JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: June 15, 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

"Modernization of electric power distribution system at OJSC "Odesaoblenergo"

Sectoral scope: 2 – "Energy distribution".

The version number of the document: 02.

Date: 30/06/2011.

A.2. Description of the project:

Purposes of project activity: The main purpose of the Joint Implementation Project (hereinafter - JIP) implementation "Modernization of electric power distribution system at OJSC "Odesaoblenergo" is the implementation of the program on the technical improvement of electrical networks and equipment, advanced technologies implementation, the transition to a higher level of organisation of transmission and distribution of electric energy.

Implementation of the measures under the Project will allow for improvement of the reliability and efficiency of distribution electrical grids of Open Joint Stock Company "Odesaoblenergo" (hereinafter – OJSC "Odesaoblenergo") and this will help reduce the amount of electricity that is lost during transport thereof to the consumers of all forms of ownership, so the production of electricity at thermal power plants will decrease and correspondingly emissions of GHG gases will decrease in comparison to current practice.

Historical details of OJSC "Odesaoblenergo" development

The year 1951 became the year of regional energy administration "Odesaenergo" formation (REA "Odesaenergo"). In June 1957 REA "Odesaenergo" starts parallel work with Moldova, and in January 1961 power bridge Kakhovska hydro power plant (HPP) - Kherson - Central'na - Usatove linked it with other energy association of Ukraine. Electricity of Dnieper and Donbas came in Kherson, Mykolaiv and Odesa, giving new impetus to the construction of electricity transmission lines and substations. In 80's SEO "Odessaenergo", annually built up to 1000 km of electricity transmission lines of different voltage. This type of work was notably extended after the transfer of rural energy enterprises from the Ministry of Agriculture to the Ministry of Energy in Ukraine in 1973. In 1995 by the Decree of the President of Ukraine in the context of the reform Pivdennyi RDC , Southern Electrical grids of energy supplying company OJSC "Odesaoblenergo" were formed instead of SEO "Odessaenergo".

Description of conditions whereon the project will be implemented.

Electrical grid is a complex of electrical equipment and devices for electricity transmission and distribution. Electrical grids relate to complex technical systems in terms of their structure, organization of operation and the principles of managing.

Technical state of the distribution electrical grids at OJSC "Odesaoblenergo" is getting worse due to lack of necessary funds to implement energy-efficient equipment and a natural deterioration factor plays a crucial role in this process. At the same time a problem of maintaining at the quite required level of reliability of the electricity supply systems for electric energy consumers is getting more acute. Extensive distribution electrical grids often work under severe conditions of pollution, moisture, frequent dynamic and thermal overloads, and the average operating life of most of the major equipment in the electrical grids significantly exceeds the standard lifetime.

By the beginning of the Project OJSC "Odesaoblenergo" had only carried out measures aimed at maintaining electrical grids in operational state. In most cases, these measures included repairs intended to correct defects arising during the operation of the electrical grids.

Most equipment that operated at that time in the grids of OJSC "Odesaoblenergo" was already morally and physically obsolete, but because of insufficient funding and operational reserve of existing equipment, it could further be exploited. In addition, changing of the existing situation was possible on condition of not only changes of the technical provision of the grid, but also improvement of organizational structures, and this also required financial and human resources.

Project scenario

The basis of the JIP is the introduction of new energy-efficient equipment and activities:

- organizational and technical measures,
- technical measures that aim to eliminate energy losses when transporting electricity via distribution grids.

Measures to be implemented under the project (see Section A.4.2 below), as well as application and implementation of ongoing monitoring of possible sources of loss and preventing from their occurrence would significantly reduce energy losses in the electrical grids of OJSC "Odesaoblenergo".

Historical details of "Modernization of electric power distribution system at OJSC "Odesaoblenergo" Joint Implementation project development

The management of OJSC "Odesaoblenergo" made a decision to implement the JI project "Modernization of electric power distribution system at OJSC "Odesaoblenergo" at the enterprise during a board meeting on December 22, 2002.

05/2003 is a commencement date of implementation of new energy efficient equipment according to the project design document.

12/04/2011 - preparation of project proposal and justification for the reduction of anthropogenic greenhouse gases to the State Environmental Investment Agency of Ukraine.

31/05/2011 - a Letter of Endorsement №1382/23/7 was issued by the National Environmental Investment Agency of Ukraine.

The baseline scenario provides for the further use of existing equipment and routine repairs and recovery work without significant investment. Losses of electricity in the electrical grids would remain at the same level, leading to greenhouse gases emissions due to burning of fossil fuels at electricity generating companies in the pre-project years. Justification of the baseline scenario is provided in Section B.

The project may promote sustainable development of OJSC "Odesaoblenergo" in the following aspects:

- Reduced load and improved working conditions at overloaded electricity generating companies;
- Decrease of national economy's dependence on import of energy and increase of country's energy security;
- High rates of labor and health protection;
- Improvement of the global ecology state (counteraction in response to global climate change by means of reduction of carbon dioxide emissions into the atmosphere);
- Creation of jobs in the course of modernization of the distribution electrical grids.

A.3. Project participants:

Party involved	Legal entity project participant (as applicable)	Please indicate if the Party involved wishes to be considered as project participant (YES/NO)
Ukraine (Host Party)	• OJSC "Odesaoblenergo"	No
Switzerland	• VEMA S.A.	No

A.4. Technical description of the project:

A.4.1. Location of the project:

The JI Project is implemented on the territory of Odesa city and Odesa region, Ukraine.

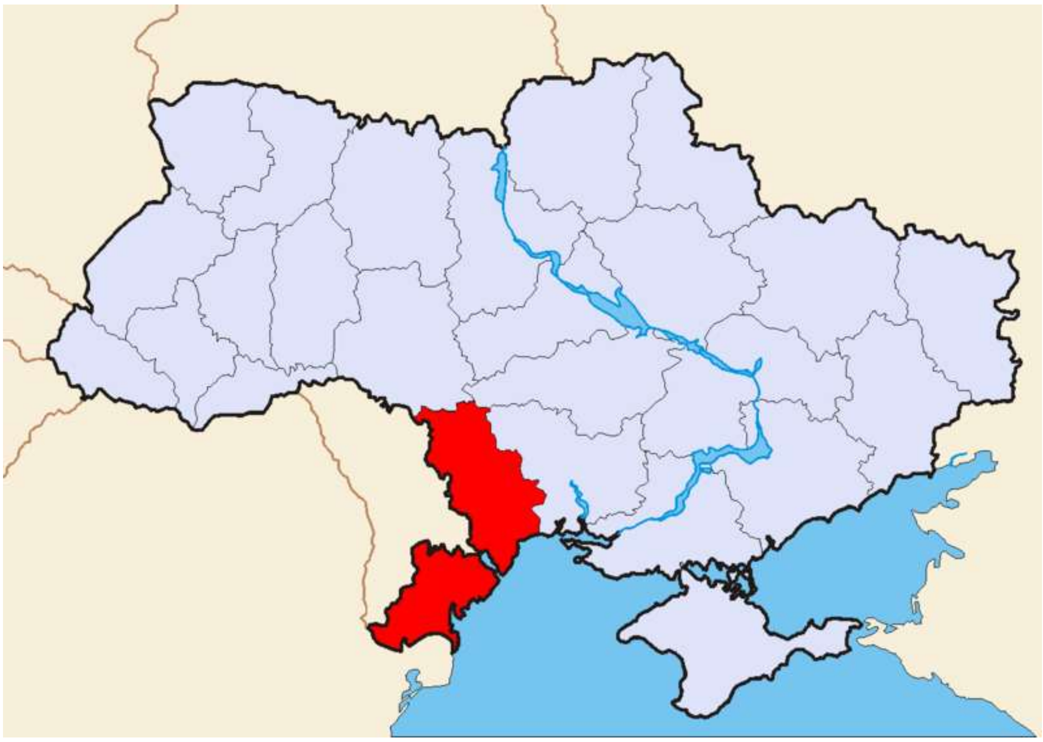

Figure 1. Geographical localization of the project activity of OJSC "Odesaoblenergo" is marked with red color

A.4.1.1. Host Party(ies):

Ukraine

A.4.1.2. Region/State/Province etc.:

Odesa region

A.4.1.3. City/Town/Community etc.:

The joint implementation project includes all the administrative - territorial units of Odesa region where the distribution electrical grids of OJSC "Odesaoblenergo" are situated.

A.4.1.4. Detail of physical location, including information allowing the unique identification of the project (maximum one page):

The Joint Implementation Project (hereinafter – JIP) is implemented in the Odesa region (46°28′00″ Nl 30°44′00″ El). Geographic localization of the project is depicted in Figure 2.

Figure 2. Location of OJSC "Odesaoblenergo" on the map of Odesa region

Project activity of OJSC "Odesaoblenergo" is located in Odessa city and Odessa region, which is located in southwestern Ukraine, bordering on the north with Vinnitska region and Kirovograd region; on the east it borders Mykolayiv region, in the west – Moldova; in the southwest there is a part of the state border of Ukraine with Romania.

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

Introduction of new equipment that aims to reduce process losses of electricity (hereinafter - PLE) in the distribution electrical grids of OJSC "Odesaoblenergo" and complex of organizational and technical measures that aims to reduce PLE are the basic elements of the JI Project, which in turn includes:

- Modernization and rehabilitation works in electrical grids and introduction of new energy efficient equipment;
- Improvement of the reliability of electricity supply to electricity consumers;
- Introduction of automated systems of electricity consumption commercial records (ASECCR) in the perimeter of energy supply company, ASECCR of consumers and subplants;

- Introduction of a complex Program on process losses of electricity decrease.

In the framework of the Project it is provided to form the PLE management system (energy rate setting, energy audit and energy management) in the Company for effective implementation of a number of organizational and technical measures as well as measures on developing and improving the methodological provision of PLE reduction during implementation of licensed activities on electricity transmission and distribution. Lists of these activities are listed below:

1. Organizational and technical measures

1.1. Turning off transformers with seasonal load;
1.2. Regular monitoring and adjustment of phase loads in electrical grids;
1.3. Modernization of the program and technical measures on automatization of operational and dispatch management of operational and information complex (OIC), system of remote metering, telesignaling to the dispatch centers of the Company;
1.4. Optimization of schemes of normal mode of electrical grids operation;
1.5. Reduction of time of sub-optimal schemes operation of electricity distribution and supply by reducing the duration of repairing and restoration works;
1.6. Reduction of power consumption for subdivision's needs of the company;
1.7. Reduction of power consumption for the company's own needs;
1.8. Cleanout of lanes from underbrush and shrubs;
1.9. Other measures of reducing PLE for electricity transmission processes;

2. Technical measures:

2.1. Measurement of short circuit currents and changing inconsistent with standards switching devices and safety devices;
2.2. Bringing to standards of: contact connections, remote contact connections temperature control and insulation using thermal visions and pyrometers.
2.3. Instalation of longitudinal cross-reactive power compensation in electrical grids and reducing the higher harmonics level;
2.4. Introduction of automated systems of electricity consumption commercial records (ASECCR) in boundaries of energy supply company, ASECCR of customers and subplants;
2.5. Implementation of new energy efficiency technical equipment, a description of the main measures is provided below:

2.5.1. Installation of circuit breakers that are able to conduct, switch on and switch off the current, switchers designed for occasional switches, and also to protect cables and end-users from overloading and short circuits. Brief description of equipment is listed below, and on equipment seller's site[1].

Fig. 3. Circuit breaker

[1] http://www.abb.ua/

Switchers consist of arc chutes, which are concluded in aluminum and / or steel containers. Switchers poles consist of sequentially connected compression arc chutes, spring-hydraulic drive, current transformers, constructed in factory and installed under the switcher hood and power supply terminals of the transformer control cabinet.

2.5.2. Installation of transformers, that have much lower power losses and increased efficiency as well as increased number of adjustment taps levels and control range . Specifications of transformers are listed below, and on the equipment seller's site[2].

Figure 4. Transformers

Table 1. Technical characteristics of transformers

Index	*Measurement unit*	*Values*					
		3-winding			*1-winding*		
Maximum rated load current	*A*	*200*	*400*	*630*	*800*	*1200*	*1600*
Maximum rated step voltage	*V*	*4000*	*3500*	*3000*	*3000*	*2500*	*2000*
Resistance to short-circuit - *Thermal (3 sec)* - *Dynamic (peak value)*	 *kA* *kA*	 *4* *10*	 *8* *20*	 *12,6* *31,5*	 *16* *40*	 *24* *60*	 *24* *60*
Nominal switching capacity	*kV*A*	*800*	*1400*	*1890*	*2000*	*3000*	*3200*
Mechanical endurance / number of switching		10^6					
Nominal frequency	c^{-1}	*50/60*					

Transformers are designed for electricity transformation in power networks and for supplying electricity to different consumers in AC networks.

The transformers are able to regulate voltage with a control range of 5% of nominal load. Switching the transformer to another regulation level happens in non-operating condition.

Transformers consist of active parts, coatings and a weld rectangular tank. On the cover there are inputs for high and low voltage.

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2 http://www.uer.com.ua/Default.aspx

2.5.3. Replacing of wires of overhead transmission lines from aluminum to steel-aluminum , steel-aluminum enforced. Specifications of overhead listed in Table 2 and on equipment seller's site[3].

Figure 5. Self-supporting insulated wire.

Table 1. Technical characteristics of wires of overhead lines

Nominal cross section, mm^2	Diameter mm	DC at 20oC, Ohm / km	Efforts to rupture, H, not less	Weight, kg
10	4,5	2,76630	3790	43
16	5,6	1,800934	6220	65
25	6,9	1,1759	9300	100
35	8,4	0,7897	13500	148
50	9,6	0,60298	17110	195
70	11,4	0,42859	24130	276
95	13,5	0,30599	33370	385
120	15,2	0,24917	41520	471
150	16,8	0,19919	46310	554
150	17,1	0,19798	52280	599
185	18,8	0,15701	58080	705
185	18,9	0,16218	62060	728
240	21,6	0,12060	75050	921
240	21,6	0,12428	80900	952
240	22,4	0,12182	98250	1106
300	24,0	0,09747	90570	1132
300	24,1	0,09983	100620	1186
300	24,5	0,10226	126300	1313
500	29,4	0,06129	112550	1537
500	30,6	0,06040	148260	1852
600	33,2	0,05091	183840	2170
800	39,7	0,03586	260070	3092
1000	42,4	0,02936	224050	3210

[3] tehtorg-sm.ru

2.5.4. Installation of glass and polymer insulators. Specifications of insulators are listed below, and on the equipment seller's site.

Figure 6. Glass insulator [4]

Figure 7. Polymer insulator [5]

The main specifications of polymer insulators:
Rated voltage of contact system, 27.5 kV
The test voltage of industrial frequency, not less, kV
- in the dry state 200
- in the rain 160

The level of interference at the test voltage of 30kV, max, 15 dB
Weight, not more than 2.7 kg

Materials

Insulating component is glass and plastic with ribbed protective shell of organic silicon rubber. Tops - steel, hot galvanized coating method.

