCHANGE PROCESS IN UKRAINE IN ACCORDANCE TO REQUIREMENTS OF STANDARD 62325**

In standard IEC 62325-102 shows an example of building object-oriented model of one of the segments of electricity market (pages 15-25). Using the above example will build and consider at an example of object-oriented model segment BCBM of Ukraine for example "day ahead" market (electricity exchange). In fig. 5 shows a diagram of the conceptual scheme of role model "day ahead" market. In the conceptual scheme of role model showing the interaction between the segment the roles of the participants in this segment BCBM, and mentioned segment can be seen not only as an abstract description of certain relationships, but also as the primary architecture of IT system management of work "day ahead" market.

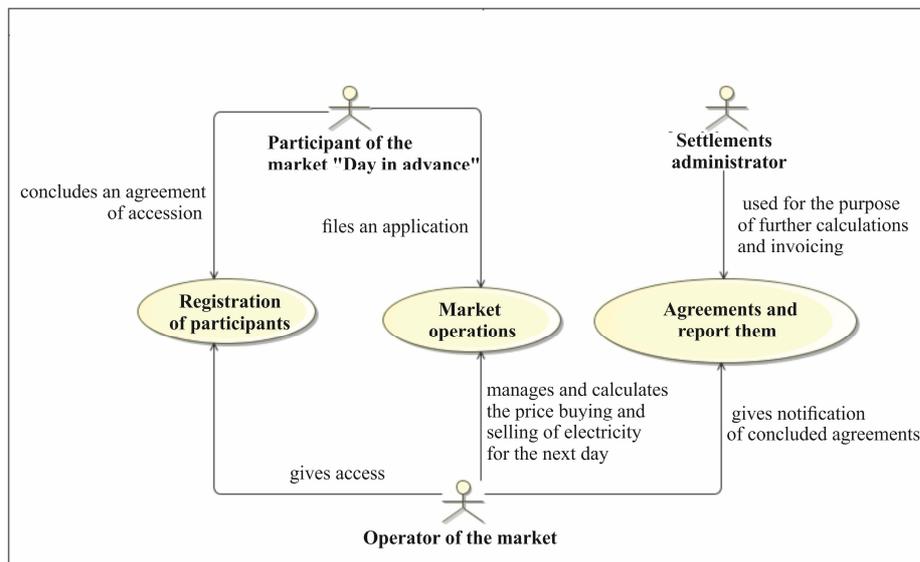
For a more detailed presentation of the essence of roles on fig. 6 are to the inclusion some type of role to other roles, and directed relation from one role to another indicates that every role, from which directed this attitude includes the functionality of the role to which is directed it relationship. For example, it is shown that as the market participants a day forward may be made only by market participants.

To highlight certain areas of process in the segment BCBM or processes in the areas of processes, mapping the relationship between the roles of participants, processes/areas of processes and their functions used UML-Use Case diagram (fig. 6). To highlight certain areas of in the segment BCBM process or processes in the areas of processes, mapping the relationship between the roles of participants, processes/areas of processes and their functions used UML-Use Case diagram (fig. 6). This type of diagrams allows you to define a list of operations that must execute system control segment BCBM, so often mentioned type of diagrams called diagrams of functions because based on a set of such diagrams in the future created a list of requirements to control systems by segment BCBM.

Should be noted that for display connection role with the "usecases" specific process in UML used association. It should be noted that display connection role with the "usecases" specific process used in UML association. In diagrams variants of the use associations serve to designate the specific role of behavior in relation to a particular process, that the association reflects the semantic features of the interaction roles of members and processes (in the field of processes) in the graphic system role model.