[4] http://elfarfor.com.ua/

[5] http://izoplast.biz/izolator2.html

2.5.5. Installing and modernization of towers of overhead power lines. Towers specifications are below, as well as on equipment seller's site.[6]

Figure 8. Towers of overhead power lines

Table 3. Technical characteristics of towers of overhead power lines

Type	Height to the bottom of crossarm, m	Weight without zinc coating, kg	Weight with zinc coating, kg
OL of 110 kV			
US110-7	10,5	7438	7729
US 110-7+5	15,5	9450	9819
US 110-7+9	19,5	11115	11550
US 110-7+14	24,5	14368	14930
US 110-8	10,5	12068	12540

2.5.6. Replacement of meters with meters with a higher accuracy (meters of accuracy classes 0,2, 0,5, 1,0) the characteristics thereof is given in Table 3, the exterior appearance is shown in the Figure 9 and also on equipment seller's site[7]

Figure 9. Three-phase multi-tariff, multi-function energy meter

[6] http://www.enzp.ru/

[7] www.telecard.odessa.ua

Table 4. Technical characteristics of three-phase multi-tariff, multi-function energy meters

Accuracy class	1,0; 0,5S; 0,2S
Rated current H5 (H6)	10A (40A)
Maximum current H5 (H6)	40A (100A)
Temperature range	from -40°C to +55°C
Thresholds of sensitivity	6,25 mA
System of self-diagnostics	availabe
Integration period, min	0.25, 0.5, 1, 3, 5, 10, 30, 60
Inspection interval	6 years

Purchase of equipment and components, as well as fulfilment of design and commissioning installation works carried out by contractors are organized on a competitive basis through tenders according to the established order in Ukraine. In addition to equipment prices and the cost of works - the main criterion for equipment selection is its quality and reliability, and for performers - professionalism and compliance with international Standard ISO 9001. Equipment suppliers are domestic and foreign manufacturers who have proven themselves in the energy sector.

Project milestones

Table 5. Schedule of modernization of distribution electrical grids at OJSC "Odesaoblenergo"

Distribution electrical grids system at OJSC "Odesaoblenergo"										
Name of measures	Date of implementation									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
1. Organizational and technical measures										
1.1.*	///	///	///	///	///	///	///	///	///	///
1.2.		///	///	///	///	///	///	///	///	///
1.3.	///	///	///	///	///	///	///			
1.4.	///	///	///	///	///	///	///	///	///	///
1.5.			///	///	///	///	///	///	///	///
1.6.	///	///	///	///	///	///	///	///	///	///
1.7.	///	///	///	///	///	///	///	///	///	///
1.8.			///	///	///	///	///	///	///	///
1.9.	///	///	///	///	///	///	///	///	///	///
2. Technical measures.										
2.1.	///	///	///	///	///	///	///	///	///	///
2.2.					///	///	///	///	///	///
2.3.				///	///	///	///	///	///	///
2.4.						///	///	///	///	///
2.5.	///	///	///	///	///	///	///	///	///	///
** - description of measures according to paragraphs 1.1.-1.9, 2.1.-2.5. see in section A.4.2.*										

Table 5.1.Distribution electrical grids facilities whereat energy efficient equipment is implemented:

Year	Total length of electrical grids	Total number electrical grids	Total number of substantions
	km	units	units
2004-2010*	42638	13491	985
2011	48729	15418	3251
2012	54820	17345	4275
Total:	**146187**	**46254**	**8511**

*- Data as of 2010

At the beginning of the project OJSC "Odesaoblenergo" performed only measures aimed at maintaining electrical grids in operational condition. Basically, these measures included repairs to correct defects arising in the operation of electrical grids, as well as replacement of faulty old equipment by similar one, due to the cheapness of the latter. The project provides for the implementation of new energy-efficient equipment with consideration of the latest trends in the energy sector.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

The project aims at introducing measures to reduce energy losses in distribution electrical grids of OJSC "Odesaoblenergo". Correspondingly the use of fossil fuels to produce electricity at power generating plants will reduce. Fuel savings will reduce GHG emissions.

In the absence of the proposed project, the losses in the gridss would remain constant. When satisfying the needs of consumers for electricity fossil fuels would be burned, which in turn would lead to emissions of carbon dioxide into the atmosphere. Emissions reductions would not occur.

There are several main reasons which make the implementation of the project without the mechanism of joint implementation unlikely to happen:

- No significant changes in the legislation of Ukraine in the energy sphere, which could force the company to give up the existing practices of operation, modernization and reconstruction of distribution electrical grids, are expected;
- There are no restrictions for Ukrainian enterprises regarding GHG emissions, and they are unlikely to be imposed by 2012;
- In the absence of the project additional, very risky, investments and financial risks associated with the operation of new equipment might have been avoided;
- According to Ukrainian legislation the company will not receive any financial benefits from reduced electricity losses during its transportation (more details are given in Section B2).

A.4.3.1.Estimated amount of emission reductions over the crediting period:

Table 6. Estimated amount of emission reductions before the first commitment period

	Years
Length of the crediting period	4
Years	Estimated annual emission reductions in tonnes of CO_2 equivalent
2004	60 355
2005	104 948
2006	172 055

2007	226 586
Total estimated emission reductions over the crediting period of 2004-2007 (tonnes of CO_2 equivalent)	**563 944**
Annual average of estimated emission reductions over the crediting period of 2004-2007 (tonnes of CO_2 equivalent)	140 986

Table 7. Estimated amount of emission reductions during the first commitment period

	Years
Length of the crediting period	5
Years	Estimated annual emission reductions in tonnes of CO_2 equivalent
2008	383 181
2009	519 035
2010	680 991
2011	679 123
2012	679 123
Total estimated emission reductions over the crediting period of 2008-2012 (tonnes of CO_2 equivalent)	**2 941 453**
Annual average of estimated emission reductions over the crediting period of 2008-2012 (tonnes of CO_2 equivalent)	588 291

Table 8. Estimated amount of emission reductions after the first commitment period

	Years
Length of the crediting period	8
Years	Estimated annual emission reductions in tonnes of CO_2 equivalent
2013	679 123
2014	679 123
2015	679 123
2016	679 123
2017	679 123
2018	679 123
2019	679 123
2020	679 123
Total estimated emission reductions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	**5 432 984**
Annual average of estimated emission reductions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	679 123

More detailed information is given in the Accompanying Document 1.

Description of formulae used for preliminary estimation of emission reductions is given in Sections D.1.4.

A.5. Project approval by the parties involved:

National Environmental Investment Agency of Ukraine issued a Letter of Endorsement for the Joint Implementation project.
After determination of the project, the PDD and Determination report will be submitted to the National Environmental Investment Agency of Ukraine to obtain a Letter of Approval.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

Dynamic baseline was chosen in accordance with JI Guidance on criteria for baseline setting and monitoring, version 02[8]. According to Guidelines for users of the JI PDD form, version 04, step by step approach was used for description and justification of selected baseline:

Step 1. Identification and description of the approach to establishing the baseline.

A specific approach based on the requirements of Joint Implementation in accordance with paragraph 9 (a) of JI Guidance on criteria for baseline setting and monitoring, Version 02 is used to describe and justify the baseline chosen in the project design documents.

The baseline is determined by the choice of the most plausible scenario from a list and by description of plausible future scenarios based on conservative assumptions.
The following steps were applied to determine the most plausible baseline scenario:
1. Identification of possible alternatives that could be a baseline scenario
2. Justification of exclusion from consideration of alternatives, that are unlikely to take place from a technical and / or economic points of view

We've described and analyzed all alternatives and selected the most plausible thereof as the baseline scenario.

To establish the baseline and to further justify additionality in section B.2. we've directly took into account:
- State policy and applicable law in the energy sector;
- Economic situation in the energy sector of Ukraine;
- Technical aspects of management and operation of electrical grids;
- Availability of capital (including investment barriers), that are typical for OJSC "Odesaoblenergo";
- Local availability of technology / equipment;
- Price and availability of fuel.

Step 2. Application of the chosen approach

Choosing the plausible baseline scenario is based on an assessment of alternative options for transportation of electrical energy, which potentially could have occurred at the beginning of the project.
These options are the following alternatives:

Alternative 1.1: Continuation of the current situation, without JI project implementation.
Alternative 1.2: The proposed project activity without the use of Joint Implementation mechanism.

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[8] http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf

Alternative 1.3: Partial project activities (to implement not all project equipment) without the use of the Joint Implementation Mechanism.

The detailed analysis of each alternative is stated below.

Alternative 1.1

Continuation of existing practice with the introduction of minimum repairs on the background of the overall deterioration in electricity supply systems.

The state of the energy sector of Ukraine.

The state and tendencies of development of the energy sector of Ukraine were quite unsatisfactory. This was due to unsound principle of pricing for services ("Retail electricity tariffs for consumers"[9]) that does not ensure the development of business in power sector and inflow of investments into the sector (lack of cost-effective modernization)[10]. To improve this situation the National security and defense council of Ukraine analyzed the situation and issued the decision of June 5, 2009 "On the energy resources market development within the Energy Strategy of Ukraine till 2030"[11], in this decision it described in detail the status of the State support of the development of the electricity sector.

The introduction of a new model of the competitive electricity market in Ukraine is slower than it was provided for by the Concept of functioning and development of the wholesale electricity market of Ukraine, approved by the Cabinet of Ministers of Ukraine of November 16, 2002 # 1789, because the main efforts of the executive authorities and market players during 2003-2006, were aimed at creating certain pre-conditions stipulated by the Concept for transition to market of bilateral electricity sales contracts – ensuring of settlement payments for the consumed electricity in full, partial solution to the problem of debt, implementing appropriate information systems, accounting systems and so on.

Under the existing model the electricity market could not fully ensure effective competition among manufacturers and suppliers of electricity and formation of prices for electricity that would encourage energy companies to increase efficiency and increase investment in the energy sector. Neither existing market mechanisms, nor direct administrative measures would ensure the necessary modernization and upgrading of existing production facilities and power supply companies. A limited number of projects on upgrading and reconstruction of power plants and power grids was taken for execution. The situation is especially critical given the growth in the near future of the need for shunting facilities, lack of which threatens the safe operation of the power system of Ukraine. In recent years, the practice to solve the current economic problems by supporting certain categories of consumers and certain segments by means of the electricity industry through the mechanisms of cross-subsidies and benefits became popular. Unreasonable restraint of low tariffs for certain consumer groups, including the population, resulted in increased cross-subsidization of some consumers by consumers in other regions. In particular, the share of grant certificates in the wholesale price for electricity today is more than 25 percent and it continues to grow, that becomes an obstacle for introduction of economic instruments that would regulate power market. Introduced in connection with the Order of the Cabinet of Ministers of Ukraine of August 15, 2005 № 745 "On the transition to unified tariffs on electricity sold to consumers" and deepen cross-subsidization with subsidy certificates are the economic impediments to implementation of the new model of the electricity market. Imperfect tariff policy also leads to increases in accounts payable of power generating companies, causing their bankruptcy or non-transparent privatization. State investment programs in most cases are directed at the administrative and organizational implementations[12].

As described in National Electricity Regulation Commission of Ukraine (hereinafter - NERC) Order of 03.25.2002, № 289 "On approval of the report on the activities of NERC in 2001", the main causes of increased energy losses during its transportation to consumers are: low technical condition of grids;

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[9] *http://www.nerc.gov.ua/control/uk/publish/article/main?art_id=33153&cat_id=32004*

[10] *http://www.er.energy.gov.ua/doc.php?p=1041*

[11] *http://www.rainbow.gov.ua/documents/243.html?PrintVersion*

[12] *http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/archive?&cat_id=33495&stind=1*

inconformity of electrical grids with existing levels of load, inconformity of a number of parameters of electricity with applicable standards of quality, shortcomings in the existing metering of electricity supplied to the electric grid and electricity consumed. Addressing the negative effects that cause energy losses in electric grids, requires considerable investments to modernize electrical systems and change existing metering systems of electricity consumed, practical implementation of which will help reduce both process and above standard losses of electricity. Debt issues of the wholesale electricity market (WEM) subjects and issues of their imbalance arise when implementing measures on reduction of process losses of electricity.[13] There is a lack of conditions for the inflow of investments from both domestic and foreign investors.

This alternative is the most plausible baseline scenario as it:

- Allows you to transport electricity by means of existing facilities;
- Does not require investment in new equipment.

Accordingly, *Alternative 1.1* can be viewed as the most plausible baseline.

Alternative 1.2

The project activities without the use of joint implementation mechanism.

In this case there are two barriers: investment barrier (see more details in Section B2) because this scenario requires further substantial investment and has a very big payback period and high risks, and it is unattractive for investors, and also technological barrier as the new equipment will require additional training of personnel. Reconstruction of equipment to improve energy efficiency is not a common practice in Ukraine. Comprehensive implementation of project activities will help reduce the loss of electricity during its transmission.

This alternative is the least plausible baseline scenario as there is a need to invest in new technological equipment and it is characterized by lack of qualified personnel for servicing the equipment, therefore, *Alternative 2.1* can not be regarded as the plausible baseline.

Alternative 1.3

Partial project activities (to implement not all project equipment) without the use of joint implementation mechanism.

Alternative 1.3 provides for elimination from the project boundary any not key measures under the project, such as exclusion of new energy efficient equipment implementation, etc. However, the partial implementation of the measures will not achieve a considerable reduction in electricity in the distribution electrical grids, in addition *Alternative 1.3* requires investment in new technological equipment and it is characterized by lack of qualified personnel for servicing the equipment, therefore,

Alternative 1.3 may not be considered a plausible baseline.

Analysis of the alternatives described above shows that *Alternative 1.1* is the most plausible, and *Alternative 1.2* as well as *Alternative 1.3* are the least plausible

Results of investment analysis (see Section B.2) showed that the *Alternative 1.2 and Alternative 1.3* can not be considered as the most plausible baselines from a financial point of view. Substantiation of this conclusion is given in Section B.2. Results of the analysis made in accordance with “Tools for the demonstration and assessment of additionality" (Version 5.2) in section B2 show that the project scenario is additional.

Description of the baseline scenario

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[13] http://www.ukrenergo.energy.gov.ua/ukrenergo/control/uk/publish/archive?cat_id=35046

The base scenario provides for a continuation of existing practice with the introduction of minimum repairs on the background of the overall deterioration of electricity supply systems. In case the proposed project is not implemented electrical energy will still be transported with considerable losses in the grid. Electricity losses in the baseline scenario will be determined for each year when monitoring activity takes place. These losses will be calculated for each project measure based on the data on the grid stat before the activity implementation. Detailed information on the algorithm of baseline calculation is given in Section D.1.

Key baseline indicators are provided below:

$W^B_{y,tran(2)}$ - Electricity losses in the absence of implementation of new or reconstruction of existing double-winding transformers, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,tran(3)}$ - Electricity losses in the absence of implementation of new or reconstruction of existing three-winding transformers, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,line(1)}$ - Electricity losses in the absence of implementation of new or reconstruction of existing wires of electricity transmission lines, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,cable}$ - Electricity losses in insulation in the absence of implementation of new or reconstruction of existing wires of cable electricity transmission lines, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,insul}$ - Electricity losses in the absence of replacement of defected insulators of ETL, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,lamp}$ - Electricity losses in the absence of replacement of signalling lamps with emitting diode, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,comp}$ - Electricity losses in the absence of implementation of reactive power compensation devices, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,meter}$ - Electricity losses in the absence of new electricity meters implementation, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,switch}$ - Electricity losses in the absence of replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,motors}$ - Electricity losses in the absence of implementation of new or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,line(2)}$ - Electricity losses in the absence of replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,branch}$ - Electricity losses in the absence of implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y.n.(segm\,n).i_{12}}$- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths. kWh);
$W^B_{y,system}$ – Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the baseline scenario (ths. kWh);
EF – Carbon dioxide emission factor (t CO_2e/kWh);
$[B]$ – index that corresponds to the baseline scenario;
$[y]$ – monitoring period.

Baseline emissions are analysed in detail in **Sections D and E as well as in Appendix 2.**

Key data for baseline setting is stated in the tables given below:

Data/Parameter	$W^{B}_{y,tran(2)}$
Data unit	ths. kWh
Description	Electricity losses in the absence of implementation of new or reconstruction of existing double-winding transformers, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[14] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,tran(3)}$
Data unit	ths. kWh

[14] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

Description	Electricity losses in the absence of implementation of new or reconstruction of existing three-winding transformers, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[15] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,line(1)}$
Data unit	ths. kWh
Description	Electricity losses in the absence of implementation of new or reconstruction of existing wires of electricity transmission lines, in period «y» in the baseline scenario

[15] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[16] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,cable}$
Data unit	ths. kWh
Description	Electricity losses in insulation in the absence of implementation of new or reconstruction of existing wires of cable electricity transmission lines, in period «y» in the baseline scenario
Time of determination/monitoring	Annually

[16] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[17] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,insul}$
Data unit	ths. kWh
Description	Electricity losses in the absence of replacement of defected insulators of ETL, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment

[17] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[18] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W_{y,lamp}^{B}$
Data unit	ths. kWh
Description	Electricity losses in the absence of replacement of signalling lamps with emitting diode, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.

[18] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[19] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,comp}$
Data unit	ths. kWh
Description	Electricity losses in the absence of implementation of reactive power compensation devices, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in

[19] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

measurement methods and procedures (to be) applied	electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[20] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC “GRIFRE” Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer’s data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,meter}$
Data unit	ths. kWh
Description	Electricity losses in the absence of new electricity meters implementation, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and

[20] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[21] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,switch}$
Data unit	ths. kWh
Description	Electricity losses in the absence of replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of

[21] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Ukraine» of the Institute of general power-engineering National Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[22] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,motors}$
Data unit	ths. kWh
Description	Electricity losses in the absence of implementation of new or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National

[22] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[23] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC “GRIFRE” Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer’s data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,line(2)}$
Data unit	ths. kWh
Description	Electricity losses in the absence of replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National

[23] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[24] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,branch}$
Data unit	ths. kWh
Description	Electricity losses in the absence of implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National

[24] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[25] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y.n.(segm\ n).i_{12}}$
Data unit	ths. kWh
Description	Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National

[25] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[26] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	$W^{B}_{y,system}$
Data unit	ths. kWh
Description	Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the baseline scenario
Time of determination/monitoring	Annually
Source of data (to be) used	The values were determined by actual and calculated values based on the company data, such as: - The actual metered data at the place of installed equipment determined by means of electric metering equipment; - Passport data data of equipment; - Data of energy meters.
Value of data applied (for ex ante calculations/determinations)	The value is determined for each project year
Justification of the choice of data or description of measurement methods and procedures (to be) applied	Input data used to calculate this parameter is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC. Calculation of this indicator is subject to «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine» of the Institute of general power-engineering National

[26] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

	Academy of Sciences of Ukraine (IGPE NASU of Ukraine) 22/07/2011[27] Detailed algorithm is also presented in section D.1.
QA/QC procedures (to be) Applied	Calculations and metering are based on appropriate legal and industry-specific documents: - Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03. - Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC "GRIFRE" Input data for calculation of a parameter is obtained by metering that is conducted by means of metering equipment that is timely verified and calibrated. Characteristics of project equipment are taked from appropriate producer's data (passports).
Any comment	Data that allows for calculation of greenhouse gas emissions in the baseline scenario

Data/Parameter	*EF*
Data unit	tCO_2/MWh
Description	Carbon dioxide emission factor
Time of determination/monitoring	Annually
Source of data (to be) used	Carbon dioxide emission factors for 2004-2005 are taken from the document issued by the Ministry of economy of Netherland "Operational Guidelines for Project Design Documents of Joint Implementation Projects Volume 1: General guidelines" (ERUPT) [28] - Carbon dioxide emission factors for 2006-2007 are taken from the document "Carbon dioxide emission factors (for energy consumption according to the methodology "Ukraine - Assessment of new calculation of CEF", approved by TUV SUD 17.08.2007) [29]; - Carbon dioxide emission factors for 2008 are taken from Order of the National Environmental Investment Agency of Ukraine (hereinafter - NEIAU) № 62 of 15.04.2011 "On approval of specific carbon dioxide emission factors in 2008[30]"; - Carbon dioxide emission factors for 2009 are taken from the Order of NEIAU # 63 of 15.04.2011 "On approval of specific carbon dioxide emission factors in 2009" [31]; - Carbon dioxide emission factors for 2010 are taken from the

[27] http://www.neia.gov.ua/nature/doccatalog/document?id=129825

[28] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[29] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

[30] http://www.neia.gov.ua/nature/doccatalog/document?id=127171

[31] http://www.neia.gov.ua/nature/doccatalog/document?id=127172

	Order of NEIAU # 43 of 28.03.2011. "On approval of specific carbon dioxide emission factors in 2010"[32]; - Carbon dioxide emission factors for 2011 are taken from the Order of NEIAU # 75 of 12.05.2011. "On approval of specific carbon dioxide emission factors in 2011"[33];
Value of data applied (for ex ante calculations/determinations)	**2004**: 0,755; **2005**: 0,740; **2006-2007**: 0,807; **2008**: 1,082; **2009**: 1,096; **2010**: 1,093; **2011**: 1,090
Justification of the choice of data or description of measurement methods and procedures (to be) applied	When developing the joint implementation project national carbon dioxide emission factors are used, in case of their absence factors for 2004-2005 are taken from ERUPT, factors for 2006-2007 are taken from the document Carbon dioxide emission factor approved TUV SUD
QA/QC procedures (to be) Applied	Only officially approved factors are used for calculations.
Any comment	Researches don't take into consideration production of energy by nuclear power plants

2004	2005	2006-2007	2008	2009	2010	2011
0,755	0,740	0,807	1,082	1,096	1,093	1,090

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

Anthropogenic emissions of greenhouse gases in the project scenario will decrease due to complex modernization of electricity grids through the implementation of the technologies proposed in the project activity as described above, including:

- Modernization and rehabilitation works in electrical grids and introduction of new energy efficient equipment;
- Improvement of reliability of electricity supply to electricity consumers;
- Introduction of automated systems of electricity consumption commercial records (ASECCR) in the perimeter of energy supply company, ASECCR of consumers and subplants;
- Introduction of a complex Program on process losses of electricity decrease;

Additionality of the project

The additionality of the project activity is demonstrated and assessed by using the "Tool for the demonstration and assessment of additionality" [34] (Version 05.2). This manual was originally elaborated for CDM projects, but it may be also applied to JI projects.

STEP 1. Identification of alternatives to the project activity and their conformity with current laws and regulations

Step 1a: Define alternatives to the project activity
There are three alternatives to this project. (that were described in Section B1)

Alternative 1.1: *Continuation of the current situation, without JI project implementation.*

[32] http://www.neia.gov.ua/nature/doccatalog/document?id=126006

[33] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

[34] *http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf*

Alternative 1.2*: The proposed project activity without the use of Joint Implementation mechanism.*

Alternative 1.3: Partial project activities (to implement not all project equipment) without the use of the Joint Implementation Mechanism.

Conclusion on Step 1a: Three realistic alternatives to the project activity were identified.

Step 1b: Consistency of the alternatives with mandatory laws and regulations

Alternative 1.1: Existing legal documents do not obligate OJSC "Odesaoblenergo" to pursue the modernization of electricity distribution electrical grids. According to the Law of Ukraine "On Electric Energy Sector"[35] Article 5. *State policy in the energy sector is based on following principles:*

- State regulation of activities in the energy sector;
- Creating conditions for safe operation of power facilities;
- Ensurance of efficient consumption of fuel and energy;
- Adherance to uniform state regulations and standards by all subjects of relations connected with the production, transmission, supply and use of energy;
- Creating conditions for development and improvement of the technical level of energy sector;
- Improvement of the environmental safety of energy facilities;
- Protection of the rights and interests of consumers of energy;
- Maintaining of the integrity and ensurance of the safe and efficient operation of unified power system of Ukraine, unified dispatch control (operational and technological) thereof;
- Promotion of a competitive market for electricity;
- Providing training to prepare qualified specialists for energy sector;
- Creating conditions for prospective scientific research;
- Ensurance of a stable financial state of energy sector;
- Ensurance of accountability of energy suppliers and consumers.

The current practice of reducing electricity losses in the distribution electrical grid complies with all applicable laws and regulations of Ukraine. The legislation allowed for the losses in the electrical grids. Standards are set only for the frequency with which energy supplying organizations must carry out calculation of regulatory power losses in the electrical grid. Monitoring of compliance with regulations is made by the calculation of normative losses once a year.

Alternative 1.2: Reconstruction and modernization without the JI mechanism is consistent with mandatory laws and regulations, detailed analysis of consistency with the law was made for *Alternative 1.1,* which is similar to consistency with mandatory laws and regulations for *Alternative 1.2*.

Alternative 1.3: Reconstruction without the use of JI mechanism and with the exclusion of some key project activities is in line with mandatory laws and regulations, detailed analysis of consistency with the law was made for *Alternative 1.1,* which is similar to consistency with mandatory laws and regulations for *Alternative 1.3.*

Conclusion on Step 1b: Under such conditions one may say that all scenarios don't contradict current laws and regulatory acts.

Hence, the Step 1 is satisfied.

According to the document the "Tool for the demonstration and assessment of additionality" [36] (Version 05.2) further justification of additionality is used by means of investment analysis.

[35] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0

STEP 2. Investment analysis

Step 2a: Determine appropriate analysis method

According to the art. 191 of the Civil Code of Ukraine[37] state (communal) fixed prices (tariffs) shall be established for products (services) that are manufactured by business entities-monopolists and are of great social importance for population. By virtue of the authority granted by the Law of Ukraine "On Electric Energy Sector"[38] and the Order of the President of Ukraine as of 14.03.95 № 213/95 "On measures to support the activity of the National Commission for Electric energy Regulation of Ukraine "[39], National Electricity Regulation Commission of Ukraine forms and ensures the implementation of unified state policy for development and operation of the wholesale electricity market, carries out price and tariff policy in the electricity sector. According to the Resolution of the Cabinet of Ministers of Ukraine as of 15.08.2005 № 745 "On the transition to unified tariffs for electric energy that is released to consumers"[40], Resolution of the NERC of Ukraine of 10.03.1999 № 309 "On tariffs for electricity, which is released to population and settlements"[41] (Edition: № 343 of March 17, 2011.), Resolution of NERC of Ukraine of 22.01.2001 № 47 "On approval of the procedure for formation of retail tariff for electricity to consumers (except population and population settlements) by the licensees that supply electricity at a regulated tariff"[42] national tariffs for households and settlements, the tariffs that consider threshold levels for legal entities, limits of tariff zones are established. The components of the tariff are a wholesale price, average price for the purchase electricity, tariff for the supply of electricity, tariff for electricity transmission and standard process losses of electricity in grids. The main component is the rate of process losses. Rate setting of electricity process losses in the electricity transmission power grids (PLE) is based on the balance of power in the previous year according to the reporting forms and technical data base of electricity grids.
The procedure for the approval of standardized process losses for the company provides for:

- calculation of the standardized process losses of energy in electricity grids of OJSC “Odesaoblenergo”;
- verification of calculations by JSC “LvivORHRES" and JSC "DonORHRES”;
- the approval of the prime data and the results of calculations of standardized process losses of electricity at regional power distribution companies with the Ministry of Energy;
- g) approval of standardized process losses of electricity by NERC after following procedures "a", "b" and "c".

Rate setting of process losses of electricity should be implemented according to guidelines "Rate setting of process losses of electricity during transmission in electrical grids”. Calculation of standardazed values of losses differs from the calculation of process losses because the standardized characteristics apply not factual but standardized values of regime parameters, including: medium operating voltage of electrical grids, the rate

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[36] *http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf*

[37] http://zakon1.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=436-15&p=1302268052983958

[38] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=575%2F97-%E2%F0

[39] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=213%2F95

[40] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=745-2005-%EF

[41] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0151-99

[42] http://www.nerc.gov.ua/control/uk/publish/article?showHidden=1&art_id=100901&cat_id=34446

of uneven load distribution in phases, nominal frequency etc. When formating retail electricity prices the electricity losses, which are determined using the regime parameters outside the standardized values, are not used. According to NERC regulations of 25.05.2006 № 654 "On approval of the procedure for filing, determination and approval of economic factors of standardized process losses of electricity"[43] decisions on compensation or absence of compensation to a licensee for loss of electricity by distribution third-party organizations, is made by NERC following discussion with stakeholders and formalization of a protocol. Compensation of standardized electricity process losses is carried out by their consideration in the determining of the electricity supply to the grids of the licensee to transfer to other licensees.

Thus, OJSC “Odesaoblenergo” has no right to set prices (tariffs) for services provided: transmission and supply of electricity and due to the existing Procedure for the tariffs for electricity transmission and supply formation, reducing energy losses will not bring any additional income to the enterprise as reducing electricity losses, according to this procedure leads to a reduction of the level of standardized losses and absence of compensation from the state.
Since the Project does not bring any other financial or economic benefits, but for the revenue from the Project implementation, which can be obtained under the mechanism established by Article 6 of the Kyoto Protocol to the UN Framework Convention on Climate Change, to come to the conclusion that the proposed implementation of the project is less economically feasible in the absence of such revenue, according to the additionality tool, a simple cost analysis is used.

All project activities require large investments. Without ERU selling the project will not be economically feasible for the Applicant, that makes it impossible to implement most of the activities. More cost-effective and realistic scenario without selling of emission reduction units (hereinafter – ERUs) credits is the baseline scenario of very slow reconstruction. However, taking into account the degradation of the whole system and reduced efficiency at other facilities, the total actual emissions of the Applicant will stay at the same level. This scenario is less attractive in terms of environment in the future (including the period of 2003-2012), when Applicant’s emissions will be at the same or even higher level, but from an economic point of view such scenario is more attractive. Accelerated implementation of the project activities not only requires high costs, but also provides significant reductions of greenhouse gases, and proves that the project is additional.

The following steps have been made according to the additionality tools of the CDM Executive Committee “Tool for the demonstration and assessment of additionality[44]” (version 05.2).

***S*tep 2b Alternative I. Application of simple cost analysis**

Project implementation will require costs in addition to existing costs for modernization of the electricity supply system. Additional costs of Project implementation include the costs of:

- Modernization and rehabilitation works in electrical grids and introduction of new energy efficient equipment;
- Improvement of the reliability of electricity supply to electricity consumers;
- Introduction of automated systems of electricity consumption commercial records (ASECCR) in the perimeter of energy supply company, ASECCR of consumers and subplants;
- Introduction of a complex Program on process losses of electricity decrease.