**Fig. 5. "Day ahead" market**

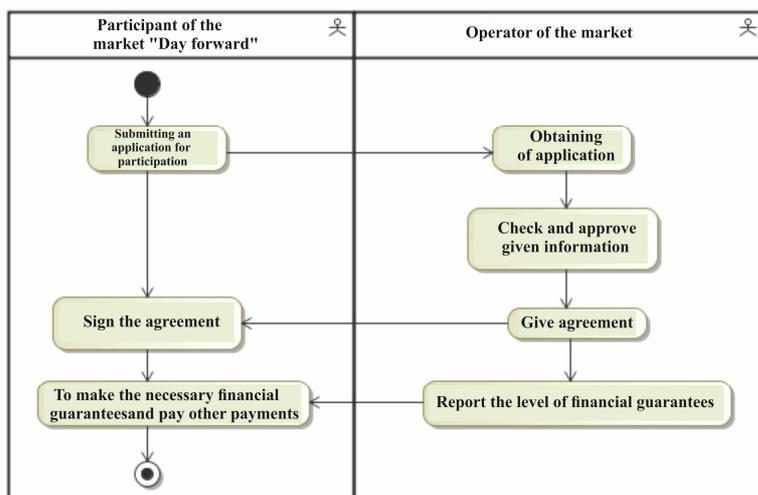


**Fig. 6. Processes on the "Day ahead" market**

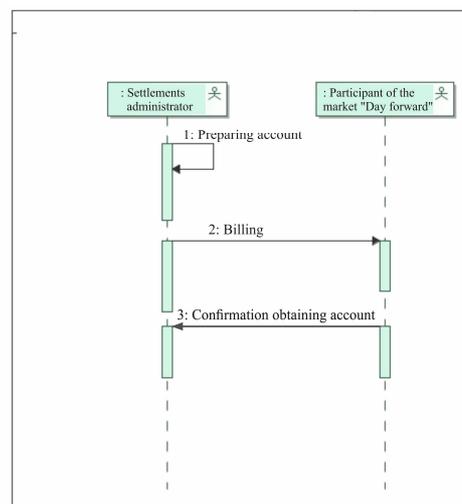
When modeling processes a specific area the segment processes BCBM it is necessary to detail features of algorithmic or logical realization as BCBM processes and operations management systems segment of BCBM. For this purpose used flowcharts or structural diagrams of algorithms that focus on the sequence of execution certain actions, elementary operations, which together leading to the desired results. As such flowcharts and algorithms for the construction of role models provided for the use of diagrams action. Diagrams actions are mainly used for visualization features of implementation of certain processes and interactions between market participants in mid of processes, though such diagrams also appropriate to use when describing specific actions in the of processes along with diagrams variants of the use. In fig. 7 shows a diagram field actions of processes "Registration of day ahead market participants".

It should be noted that during the interaction between the roles generated events that transmitted to information-technology control system by segment of BCBM and other roles of participants. Such events are the requests to perform certain actions or responses to such requests. As a system of notation a part of UML language and methodology UMM diagrams are action sequences, using which you can illustrate interactions between roles and interactions that are initiated at the same time. Diagram sequences of actions is a scheme that for a certain "scenario" behavior roles members within the of processes area displays events that generated by the roles and their order.

When building a role model for describing the relationship between information messages and electronic document within a certain field processes or BCBM the segment as a whole, using class diagrams, construction of which is beyond the scope of this project.



**Fig. 7. Registration of participants of a day ahead**



**Fig. 8. Billing**

## CONCLUSION

So, during the performance of work were tested resolutions and recommendations of the series of standards IEC 62325 part 101 and part 102. It is shown the use of this standard for building object-oriented models Electricity Market of Ukraine.

Also was developed general role model of electricity market of Ukraine, which was harmonized with the existing model of the European electricity market. When developing a model identified differences between Ukrainian and PanEuropean role models.

These models make it possible to solve the following basic tasks:

- understanding of the structure, areas of processes and BCBM work processes;
- visual display of the model and the basic rules of functioning BCBM;
- providing an overview of the model and principles of functioning BCBM for all users, developers of standard and suppliers of software; use role models as the primary architecture in creating information technology systems to manage this segment.

When performing the works was built: the general role model market of bilateral contracts and balancing electricity market of Ukraine. For this at intermediate stages was investigated Model of Power exchange process, Model of Settlement Process, Model of Capacity Allocation. Some of these diagrams and models was built based on the series of standards IEC 62325, and developed ENTSO-E/eBiX models but considering the peculiarities of Ukrainian electricity market.

After the improvement of developed models it is possible to develop technical specifications for the development of information models and information and technology management systems segments BCBM work in Ukraine.

## REFERENCE

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