[43] http://www.nerc.gov.ua/control/uk/publish/article/main?art_id=45694&cat_id=34446&

[44] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

Expenses as to implementation and realization of the "Modernization of electric power distribution system at OJSC "Odesaoblenergo" consist of:

- Organisational measures, EUR 20 825 163;
- Technical measures, EUR 41 650 326;
- Consulting, personnel trainin, other activities, EUR 12 495 098;
- Other expenses, EUR 8 330 065;

Total amount to be spent EUR 83 300 652;

Equipment used in this project is the best in terms of Efficiency Factor, quality of execution and applied technical solutions among the materials and equipment available on Ukrainian market. Availability of spare parts in Ukraine was an important parameter of equipment selection.

As a result of current practice all losses of electric energy are borne by end consumers that is why OJSC "Odesaoblenergo" has not incentive to introduce power efficient equipment.

At the moment of the project's beginning the company uses old equipment manufactured mainly in the USSR.

Application of Kyoto mechanisms to this project neutralizes financial risks and is the only way for its implementation.
As emission reductions do not bring any economic benefit to OJSC "Odesaoblenergo", except for the benefit achieved under the Joint Implementation Project (JIP), we can make a conclusion that Project implementation without receiving proceeds under the JI project is impossible as there appear obstacles for investments.

Conclusion on Step 2b:

In connection therewith it is obvious that this project is economically unattractive without registration of the project as JI project, which proves additionality of this project.
Therefore Step 2 is satisfied.

STEP 4: Common practice analysis

Step 4a. Analysis of other alternatives similar to proposed project activities

Analysis of project activity similarity demonstrated absence of similar projects in Ukraine.
Existing practice of equipment maintenance represented in the variant of the baseline chosen for this Project is customary for Ukraine. Due to current practice all losses of electric energy are borne by end consumers; that is why the companies engaged in electricity supply don't have incentives for energy effective projects implementation.

Conclusion on Step 4a: As there are no similar projects in Ukraine, there is no need to make analysis of other alternatives similar to proposed project activities.
According to the "Tool for the demonstration and assessment of additionality[45]" (version 05.2) all steps are satisfied, but still there are some obstacles.

One of these obstacles is additional costs of Project implementation on:

- Modernization and rehabilitation works in electrical grids and introduction of new energy efficient equipment;

[45] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v5.2.pdf

- Improvement of reliability of electricity supply to electricity consumers;
- Introduction of automated systems of electricity consumption commercial records (ASECCR) in the perimeter of energy supply company, ASECCR of consumers and subplants;
- Introduction of a complex Program on process losses of electricity decrease.

The obstacle is connected with the structure of existing tariffs for electric energy; they are regulated by the state and don't take into consideration amortization and investment needs of electric energy suppliers. This situation leads to a constant shortage of funds and inability to timely complete major repairs, provide equipment operation, investment in modernization and development of electricity supply infrastructure.

Also due to financial problems, repair works have been carried out not in full recently, and aimed mostly to maintain equipment in working condition, without taking into account economic performance. At the same time, many equipment units require replacement. Given the complexity of the implementation of the new highly effective energy saving equipment qualifications of staff may be insufficient. To overcome this obstacle training of employees is required.

OJSC "Odesaoblenergo" has no experience in managing the implementation of JI projects, including: international negotiations, deremination, verification, registration, monitoring etc.

We can make a conclusion that the abovementioned facts may prevent implementation of the proposed project as well as other alternatives - reconstruction without the use of JI mechanism and reduction of project activities with the exception of any project key activities.
However one of the alternatives is continuation of "business as usual". Since the obstacles identified above directly relate to investment into modernization of the electrical grids, OJSC "Odesaoblenergo" doesn't have any obstacles for further exploitation of grids at the previous level. Therefore the identified obstacles can not impede introduction of at least one alternative scenario – continuation of «business as usual».

CONCLUSION

Based on the above analysis one may make a conclusion that the proposed project is additional.

B.3. Description of how the definition of the project boundary is applied to the project:

Sources of greenhouse gases and boundaries of the baseline scenario

Electricity transportation in the distribution electrical grids to consumers of all forms of ownership is associated with the following GHG emissions:
• CO_2 - as a result of electricity losses during transportation that was obtained in the process of fossil fuel combustion at heat power plant.

Table 9. The table below shows an overview of sources of emissions in the baseline scenario

Source of emissions	Emissions	Included or excluded	Explanations
Baseline emissions			
Combustion of fossil fuel at heat power plants	CO_2	Included	Only CO_2 emissions due to electricity losses in the grid

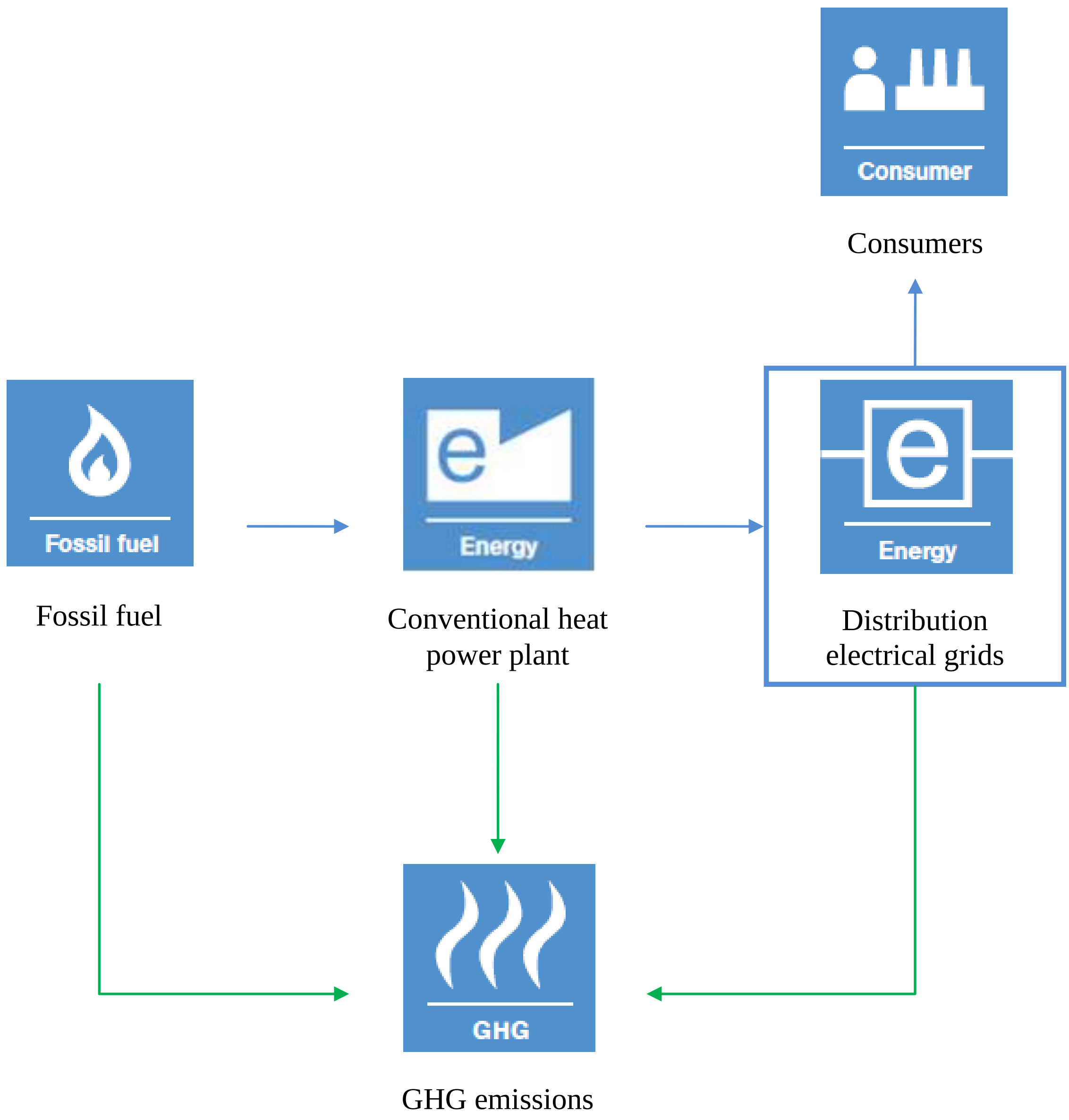

Figure 10. The scheme of boundaries for the baseline scenario

Sources of greenhouse gases and boundaries of the project scenario

Figure 11 shows the boundaries of the project scenario (outlined with blue line).

Table 10. The table shows an overview of sources of emissions in the project scenario

Source of emissions	**Emissions**	**Included or excluded**	**Explanations**
Project emissions			
Combustion of fossil fuel at heat power plants	CO_2	Included	Only CO_2 emissions due to electricity losses in the grid

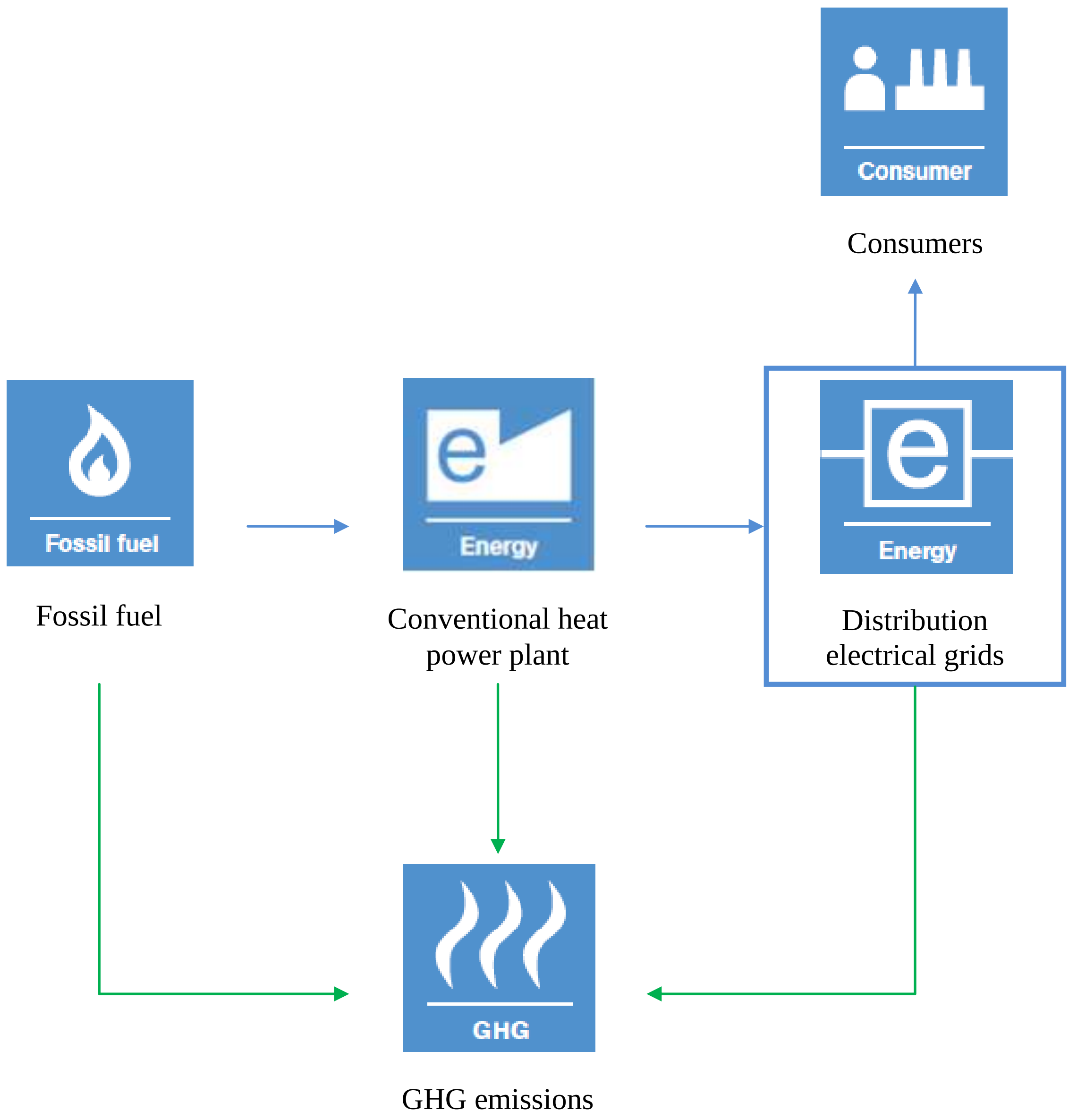

Figure 11. Project boundary of the project scenario.

Currently in the energy sector, hexafluoride circuit breakers and current transformers are used to transport electric energy in distribution electricity grids.
They are characterized by high reliability, durability, simplicity of construction and installation as well as safety. A distinguishing feature of hexafluoride circuit breakers and current transformers is the fact that sulfur hexafluoride (electrical and technical gas) fulfils the function of arc control and heat insulating medium. Sulfur hexafluoride (SF_6) is a greenhouse gas whose density under normal conditions is five times higher than density of air.
Since this equipment provides for a system of leak-proofness control and equipment manufacturers guarantee its smooth operation for 25 years, we can conclude that leakages of SF_6 are absent and excluded from the project boundaries.
Indirect extraneous leakage of CO_2, CH_4, N_2O from fuel production and its transportation are excluded. Leakages are not controlled by the project's developer (it is impossible to estimate quantity of leakages), due to this they were excluded.

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline determination: 30/06/2011
Baseline was determined by VEMA S.A., the project developer, and OJSC “Odesaoblenergo”, the host of the project

Open Joint Stock Company "Odesaoblenergo"
Odesa, Ukraine
Stryuchenko Oleksandr Mykolayovych
Financial director
Telephone/Fax: +38 (048)-705-20-59
E-mail: findir@oblenergo.odessa.ua
Open Joint Stock Company "Odesaoblenergo" is the project participant (stated in Annex 1).

VEMA S.A.:
Kyiv, Ukraine.
Fabian Knodel,
Director
Telephone: +38 (044) 594 48 10
Fax: +38 (044) 594 48 19
e-mail: info@vemacarbon.com
VEMA S.A. is the project participant (stated in Annex 1).

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

22/12/2002 - OJSC "Odesaoblenergo" management made a decision on the start of implementation of JI project at the company.

C.2. Expected operational lifetime of the project:

05/2003 – 12/2020 (17 years and 8 months (212 months) on condition of proper maintenance

C.3. Length of the crediting period:

01/01/2004 – 31/12/2007 (4 years or 48 months), continuation 01/01/2008- 31/12/2012 (5 years or 60 months), continuation 01/01/2013- 31/12/2020 (8 years or 96 months)
The extension of the crediting period beyond 2012 is subject to the host Party approval

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The proposed project uses a specific approach for JI projects on the basis of Guidance on criteria for baseline setting and monitoring, version 2 JISC (Joint Implementation Supervisory Committee – JISC[46]). The monitoring plan is designed for accurate and clear greenhouse gas emissions measurements and calculation and conducted according to practices established at OJSC "Odesaoblenergo" to measure the transmitted and consumed electricity. Monitoring of the project does not require changes in existing metering and data collection system. All relevant data are calculated and recorded and will be stored within two years after emission reduction units generated by the project are delivered.

The actual losses of electricity during its transmission have four components[47].

1. Technical losses of electricity are caused by physical processes that occur during its transmission in electricity grids and are expressed by converting its part into heat in the element of grid;
2. Consumption of electricity for company's own substations needs to ensure the operation of technical equipment of substations;
3. The losses of electricity are caused by control and metering equipment and tools (instrumental losses);
4. Above standard losses are caused by the theft of electricity, disparity of payment by consumers, delayed payments, non-payment of bills and other causes,

And are equal to the difference between electricity volume incoming into the distribution grid and electricity volume incoming to consumers.

Due to the specificity of the project "Modernization of electric power distribution system at OJSC "Odesaoblenergo" it is impossible to apply the so-called "classical" model for determining the baseline by using historical data, that is why based on the principles of conservative approach dynamic baseline with determining of historical parameters for each type of equipment is applied.

The project "Modernization of electric power distribution system at OJSC "Odesaoblenergo" is aimed at reducing process losses of electricity during its transportation to consumers of all forms of ownership. However, one can assume that in the absence of project (baseline scenario) the percentage of losses would have remained constant (at a level that corresponds to the pre-project level) because it is also affected by other factors beyond the control of project activities (eg, increase or reduction in the number of consumers, etc.). However, it is not possible to reliably assess and predict the future impact of other factors besides those that are proposed by the project. Therefore, the methodology that is based on the JI specific approach, considers reduction of energy losses that can be achieved through implementation of each specific project activity was proposed (detailed calculations of the effect of the introduction of a specific measure for each year can be found in the accompanying Excel file). The calculation of losses in the baseline scenario is actually performed with

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[46] *http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf*

[47] Zhelezko U. Rate setting of process losses of electricity in grids – new calculation methodology. / / Electric technology news. Informational edition. № 5 (23), 2003.

consideration of the state of power grid until the introduction of this measure. Thus, the application of developed methodology for calculating emissions in the baseline scenario actually leads to their underestimation by taking into account the effect of energy saving measures implemented earlier, which is conservative.

Input data used to calculate electricity losses is the official data of the enterprise, which is also used to calculate process losses in electricity distribution grids of Oblenergo that are further agreed in the Ministry of Energy and approved by NERC.

The main method of process losses of electricity calculation is based on the industry normative documents:

- Industry-specific normative document 34. 09.104-2003 Methodology of compiling the balance of power structure in electrical networks of 0.38-154 kV, analysis of its components and electricity process losses rate setting, approved by the order #757 of the Ministry of Energy of Ukraine as of 17.12.03.
- Industry-specific normative document 34.09.204-2004, Methodological guidance for electricity process losses analysis and the choice of measures of their reduction, industry-specific normative document, the Ministry of Energy of Ukraine, APC “GRIFRE”

These Methodologies are mandatory for all energy companies (EC) of Ukraine, which have the distribution grids of indicated voltage classes.

The monitoring plan includes a set of activities (metering, maintenance, registration and calibration) which must be carried out to satisfy the requirements of the chosen monitoring methodology and ensure the possibility to verify calculations of GHG emission reductions.

Data and parameters that are not controlled during the crediting period but are identified only once and are available at the PDD development stage:

$S^{P}_{T,y,tran(2),i}$	Nominal load of a double-winding transformer "i" on the side of high voltage (kVA)
$\Delta P^{P}_{XX,P,y,tran(2),i}$	Rated power losses of no-load run in a double-winding transformer «i» (kW)
$\Delta P^{P}_{кз,P,y,tran(2),i}$	Rated power losses of short circuit in a double-winding transformer «i» (kW)
$S^{P}_{T,y,tran(3),i_1}$	Nominal load of a three-winding transformer «i_1» (kVA)
$\Delta P^{P}_{XX,P,y,tran(3),i_1}$	Rated power losses of no-load run in a three-winding transformer «i_1» (kVA)
$\Delta P^{P}_{кз,P,y,tran(3.1),i_1}$	Rated power losses of short circuit in a three-winding transformer «i_1», of high voltage (kW)
$\Delta P^{P}_{кз,P,y,tran(3.2),i_1}$	Rated power losses of short circuit in a three-winding transformer «i_1», of medium voltage (kW)
$P^{P}_{кз,P,y,tran(3.3),i_1}$	Rated power losses of short circuit in a three-winding transformer «i_1», of low voltage (kW)
$\Delta W^{P}_{п,P,y,cable,i_3}$	Rated specific losses of insulation of cable «i_3» (ths. kWh/km)
$W^{P}_{P,y,insul,i_4}$	Rated electricity losses in insulation (kWh)
$W^{P}_{y,comp,i_6}$	Specific decrease of electricity losses due to reactive power compensation equipment implementation at consumers place, ip period “y” in the project scenario (kW/kVAr)
$A^{P}_{P,y,meter,i_7}$	Rated electricity losses per hour in one meter (kWh)

$P^{P}_{y,switch,i_8}$	Rated power of switch (kW)
$\rho^{P}_{Al,y,line(2),i_{10}}$	Specific resistance of aluminium for lines with distributed load (Ohm·mm^2/m)
$F^{P}_{n,y,line(2),i_{10}}$	Section of wire of segment n for lines with distributed load (mm^2)
$\rho^{P}_{Al,y,branch,i_{11}}$	Specific resistance of aluminium for branches (Ohm·mm^2/m)
$F^{P}_{n,y,branch,i_{11}}$	Section of wire of segment n for branches (mm^2)
$\Delta P^{B}_{XX,P,y,tran(2),i}$	Rated power losses of no-load run in a double-winding transformer «i» (kW)
$\Delta P^{B}_{кз,P,y,tran(2),i}$	Rated power losses of short circuit in adouble-winding transformer «i» (kW)
$\Delta P^{B}_{XX,P,y,tran(3),i_1}$	Rated power losses of short circuit in a three-winding transformer « i_1» (kW)
$\Delta P^{B}_{кз,P,y,tran(3.1),i_1}$	Rated power losses of short circuit in a three-winding transformer « i_1» of high voltage (kW)
$\Delta P^{B}_{кз,P,y,tran(3.2),i_1}$	Rated power losses of short circuit in a three-winding transformer « i_1» of medium voltage (kW)
$\Delta P^{B}_{кз,P,y,tran(3.3),i_1}$	Rated power losses of short circuit in a three-winding transformer « i_1» of low voltage (kW)
$\Delta W^{B}_{п,P,y,cable,i_3}$	Rated specific losses of insulation of cable «i_3» (ths. kWh/km)
$W^{B}_{P,y,insul,i_4}$	Rated electricity losses in insulator (kWh)
$\Delta W^{B}_{0.38,y,comp,i_6}$	Specific reduction of losses at voltage 0.38 kV, (kW/kVAr)
$\Delta W^{B}_{6-20,y,comp,i_6}$	Specific reduction of losses at voltage 6-20 kV, (kW/kVAr)
$\Delta W^{B}_{35-154,y,comp,i_6}$	Specific reduction of losses at voltage 35-154 kV, (kW/kVAr)
$A^{B}_{P,y,meter,i_7}$	Rated electricity losses per hour in one meter (kWh)
$P^{B}_{y,switch,i_8}$	Rated power of switch (kW)
$\rho^{B}_{Al,y,line(2),i_{10}}$	Specific resistance of aluminium for lines with distributed load (Ohm·mm^2/m)
$F^{B}_{n,y,line(2),i_{10}}$	Section of wire of segment n for lines with distributed load (mm^2)
$\rho^{B}_{Al,y,branch,i_{11}}$	Specific resistance of aluminium for branches (Ohm·mm^2/m)
$F^{B}_{n,y,branch,i_{11}}$	Section of wire of segment n for branches (mm^2)

$[B]$ – index that corresponds to the baseline scenario;
$[P]$ – index that corresponds to the project scenario;
$[y]$ – index that corresponds to the monitoring period.

Data and parameters that are not controlled during the crediting period but are identified only once and are not available at the PDD development stage: none

Data and parameters that are controlled during the crediting period:

$К\Pi^{P}_{XX,y,tran(2),i}$	Degradation factor of no-load run losses in double-winding transformer "*i*"
$К\Pi^{P}_{кз,y,tran(2),i}$	Degradation factor of short-circuit losses in double-winding transformer "*i*"
$P^{P}_{y,tran(2),max,i}$	Power of double-winding transformer "i" at the side of high voltage in an hour of maximum load (kW)
$cos\varphi^{P}_{y,tran(2),i}$	Cosine of the angle between active and gross power in double-winding transformer *"i"*
$T^{M}_{y,tram(2),i}$	Annual number of hours of maximum power use in double-winding transformer "*i*" (hour)
$P^{P}_{y,tran(2),min,i}$	Power of double-winding transformer "i" at the side of high voltage in an hour of minimum load (kW)
$I^{P}_{A,y,tran(2),i}$	Current of phase A in double-winding transformer "*i*" (A)
$I^{P}_{B,y,tran(2),i}$	Current of phase B in double-winding transformer "*i*" (A)
$I^{P}_{C,y,tran(2),i}$	Current of phase C in double-winding transformer "*i*" (A)
$R^{P}_{0n,y,tran(2),i}$	Specific resistance of zero wire in double-winding transformer "*i*" (Ohm/km)
$L^{P}_{y,tran(2),i}$	Length of electricity transmission line (km)
$R^{P}_{фn,y,tran(2),i}$	Specific resistance of phase wire in double-winding transformer "*i*" (Ohm/km)
$К\Pi^{P}_{XX,y,tran(3),i_1}$	Degradation factor of no-load run losses in three-winding transformer "*i*"
$К\Pi^{P}_{кз,y,tran(3),i_1}$	Degradation factor of short-circuit losses in three-winding transformer "*i*"
$P^{P}_{y,tran(3),max,i_1}$	Power of three-winding transformer "i_1" in an hour of maximum load (kW)
$cos\varphi^{P}_{y,tran(3.1),i_1}$	Cosine of the angle between active and gross power in three-winding transformer "i_1" of high voltage
$cos\varphi^{P}_{y,tran(3.2),i_1}$	Cosine of the angle between active and gross power in three-winding transformer "i_1" of medium voltage
$cos\varphi^{P}_{y,tran(3.3),i_1}$	Cosine of the angle between active and gross power in three-winding transformer "i_1" of low voltage
$P^{P}_{y,tran(3),min,i_1}$	Power of three-winding transformer "i_1" in an hour of minimum load (kW)
$T^{M}_{y,tran(3),i_1}$	Number of hours of maximum power use of windings (hour)
$P^{P}_{y,line(1),max,i_2}$	Power of ETL «i_2» during maximum load (kW)
$U^{P}_{y,line(1),max,i_2}$	Voltage of ETL «i_2» during maximum load (kV)
$cos\varphi^{P}_{y,line(1),i_2}$	Cosine of the angle between active and gross power in ETL
$R^{P}_{f,y,line(1),max,i_2}$	Specific resistance of phase wire in ETL (Ohm/km)
$L^{P}_{y,line(1),max,i_2}$	Length of ETL (km)

$P^{P}_{y,line(1),max,i_2}$	Power that is transported by ETL «i_2» in an hour of maximum load (kW)
$P^{P}_{y,line(1),min,i_2}$	Power that is transported by ETL «i_2» in an hour of minimum load (kW)
$T^{M}_{y,line(1),i_2}$	Annual number of hours of maximum active power use in ETL «i_2» (hour)
$I^{P}_{A,y,line(1),i_2}$	Current of phase A of ETL «i_2» (A)
$I^{P}_{B,y,line(1),i_2}$	Current of phase B of ETL «i_2» (A)
$I^{P}_{C,y,line(1),i_2}$	Current of phase C of ETL «i_2» (A)
$R^{P}_{0n,y,line(1),i_2}$	Specific resistance of zero wire of ETL (Ohm / km)
$L^{P}_{y,cable,i_3}$	Length of electricity transmission line (km)
$K\Pi^{P}_{R,y,cable,i_3}$	Degradation factor of cable insulation
$N^{P}_{y,insul,i_4}$	Number of replaced insulators (units)
$K\Pi^{P}_{R,y,insul,i_4}$	Magnification factor of losses in insulator
$P^{P}_{y,lamp,i_5}$	Power of one signalling lamp or light emitting diode (kW)
$N^{P}_{y,lamp,i_5}$	Number of replaced signalling lamps (units)
$T^{P}_{y,lamp,i_5}$	Operational period of signalling lamps (hours)
$N^{P}_{y,meter,i_7}$	Number of replaced meters (units)
$T^{P}_{y,meter,i_7}$	Operational period of a meter per year (hours)
$K\Pi^{P}_{R,y,meter,i_7}$	Degradation factor of electrical characteristics of a meter
$N^{P}_{y,switch,i_8}$	Number of replaced switches (units)
$N^{P}_{d,y,switch,i_8}$	Number of days (of switch operation) with a temperature below 5 ^{0}C (units)
$N^{P}_{y,motors,i_9}$	Number of replaced or reconstructed electrical motors (units)
$P^{P}_{y,motors,i_9}$	Power of a motor (kW)
$N^{P}_{d,y,motors,i_9}$	Number of days (of electric motor operation) with a temperature below 5 ^{0}C (units)
$I^{P}_{y,a,d,\,line(2),i_{10},gd}$	Current of the main area (at the exit from a transformer) of phase wire of phase A (A)
$R^{P}_{y,a,d\,line(2),i_{10},\,droty}$	Resistance of one kilometre of wire of corresponding mark, phase A (Ohm/km)
$L^{P}_{y,a,line(2),i_{10}}$	Length of line with distributed load, phase A (km)
$N^{P}_{y,a,d,\,line(2),i_{10}}$	Number of sections (branch connections), phase A (units)
$I^{P}_{y,a,d,\,line(2),i_{10},(n-1)}$	Current of a previous section, phase wire of phase A of a line with distributed load (A)
$R^{P}_{y,a,v,\,line(2),i_{10}}$	Average resistance of a branch, phase A (Ohm/km)

$R^{P}_{y,a,nav,\ line(2),i_{10}}$	Load resistance of phase wire of phase A (kW)
$U^{P}_{y,a,d,\ line(2),i_{10}(n\text{-}1)}$	Voltage of a previous section, phase wire of phase A (kV)
$U^{P}_{y,a,d,\ line(2),i_{10},\ vh}$	Voltage at the entrance of the first section, phase wire of phase A (kV)
$I^{P}_{y,b,d,\ line(2),i_{10},gd}$	Current of the main section (at the exit from a transformer), phase wire of phase B (A)
$R^{P}_{y,b,d\ line(2),i_{10},\ droty}$	Resistance of one kilometre of wire of corresponding mark, phase B (Ohm/km)
$L^{P}_{y,b,line(2),i_{10}}$	Length of line with distributed load, phase B (km)
$N^{P}_{y,b,,d,\ line(2),i_{10}}$	Number of sections (branch connections), phase B (units)
$I^{P}_{y,b,d,\ line(2),i_{10},(n\text{-}1)}$	Current of a previous section, phase wire of phase B of a line with distributed load (A)
$R^{P}_{y,b,v,\ line(2),i_{10}}$	Average resistance of a branch, phase B (Ohm/km)
$R^{P}_{y,b,nav,\ line(2),i_{10}}$	Load resistance of phase wire of phase B (kW)
$U^{P}_{y,b,d,\ line(2),i_{10}(n\text{-}1)}$	Voltage of a previous section, phase wire of phase B (kV)
$U^{P}_{y,b,d,\ line(2),i_{10},\ vh}$	Voltage at the entrance of the first section, phase wire of phase B (kV)
$I^{P}_{y,c,d,\ line(2),i_{10},gd}$	Current of the main section (at the exit from a transformer), phase wire of phase C (A)
$R^{P}_{y,c,d\ line(2),i_{10},\ droty}$	Resistance of one kilometre of wire of corresponding mark, phase C (Ohm/km)
$L^{P}_{y,c,line(2),i_{10}}$	Length of line with distributed load, phase C (km)
$N^{P}_{y,c,,d,\ line(2),i_{10}}$	Number of sections (branch connections), phase C (units)
$I^{P}_{y,c,d,\ line(2),i_{10},(n\text{-}1)}$	Current of a previous section, phase wire of phase C of a line with distributed load (A)
$R^{P}_{y,c,v,\ line(2),i_{10}}$	Average resistance of a branch, phase C (Ohm/km)
$R^{P}_{y,c,nav,\ line(2),i5}$	Load resistance of phase wire of phase C (kW)
$U^{P}_{y,c,d,\ line(2),i_{10},(n\text{-}1)}$	Voltage of a previous section, phase wire of phase C (kV)
$U^{P}_{y,c,d,\ line(2),i_{10},\ vh}$	Voltage at the entrance of the first section, phase wire of phase C (kV)
$I^{P}_{A,y,line(2),i_{10}}$	Current of phase A of ETL «i_{10}» (A)
$I^{P}_{B,y,line(2),i_{10}}$	Current of phase B of ETL «i_{10}» (A)
$I^{P}_{C,y,line(2),i_{10}}$	Current of phase C of ETL «i_{10}» (A)
$k^{P}_{Cu,y,line(2),i_{10}}$	Factor that accounts partial use of copper wires of a line with distributed load
$R^{P}_{0n,y,line(2),i_{10}}$	Specific resistance of zero wire of a line with distributed load (Ohm/km)
$L^{P}_{y,line(2),i_{10}}$	Length of a line with distributed load (km)

$R^{P}_{\phi n,y,line(2),i_{10}}$	Specific resistance of phase wire of a line with distributed load (Ohm/km)
$T^{M}_{y,line(2),i_{10}}$	Annual number of hours of use of maximum active power of a line with distributed load (hour)
$P^{P}_{y,line(2),max,i_{10}}$	Power that is transported by ETL «i» in an hour of maximum load (kW)
$P^{P}_{y,line(2),min,i_{10}}$	Power that is transported by ETL «i» in an hour of minimum load (kW)
$U^{P}_{y,line(2),max,i_{10}}$	Voltage at the entrance of line during maximum load (V)
$cos\varphi^{P}_{y,line(2),i_{10}}$	Cosine of the angle between active and gross power during maximum load of a line with distributed load
$P^{P}_{l,y,line(2),i_{10}}$	Power at the entrance of electricity transmission line (kW)
$P^{P}_{n,y,line(2),i_{10}}$	Power than runs in the section "n" (kW)
$L^{P}_{n,y,line(2),i_{10}}$	Length between the beginning of a line and point of consumer connection (km)
$P^{P}_{y,branch,max,i_{11}}$	Power during maximum load (kW)
$U^{P}_{y,branch,max,i_{11}}$	Voltage at the entrance of line during maximum load (V)
$cos\varphi^{P}_{y,branch,i_{11}}$	Cosine of the angle between active and gross power during maximum load of branches
$P^{P}_{l,y,branch,i_{11}}$	Power at the entrance of electricity transmission line (kW)
$P^{P}_{n,y,branch,i_{11}}$	Power than runs in the section "n" (kW)
$L^{P}_{n,y,branch,i_{11}}$	Length between the beginning of a line and point of consumer connection (m)
$I^{P}_{A,y,branch,i_{11}}$	Current of phase A of ETL «i_{11}» (A)
$I^{P}_{B,y,branch,i_{11}}$	Current of phase B of ETL «i_{11}» (A)
$I^{P}_{C,y,branch,i_{11}}$	Current of phase C of ETL «i_{11}» (A)
$k^{P}_{Cu,y,branch,i_{11}}$	Factor that accounts partial use of copper wires of branches
$R^{P}_{0n,y,branch,i_{11}}$	Specific resistance of zero wire of branches (Ohm/km)
$L^{P}_{y,branch,i_{11}}$	Length of branches (km)
$R^{P}_{\phi n,y,branch,i_{11}}$	Specific resistance of phase wire of branches (Ohm/km)
$T^{M}_{y,branch,i_{11}}$	Annual number of hours of use of maximum active power at «i_{11}» (of branches) (hour)
$P^{P}_{y,branch,min,i_{11}}$	Power that is transported by «i_{11}» (branches) in an hour of minimum load (kW)
$W^{P}_{y.n.(segm\ n).i_{12}}$	Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths. kWh)
$W^{P}_{y,system}$	Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the project scenario (ths. kWh)
$K\Pi^{B}_{XX,y,tran(2),i}$	Degradation factor of no-load run losses in double-winding transformer «*i*»

$K\Pi^{B}_{кз,y,tran(2),i}$	Degradation factor of short-circuit losses in double-winding transformer «*i*»
$K\Pi^{B}_{XX,y,tran(3),i_1}$	Degradation factor of no-load run losses in three-winding transformer «*i*»
$K\Pi^{B}_{кз,y,tran(3),i_1}$	Degradation factor of short-circuit losses in three-winding transformer «*i*»
$R^{B}_{f,y,line(1),max,i_2}$	Specific resistance of phase wire in ETL (Ohm/km)
$L^{B}_{y,line(1),max,i_2}$	Length of ETL (km)
$L^{B}_{y,cable,i_3}$	Length of electricity transmission line (km)
$K\Pi^{B}_{R,y,cable,i_3}$	Degradation factor of cable insulation
$N^{B}_{y,insul,i_4}$	Number of replaced insulators (units)
$K\Pi^{B}_{R,y,insul,i_4}$	Magnification factor of losses in insulator
$P^{B}_{y,lamp,i_5}$	Power of one signalling lamp or light emitting diode (kW)
$N^{B}_{y,lamp,i_5}$	Number of replaced signalling lamps (units)
$N^{B}_{y,meter,i_7}$	Number of replaced meters (units)
$K\Pi^{B}_{R,y,meter,i_7}$	Degradation factor of electrical characteristics of a meter
$N^{B}_{y,switch,i_8}$	Number of replaced switches (units)
$N^{B}_{d,y,switch,i_8}$	Number of days (of switch operation) with a temperature below 5 ^{0}C (units)
$N^{B}_{y,motors,i_9}$	Number of replaced or reconstructed electrical motors (units)
$P^{B}_{y,motors,i_9}$	Power of a motor (kW)
$N^{B}_{d,y,motors,i_9}$	Number of days (of electric motor operation) with a temperature below 5 ^{0}C (units)
$R^{B}_{y,a,v,\ line(2),i_{10}}$	Average resistance of branch, phase A in an hour of maximum load (Ohm/km)
$R^{B}_{y,b,v,\ line(2),i_{10}}$	Average resistance of branch, phase B in an hour of maximum load (Ohm/km)
$R^{B}_{y,c,v,\ line(2),i_{10}}$	Average resistance of branch, phase C in an hour of maximum load (Ohm/km)
$R^{B}_{y,a,nav,\ line(2),i_{10}}$	Load resistance, phase wire of phase A (kW)
$R^{B}_{y,a,d\ line(2),i_{10},\ droty}$	Resistance of one kilometre of wire of corresponding mark of phase A (Ohm/km)
$L^{B}_{y,a,line(2),i_{10}}$	Length of line with distributed load of phase A (km)
$N^{B}_{y,a,d,\ line(2),i_{10}}$	Number of sections (branch connections) of phase A (units)
$I^{B}_{y,a,d,\ line(2),i_{10},(n+1)}$	Current of a next section, phase wire of phase A of a line with distributed load (A)
$U^{B}_{y,a,d,\ line(2),i_{10}(n+1)}$	Voltage of the next branch “n”, phase wire of phase A (kV)

$I^{B}_{y,a,d,\, line(2),i_{10},\, (n+1)}$	Current of the next branch “n”, phase wire of phase A (A)
$R^{B}_{y,b,nav,\, line(2),i_{10}}$	Load resistance, phase wire of phase B (kW)
$R^{B}_{y,b,d\, line(2),i_{10},\, droty}$	Resistance of one kilometre of wire of corresponding mark of phase B (Ohm/km)
$L^{B}_{y,b,line(2),i_{10}}$	Length of line with distributed load of phase B (km)
$N^{B}_{y,b,d,\, line(2),i_{10}}$	Number of sections (branch connections) of phase B (units)
$I^{B}_{y,b,d,\, line(2),i_{10},(n+1)}$	Current of a next section, phase wire of phase B of a line with distributed load (A)
$U^{B}_{y,b,d,\, line(2),i_{10}(n+1)}$	Voltage of the next branch “n”, phase wire of phase B (kV)
$I^{B}_{y,b,d,\, line(2),i_{10},\, (n+1)}$	Current of the next branch “n”, phase wire of phase B (A)
$R^{B}_{y,c,d\, line(2),i_{10},\, droty}$	Resistance of one kilometre of wire of corresponding mark of phase C (Ohm/km)
$L^{B}_{y,c,line(2),i_{10}}$	Length of line with distributed load of phase C (km)
$N^{B}_{y,c,d,\, line(2),i_{10}}$	Number of sections (branch connections) of phase C (units)
$I^{B}_{y,c,d,\, line(2),i_{10},(n+1)}$	Current of a next section, phase wire of phase C of a line with distributed load (A)
$U^{B}_{y,c,d,\, line(2),i_{10}(n+1)}$	Voltage of the next branch “n”, phase wire of phase C (kV)
$I^{B}_{y,c,d,\, line(2),i_{10},\, (n+1)}$	Current of the next branch “n”, phase wire of phase C (A)
$L^{B}_{n,y,line(2),i_{10}}$	Length between the beginning of a line and point of consumer connection (km)
$L^{B}_{n,y,branch,i_{11}}$	Length between the beginning of a line and point of consumer connection (m)
$W^{B}_{y.n.(segm\, n).i_{12}}$	Electricity losses in element n of the grid’s segment before reconstruction of the element that are estimated by means of calculated values of the segment’s operating mode after the reconstruction, (ths. kWh)
$W^{P,C}_{y,system,n}$	Volume of electricity consumed in period “y” by all consumers connected to grids of voltage class with index n (net consumption), in the project scenario (ths. kWh)
$\Delta W^{P}_{1\div(y-1),elem,n}$	Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period (1 ÷ (y-1)), in the project scenario (ths. kWh).
$\Delta W^{P}_{y,system,n}$	Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period "y", in the project scenario (ths. kWh).
$\Delta W^{P}_{(y-1),segm,n}$	Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y-1", in the project scenario (ths. kWh).
$\Delta W^{P}_{y,segm,n}$	Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y", in the project scenario (ths. kWh).
$W^{P,T,n}_{y,system,m}$	Volume of electricity that outflew in period «y» from transformer for its consumption in the grid of voltage class with index m,

	after its conversion from voltage networks with index n, here $n > m$, in the project scenario (ths. kWh)
$W^{P}_{y,system,m}$	Volume of electricity, which has to be transfered in period y to the grids of voltage class with the index m for all consumers connected to them (gross consumption), in the project scenario (ths. kWh)
$K^{P,L}_{y,system,m}$	Coefficient of electricity losses in grids of voltage class with index m (withous losses in transformers) for period «y», in the project scenario
$K^{P,T,n/m}_{y,system}$	Coefficient of electricity losses in transformer for period y, that occur due to conversion thereof from grids of voltage class with index n into grids of voltage class with index m, here $n > m$
$W^{P,T}_{y,system,n.yp}$	No-load electricity losses in transformer for period y, that occur due to conversion thereof from grids of voltage class with index n into grids of voltage class with index m, here $n > m$ (ths. kWh.)
$W^{P,I}_{y,system,m}$	Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external consumers, in the project scenario (ths. kWh)
$W^{B}_{y,system,m}$	Volume of electricity, which has to be transfered in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), in the baseline scenario (ths. kWh)
$W^{P}_{y,system,0.38}$	Volume of electricity, which has to be transfered in period «y» to grids of voltage class with index «n» for all consumers connected to them (gross consumption), in the project scenario (ths. kW)
EF	Carbon dioxide emission factor (t CO_{2e}/kWh)

$[B]$ – index that corresponds to the baseline scenario;
$[P]$ – index that corresponds to the project scenario;
$[y]$ – index that corresponds to the monitoring period.

Table of parameters that will be included in the process of monitoring and examination for ERU calculation are given in Sections **D.1.1.1** and **D.1.1.3.**

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID Number (Please use numbers to ease cross-referencing to D.2.)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1	$S^{P}_{T,y,tran(2),i}$ - Nominal load of a double-winding transformer "i" on the side of high voltage	Nameplate data	(kVA)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
1.1	$\Delta P^{P}_{XX,P,y,tran(2),i}$ - Rated power losses of no-load run in a double-winding transformer «i»	Nameplate data	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
1.2	$K\Pi^{P}_{XX,y,tran(2),i}$ - Degradation factor of no-load run losses in double-winding transformer "i"	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
1.3	$\Delta P^{P}_{\text{кз},P,y,tran(2),i}$ - Rated power losses of short circuit in a double-winding	Nameplate data	(kW)	e	Once at the beginning of	100%	In electronic and paper forms	Fixed value that doesn't change during

	transformer «i»				the project			implementation of the project activity
1.4	$K\Pi^{P}_{\text{кз},y,tran(2),i}$ - Degradation factor of short-circuit losses in double-winding transformer "i"	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
1.5	$P^{P}_{y,tran(2),max,i}$ – Power of double-winding transformer "i" at the side of high voltage in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
1.6	$cos\varphi^{P}_{y,tran(2),i}$ - Cosine of the angle between active and gross power in double-winding transformer "i"	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
1.7	$T^{M}_{y,tram(2),i}$ – Annual number of hours of maximum power use in double-winding transformer "i"	Hour-based schedule of power of a working day of the month.	(hour)	m	annually	100%	In electronic and paper forms	Company data
1.8	$P^{P}_{y,tran(2),min,i}$ – Power of double-winding transformer "i" at the side of high	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data

	voltage in an hour of minimum load							
1.9	$I^P_{A,y,tran(2),i}$- Current of phase A in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
1.10	$I^P_{B,y,tran(2),i}$- Current of phase B in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
1.11	$I^P_{C,y,tran(2),i}$- Current of phase C in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
1.12	$R^P_{0n,y,tran(2),i}$ - Specific resistance of zero wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
1.13	$L^P_{y,tran(2),i}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
1.14	$R^P_{\phi n,y,tran(2),i}$ - Specific resistance of phase wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used

2	$S^{P}_{T,y,tran(3),i_1}$ - Nominal load of a three-winding transformer «i_1»	Nameplate data	(kVA)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
2.1	$\Delta P^{P}_{XX,P,y,tran(3),i_1}$ - Rated power losses of no-load run in a three-winding transformer «i_1»	Nameplate data	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
2.2	$K\Pi^{P}_{XX,y,tran(3),i_1}$ - Degradation factor of no-load run losses in a three-winding transformer	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
2.3	$\Delta P^{P}_{кз,P,y,tran(3.1),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of high voltage	Nameplate data	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
2.4	$\Delta P^{P}_{кз,P,y,tran(3.2),i_1}$ - Rated power losses of short circuit in a	Nameplate data	(kW)	e	Once at the beginni	100%	In electronic and paper forms	Fixed value that doesn't change

	three-winding transformer «i_1», of medium voltage				ng of the project			during implementation of the project activity
2.5	$\Delta P^P_{кз,P,y,tran(3.3),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of low voltage	Nameplate data	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
2.6	$К\Pi^P_{кз,y,tran(3),i_1}$ - Degradation factor of short-circuit losses in a three-winding transformer	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
2.7	$P^P_{y,tran(3),max,i_1}$ – Power of a three-winding transformer "i_1" in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
2.8	$cos\varphi^P_{y,tran(3.1),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of high voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
2.9	$cos\varphi^P_{y,tran(3.2),i_1}$ - Cosine of the angle	To measure cosine of the angle between active and		m	annually	100%	In electronic and paper forms	Company data

	between active and gross power in a three-winding transformer "i_1" of medium voltage	gross power phase meter is used						
2.10	$cos\varphi^{P}_{y,tran(3.3),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of low voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
2.11	$P^{P}_{y,tran(3),min,i_1}$ – Power of a three-winding transformer "i_1" in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
2.12	$T^{M}_{y,tran(3),i_1}$ – Number of hours of maximum power use of windings of a three-winding transformer	Hour-based schedule of power of a working day in a month.	(hour)	m	annually	100%	In electronic and paper forms	Company data
3	$P^{P}_{y,line(1),max,i_2}$ – Power of ETL «i_2» during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
3.1	$U^{P}_{y,line(1),max,i_2}$ – Voltage of ETL «i_2» during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
3.2	$cos\varphi^{P}_{y,line(1),i_2}$ – Cosine of the angle between active and gross power in ETL	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
3.3	$R^{P}_{f,y,line(1),max,i_2}$ –	Nameplate data or measurements with the	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible

	Specific resistance of phase wire in ETL	help of ammeter of voltmeter						to carry out measurements passport data of equipment are used
3.4	$L^{P}_{y,line(1),max,i_2}$– Length of ETL	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
3.5	$P^{P}_{y,line(1),min,i_2}$ – Power that is transported by ETL «i_2» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
3.6	$T^{M}_{y,line(1),i_2}$ – річна Annual number of hours of maximum active power use in ETL «i_2»	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
3.7	$I^{P}_{A,y,line(1),i_2}$ - Current of phase A of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
3.8	$I^{P}_{B,y,line(1),i_2}$ - Current of phase B of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
3.9	$I^{P}_{C,y,line(1),i_2}$ - Current of phase C of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
3.10	$R^{P}_{0n,y,line(1),i_2}$ - Specific resistance of zero wire in ETL	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measureme

								nts passport data of equipment are used
4	$L^{P}_{y,cable,i_3}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
4.1	$\Delta W^{P}_{\Pi,P,y,cable,i_3}$ - Rated specific losses of insulation of cable «i_3»	Nameplate data	(ths. kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
4.2	$K\Pi^{P}_{R,y,cable,i_3}$ - Degradation factor of cable insulation	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
5	$N^{P}_{y,insul,i_4}$– Number of replaced insulators	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
5.1	$W^{P}_{P,y,insul,i_4}$ - Rated electricity losses in insulator	Nameplate data	(kWh)	e	Once at the beginning of the	100%	In electronic and paper forms	Fixed value that doesn't change during implementa

					project			tion of the project activity
5.2	$K\Pi^{P}_{R,y,insul,i_4}$- Magnification factor of losses in insulator	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
6	$P^{P}_{y,lamp,i_5}$ - Magnification factor of losses in insulator	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
6.1	$N^{P}_{y,lamp,i_5}$ - Number of replaced signalling lamps	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
6.2	$T^{P}_{y,lamp,i_5}$ - Operational period of signalling lamps	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
7	$W^{P}_{y,comp,i_6}$ – Specific reduction of electricity losses in the absence of implementation of reactive power compensation devices, in period «y» in the project scenario	Nameplate data	(kW/kVAr)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
8	$N^{P}_{y,meter,i_7}$– Number of replaced meters	Act of working technical commission on acceptance into operation of distribution electrical grids	(unit)	m	annually	100%	In electronic and paper forms	Company data

		facilities						
8.1	$T^{P}_{y,meter,i_7}$– Operational period of a meter per year	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
8.2	$A^{P}_{P,y,meter,i_7}$– Rated electricity losses per hour in one meter	Nameplate data	(kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
8.3	$К\Pi^{P}_{R,y,meter,i_7}$- Degradation factor of electrical characteristics of a meter	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
9	$N^{P}_{y,switch,i_8}$ – Number of replaced switches	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
9.1	$P^{P}_{y,switch,i_8}$ - Rated power of a switch	Nameplate data	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Fixed value that doesn't change during implementation of the project activity
9.2	$N^{P}_{d,y,switch,i_8}$ - Number of days (of	Data on meteorological phenomena that were	(unit)	m	annually	100%	In electronic and paper forms	Company data

	switch operation) with a temperature below 5 ^{0}C	observed by a meteorological station						
10	$N^P_{y,motors,i_9}$ – Number of replaced or reconstructed electrical motors	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
10.1	$P^P_{y,motors,i_9}$ - Power of a motor	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
10.2	$N^P_{d,y,motors,i_9}$ - Number of days (of electric motor operation) with a temperature below 5 ^{0}C	Data on meteorological phenomena that were observed by a meteorological station	(unit)	m	annually	100%	In electronic and paper forms	Company data
11	$I^P_{y,a,d,\ line(2),i_{10},gd}$ – Current of the main area (at the exit from a transformer) of phase wire of phase A	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.1	$R^P_{y,a,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase A	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.2	$L^P_{y,a,line(2),i_{10}}$ – Length of line with distributed load of phase A	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data

11.3	$N^{P}_{y,a,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase A	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
11.4	$I^{P}_{y,a,d,\,line(2),i_{10},(n\text{-}1)}$ – Current of a previous section, phase wire of phase A of a line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.5	$R^{P}_{y,a,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase A	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.6	$R^{P}_{y,a,nav,\,line(2),i_{10}}$ – Load resistance of phase wire of phase A	To measure Load resistance at ETL ohmmeter is used	kW	m	annually	100%	In electronic and paper forms	Company data
11.7	$U^{P}_{y,a,d,\,line(2),i_{10}\,(n\text{-}1)}$ - Voltage of a previous section, phase wire of phase A	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.8	$U^{P}_{y,a,d,\,line(2),i_{10},\,vh}$ - Voltage at the entrance of the first section, phase wire of phase A	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.9	$I^{P}_{y,b,d,\,line(2),i_{10},gd}$ – Current of the main section (at the exit from a transformer),	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data

	phase wire of phase B							
11.10	$R^{P}_{y,b,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase B	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.11	$L^{P}_{y,b,line(2),i_{10}}$ – Length of line with distributed load of phase B	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
11.12	$N^{P}_{y,b,,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase B	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
11.13	$I^{P}_{y,b,d,\ line(2),i_{10},(n-1)}$ – Current of a previous section, phase wire of phase B of a line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.14	$R^{P}_{y,b,v,\ line(2),i_{10}}$ - Average resistance of a branch, phase B	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.15	$R^{P}_{y,b,nav,\ line(2),i_{10}}$ – Load resistance of phase wire of phase B	To measure Load resistance at ETL ohmmeter is used	kW	m	annually	100%	In electronic and paper forms	Company data

11.16	$U^{P}_{y,b,d,\ line(2),i_{10}(n\text{-}1)}$ - Voltage of a previous section, phase wire of phase B	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.17	$U^{P}_{y,b,d,\ line(2),i_{10},\ vh}$ - Voltage at the entrance of the first section, phase wire of phase B	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.18	$I^{P}_{y,c,d,\ line(2),i_{10},gd}$ – Current of the main section (at the exit from a transformer), phase wire of phase C	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.19	$R^{P}_{y,c,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase C	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.20	$L^{P}_{y,c,line(2),i_{10}}$ – Length of line with distributed load of phase C	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
11.21	$N^{P}_{y,c,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase C	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
11.22	$I^{P}_{y,c,d,\ line(2),i_{10},(n\text{-}1)}$ – Current of a previous	To measure current ammeter or galvanometer	(A)	m	annually	100%	In electronic and paper forms	Company data

	section, phase wire of phase C of a line with distributed load	are used						
11.23	$R^{P}_{y,c,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase C	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.24	$R^{P}_{y,c,nav,\,line(2),i5}$ – Load resistance of phase wire of phase C	To measure Load resistance at ETL ohmmeter is used	kW	m	annually	100%	In electronic and paper forms	Company data
11.25	$U^{P}_{y,c,d,\,line(2),i_{10},(n\text{-}1)}$ - Voltage of a previous section, phase wire of phase C	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.26	$U^{P}_{y,c,d,\,line(2),i_{10},\,vh}$ - Voltage at the entrance of the first section, phase wire of phase C	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
11.27	$I^{P}_{A,y,line(2),i_{10}}$ - Current of phase A of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.28	$I^{P}_{B,y,line(2),i_{10}}$ - Current of phase B of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.29	$I^{P}_{C,y,line(2),i_{10}}$ - Current of phase C of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
11.30	$R^{P}_{0n,y,line(2),i_{10}}$ -	Nameplate data or	(Ohm/k	e/m	annually	100%	In electronic and paper	If it is

	Specific resistance of zero wire of a line with distributed load	measurements with the help of ammeter of voltmeter	m)				forms	impossible to carry out measurements passport data of equipment are used
11.31	$L^{P}_{y,line(2),i_{10}}$ - Length of a line with distributed load	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
11.32	$R^{P}_{\phi n,y,line(2),i_{10}}$ - Specific resistance of phase wire of a line with distributed load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
11.33	$T^{M}_{y,line(2),i_{10}}$ - Annual number of hours of use of maximum active power of a line with distributed load	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
11.34	$P^{P}_{y,line(2),max,i_{10}}$ - Power that is transported by ETL «i» in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
11.35	$P^{P}_{y,line(2),min,i_{10}}$ - Power that is transported by ETL «i» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data

11.36	$U^{P}_{y,line(2),max,i_{10}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(V)	m	annually	100%	In electronic and paper forms	Company data
11.37	$cos\varphi^{P}_{y,line(2),i_{10}}$ - Cosine of the angle between active and gross power during maximum load of a line with distributed load	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
11.38	$\rho^{P}_{Al,y,line(2),i_{10}}$ - Specific resistance of aluminium for a line with distributed load	Nameplate data of equipment	(Ohm·m m^2/m)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
11.39	$k^{P}_{Cu,y,line(2),i_{10}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data
11.40	$P^{P}_{l,y,line(2),i_{10}}$ - Power at the entrance of electricity transmission line	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
11.41	$P^{P}_{n,y,line(2),i_{10}}$ - Power than runs in the section "n"	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
11.42	$F^{P}_{n,y,line(2),i_{10}}$ - Section of wire of	Nameplate data of equipment	(mm^2)	e	Once at the	100%	In electronic and paper forms	Company data

	segment n for a line with distributed load				beginning of the project			
11.43	$L^{P}_{n,y,line(2),i_{10}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
12	$P^{P}_{y,branch,max,i_{11}}$ - Power during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
12.1	$U^{P}_{y,branch,max,i_{11}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(V)	m	annually	100%	In electronic and paper forms	Company data
12.2	$cos\varphi^{P}_{y,branch,i_{11}}$ - Cosine of the angle between active and gross power during maximum load	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
12.3	$\rho^{P}_{Al,y,branch,i_{11}}$ - Specific resistance of aluminium for branches	Nameplate data of equipment	(Ohm·m m^2/m)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
12.4	$k^{P}_{Cu,y,branch,i_{11}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data

12.5	$P^{P}_{l,y,branch,i_{11}}$ - Power at the entrance of electricity transmission line	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
12.6	$P^{P}_{n,y,branch,i_{11}}$ - Power than runs in the section "n"	To measure power at transformer watt-meter or electricity meter is used	(kW)	m	annually	100%	In electronic and paper forms	Company data
12.7	$F^{P}_{n,y,branch,i_{11}}$ - Section of wire of segment n for branches	Nameplate data of equipment	(mm^2)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
12.8	$L^{P}_{n,y,branch,i_{11}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(m)	m	annually	100%	In electronic and paper forms	Company data
12.9	$I^{P}_{A,y,branch,i_{11}}$ - Current of phase A of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
12.10	$I^{P}_{B,y,branch,i_{11}}$ - Current of phase B of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
12.11	$I^{P}_{C,y,branch,i_{11}}$ - Current of phase C of ETL «i_{11}» (A);	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
12.12	$R^{P}_{0n,y,branch,i_{11}}$ - Specific resistance of zero wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment

								are used
12.13	$L^{P}_{y,branch,i_{11}}$ - Length of branches	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
12.14	$R^{P}_{\phi n,y,branch,i_{11}}$ - Specific resistance of phase wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
12.15	$T^{M}_{y,branch,i_{11}}$ - Annual number of hours of maximum active power use in ETL «i»	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
12.16	$P^{P}_{y,branch,min,i_{11}}$ - Power that is transported by «i_{11}» (branch) in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
13	$W^{P}_{y.n.(segm\ n).i_{12}}$ - Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction	Determined with the help of calculated values of segment of the grid operating mode after its reconstruction	(ths. kWh)	e	annually	100%	In electronic and paper forms	Company data

14	$W^{P}_{y,system}$ - Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the project scenario	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids”	(kWh)	e	annually	100%	In electronic and paper forms	Company data
15	Carbon dioxide emission factor, (EF);	Officially approved values for Ukrainian energy system.	tCO_2e/kWh	e	annually	100%	In electronic and paper forms	If data approved at the national level is absent data taken from “Ukraine - Assessment of new calculation of CEF”[48] or ERUPT[49] will be used

[48] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

[49] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Emissions of the project, according to the actual monitoring values (calculated for a specific approach for Joint Implementation):

$$PE_y^P = PE_{y,elem}^P + PE_{y,segm}^P + PE_{y,system}^P \quad (1)$$

$PE_{y,elem}^P$ - GHG emissions due to the introduction of new or reconstruction of existing elements of the power grid in period *"y"* of the project scenario (tCO_{2e});
$PE_{y,segm}^P$ - GHG emissions due to the reconstruction of existing segments of the power grid in period *"y"* of the project scenario (tCO_2e);
$PE_{y,system}^P$ - GHG emissions due to systemic effects of the introduction of new or reconstruction of existing elements, as well as segments of the power grid in period $"y"$ of the project scenario (t CO_2e);
$[P]$ – index, which corresponds to the project scenario;
$[elem]$ – index, which corresponds to new or reconstructed electricity transmission lines;
$[segm]$ – index, which corresponds to new or reconstructed segments of power grid;
$[system]$ – index, which corresponds to systemic effect;
$[y]$ – index, that corresponds to monitoring period.

GHG emissions due to the introduction of new or reconstruction of existing elements of the power grid within the project implementation

$$PE_{y,elem}^P = (W_{y,tran(2)}^P + W_{y,tran(3)}^P + W_{y,line(1)}^P + W_{y,cable}^P + W_{y,insul}^P + W_{y,lamp}^P + W_{y,comp}^P + W_{y,meter}^P + W_{y,switch}^P + W_{y,motors}^P + W_{y,line(2)}^P + W_{y,branch}^P) \cdot EF \quad (2)$$

$W_{y,tran(2)}^P$ - Electricity losses due to the introduction of new or reconstruction of existing double-winding transformers, in period $"y"$, of the project scenario (ths. kWh);
$W_{y,tran(3)}^P$ - Electricity losses due to the introduction of new or reconstruction of existing three-winding transformers, in period $"y"$, of the project scenario (ths. kWh);
$W_{y,line(1)}^P$ – Electricity losses due to the introduction of new or reconstruction of existing wires of electricity transmission lines in period $"y"$ of the project scenario (ths. kWh);
$W_{y,cable}^P$- Electricity losses in insulation due to the introduction introduction of new or reconstruction of existing wires of electricity transmission lines in period $"y"$, of the project scenario (ths. kWh);
$W_{y,insul}^P$ - Electricity losses due to the replacement of defected insulators of electricity transmission lines, in period $"y"$ of the project scenario (ths. kWh);
$W_{y,lamp}^P$ - Electricity losses due to the replacement of signaling lamps with light emittind diodes, in period $"y"$ of the project scenario (ths. kWh);

$W^P_{y,comp}$ - Electricity losses due to the implementation of reactive power compensation devices at consumer's place, in period «y» in the project scenario (ths. kWh.);
$W^P_{y,meter}$ - Electricity losses due to the replacement of electric meters, in period "y" of the project scenario (kWh);
$W^P_{y,switch}$ - Electricity losses due to the replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);
$W^P_{y,motors}$ - Electricity losses due to replacement or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the project scenario (ths. kWh);
$W^P_{y,line(2)}$ - Electricity losses due to the replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the project scenario (ths. kWh);
$W^P_{y,branch}$ - Electricity losses due to the implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – monitoring period.

Electricity losses due to the introduction of new or reconstruction of existing double-winding transforemers that are introduced under project implementation

$$W^P_{y,tran(2)} = \sum_{i=1}^{I} W^P_{y,tran(2),i} \quad (3)$$

$W^P_{y,tran(2),i}$ – electricity losses in a double-winding transformer "i" in period "y" of the project scenario (ths. kWh);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$W^P_{y,tran(2),i} = \frac{\Delta P^P_{XX,F,y,tran(2),i} \cdot 8760 + \Delta P^P_{кз,F,y,tran(2),i} \cdot \left(\frac{S^P_{y,tran(2),max,i}}{S^P_{T,y,tran(2),i}}\right)^2 \cdot \tau^P_{y,tran(2),max,i} \cdot k^P_{n,y,tran(2),i}}{1000} \quad (4)$$

$\Delta P^P_{XX,F,y,tran(2),i}$ - Actual power losses of no-load run in a double-winding transformer «i» (kW);
$\Delta P^P_{кз,F,y,tran(2),i}$ - Actual power losses of short circuit in a double-winding transformer «i» (kW);
$S^P_{y,tran(2),max,i}$ - Load of a double-winding transformer at the side of high voltage in an hour of maximum load in transformer "i" (kVA);
$S^P_{T,y,tran(2),i}$ – Rated load of a double-winding transformer "i" at the side of high voltage (kVA);
$\tau^P_{y,tran(2),max,i}$ – time of maximum electricity losses in a double-winding transformer (hous);
$k^P_{n,y,tran(2),i}$- unssymetry coefficient in electrical grids with zero wire;

$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta P^{P}_{XX,F,y,tran(2),i} = \Delta P^{P}_{XX,P,y,tran(2),i} \cdot K\Pi^{P}_{XX,y,tran(2),i} \quad (5)$$

$\Delta P^{P}_{XX,P,y,tran(2),i}$ - Rated power losses of no-load run in a double-winding transformer «*i*» (kW);
$K\Pi^{P}_{XX,y,tran(2),i}$ - Degradation factor of no-load run losses in a double-winding transformer "*i*";
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period

$$\Delta P^{P}_{кз,F,y,tran(2),i} = \Delta P^{P}_{кз,P,y,tran(2),i} \cdot K\Pi^{P}_{кз,y,tran(2),i} \quad (6)$$

$\Delta P^{P}_{кз,P,y,tran(2),i}$ - Rated power losses of short circuit in a double-winding transformer «*i*» (kW);
$K\Pi^{P}_{кз,y,tran(2),i}$ - Degradation factor of short-circuit losses in a double-winding transformer "*i*";
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period

$$S^{P}_{y,tran(2),max,i} = \frac{P^{P}_{y,tran(2),max,i}}{cos\varphi^{P}_{y,tran(2),i}} \quad (7)$$

$P^{P}_{y,tran(2),max,i}$ – power of a double-winding transformer "*i*" at the side of high voltage in an hour of maximum load (kW);
$cos\varphi^{P}_{y,tran(2),i}$ - Cosine of the angle between active and gross power in a double-winding transformer "*i*" ;
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period;
$[max]$ – index, which corresponds to maximum load;

$$\tau^{P}_{y,tran(2),max,i} = 2 \cdot T^{M}_{y,tran(2),i} - 8760 + \frac{8760 - T^{M}_{y,tran(2),i}}{1 + \frac{T^{M}_{y,tran(2),i}}{8760} - 2 \cdot \frac{P^{P}_{y,tran(2),min,i}}{P^{P}_{y,tran(2),max,i}}} \cdot \left(1 - \frac{P^{P}_{y,tran(2),min,i}}{P^{P}_{y,tran(2),max,i}}\right)^{2} \quad (8)$$

$T^{M}_{y,tram(2),i}$ – Annual number of hours of maximum power use in a double-winding transformer “i” (hour);
$P^{P}_{y,tran(2),max,i}$ – Power of a double-winding transformer “i” at the side of high voltage in an hour of maximum load (kW);
$P^{P}_{y,tran(2),min,i}$ – Power of a double-winding transformer “i” at the side of high voltage in an hour of minimum load (kW);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[y]$ – index which corresponds to the monitoring period.

$$k^{P}_{n,y,tran(2),i} = 3 \cdot \frac{I^{2P}_{A,y,tran(2),i}+I^{2P}_{B,y,tran(2),i}+I^{2P}_{C,y,tran(2),i}}{\left(I^{P}_{A,y,tran(2),i}+I^{P}_{B,y,tran(2),i}+I^{P}_{C,y,tran(2),i}\right)^{2}} \cdot 1 + 1.5 \cdot \frac{R^{P}_{0,y,tran(2),i}}{R^{P}_{\phi,y,tran(2),i}} - 1.5 \cdot \frac{R^{P}_{0,y,tran(2),i}}{R^{P}_{\phi,y,tran(2),i}} \quad (9)$$

$I^{P}_{A,y,tran(2),i}$- Current of phase A in double-winding transformer “i” (A);
$I^{P}_{B,y,tran(2),i}$- Current of phase B in double-winding transformer “i” (A);
$I^{P}_{C,y,tran(2),i}$- Current of phase C in double-winding transformer “i” (A);
$R^{P}_{0,y,tran(2),i}$ - Resistance of zero wire of corresponding section in double-winding transformer “i” (Ohm);
$R^{P}_{\phi,y,tran(2),i}$- Resistance of phase wire of corresponding section in double-winding transformer “i” (Ohm);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,tran(2),i} = R^{P}_{0n,y,tran(2),i} \cdot L^{P}_{y,tran(2),i} \quad (10)$$

$R^{P}_{0n,y,tran(2),i}$ – specific resistance of zero wire in double winding transformer «*i*» (Ohm/km);
$L^{P}_{y,tran(2),i}$ - Length of electricity transmission line (km);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{\phi,y,tran(2),i} = R^{P}_{\phi n,y,tran(2),i} \cdot L^{P}_{y,tran(2),i} \quad (11)$$

$R^{P}_{\phi n,y,tran(2),i}$ - Specific resistance of phase wire in double-winding transformer “i” (Ohm/km);
$L^{P}_{y,tran(2),i}$ - Length of electricity transmission line (km);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;

$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to introduction of new or reconstruction of existing three-winding transformers that are implemented under the project

$$W^P_{y,tran(3)} = \sum_{i_1=1}^{I_1} W^P_{y,tran(3),i_1} \quad (12)$$

$W^P_{y,tran(3),i_1}$ – Electricity losses in three-winding transformer «i_1», in period «y» in the project scenario (ths. kWh);
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$W^P_{y,tran(3),i_1} = \frac{\Delta P^P_{XX,F,y,tran(3),i_1}\cdot 8760+\Delta P^P_{кз,F,y,tran(3.1),i_1}\cdot\left(\frac{S^P_{y,tran(3.1),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2\cdot\tau^P_{y,tran(3.1),max,i_1}+\Delta P^P_{кз,F,y,tran(3.2),i_1}\cdot\left(\frac{S^P_{y,tran(3.2),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2\cdot\tau^P_{y,tran(3.2),max,i_1}+\Delta P^P_{кз,F,y,tran(3.3),i_1}\cdot\left(\frac{S^P_{y,tran(3.3),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2\cdot\tau^P_{y,tran(3.3),max,i_1}}{1000} \quad (13)$$

$\Delta P^P_{XX,F,y,tran(3),i_1}$ - Actual power losses of no-load run in a three-winding transformer «i_1» (kW);
$\Delta P^P_{кз,F,y,tran(3,1),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of high voltage (kW);
$S^P_{y,tran(3.1),max,i_1}$ – Load of a three-winding transformer at the side of high voltage in an hour of maximum loads in transformer «i_1» (kVA);
$\tau^P_{y,tran(3.1),max,i_1}$ – Time of maximum electricity losses for windings of high voltage in a three-winding transformer (hour);
$\Delta P^P_{кз,F,y,tran(3.2),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of medium voltage (kW);
$S^P_{y,tran(3.2),max,i_1}$ – Load of a three-winding transformer at the side of medium voltage in an hour of maximum loads in transformer «i_1» (kVA);
$\tau^P_{y,tran(3.2),max,i_1}$ - Time of maximum electricity losses for windings of medium voltage in a three-winding transformer (hour);
$\Delta P^P_{кз,F,y,tran(3,3),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of low voltage (kW);
$S^P_{y,tran(3.3),max,i_1}$ – Load of a three-winding transformer at the side of low voltage in an hour of maximum loads in transformer «i_1» (kVA);
$\tau^P_{y,tran(3.3),max,i_1}$ - Time of maximum electricity losses for windings of low voltage in a three-winding transformer (hour);
$S^P_{T,y,tran(3),i_1}$ – nominal load of a three-winding transformer «i_1» (kVA);
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index that corresponds to maximum;

$[min]$ – index that corresponds to minimum;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$\Delta P^{P}_{XX,F,y,tran(3),i_1} = \Delta P^{P}_{XX,P,y,tran(3),i_1} \cdot K\Pi^{P}_{XX,y,tran(3),i_1} \quad (14)$$

$\Delta P^{P}_{XX,P,y,tran(3),i_1}$ - Rated power losses of no-load run in a three-winding transformer «i_1» (kW);
$K\Pi^{P}_{XX,y,tran(3),i_1}$ - Degradation factor of no-load run losses in a three-winding transformer;
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$\Delta P^{P}_{кз,F,y,tran(3.1),i_1} = \Delta P^{P}_{кз,P,y,tran(3.1),i_1} \cdot K\Pi^{P}_{кз,y,tran(3),i_1} \quad (15)$$

$$\Delta P^{P}_{кз,F,y,tran(3.2),i_1} = \Delta P^{P}_{кз,P,y,tran(3.2),i_1} \cdot K\Pi^{P}_{кз,y,tran(3),i_1} \quad (16)$$

$$\Delta P^{P}_{кз,F,y,tran(3.3),i_1} = \Delta P^{P}_{кз,P,y,tran(3.3),i_1} \cdot K\Pi^{P}_{кз,y,tran(3),i_1} \quad (17)$$

$\Delta P^{P}_{кз,P,y,tran(3.1),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of high voltage (kW);
$\Delta P^{P}_{кз,P,y,tran(3.2),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of medium voltage (kW);
$\Delta P^{P}_{кз,P,y,tran(3.3),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of low voltage (kW);
$K\Pi^{P}_{кз,y,tran(3),i_1}$ - Degradation factor of short-circuit losses in a three-winding transformer;
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$S^{P}_{y,tran(3.1),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.1),i_1}} \quad (18)$$

$$S^{P}_{y,tran(3.2),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.2),i_1}} \quad (19)$$

$$S^{P}_{y,tran(3.3),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.3),i_1}} \quad (20)$$

$P^{P}_{y,tran(3),max,i_1}$ – Power of a three-winding transformer "i_1" in an hour of maximum load (kW);
$cos\varphi^{P}_{y,tran(3.1),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of high voltage;
$cos\varphi^{P}_{y,tran(3.2),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of medium voltage;
$cos\varphi^{P}_{y,tran(3.3),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of low voltage;

$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.
$[max]$ – index that corresponds to maximum load.

$$\tau^P_{y,tran(3.1),max,i_1} = \tau^P_{y,tran(3.2),max,i_1} = \tau^P_{y,tran(3.3),max,i_1} = 2 \cdot T^M_{y,tran(3),i_1} - 8760 + \frac{8760 - T^M_{y,tran(3),i_1}}{1 + \frac{T^M_{y,tran(3),i_1}}{8760} - 2 \cdot \frac{P^P_{y,tran(3),min,i_1}}{P^P_{y,tran(3),max,i_1}}} \cdot \left(1 - \frac{P^P_{y,tran(3),min,i_1}}{P^P_{ytran(3),max,i_1}}\right) \quad (21)$$

$P^P_{y,tran(3),max,i_1}$ – Power of a three-winding transformer “i_1” in an hour of maximum load (kW);
$P^P_{y,tran(3),min,i_1}$ – Power of a three-winding transformer “i_1” in an hour of minimum load (kW);
$T^M_{y,tran(3),i_1}$ – Number of hours of maximum power use of windings of a three-winding transformer (hour);
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

Electricity losses due to introduction of new or reconstruction of existing wires of electricity transition lines, which are implemented under the project

$$W^P_{y,line(1)} = \sum_{i_2=1}^{I_2} W^P_{y,line(1),i_2} \quad (22)$$

$W^P_{y,line(1),i_2}$ – Electricity losses caused by implementation of new or reconstruction of existing wires of electricity transmission lines, in period «y» in the project scenario (ths. kWh);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL, that are considered as an element in the project;
$[P]$ – index, which corresponds to the project scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[y]$ – – index that corresponds to monitoring period.

$$W^P_{y,line(1),i_2} = \left(\frac{P^P_{y,line(1),max,i_2}}{U^P_{y,line(1),max,i_2} \cdot cos\varphi^P_{y,line(1),i_2}}\right)^2 \cdot \frac{R^P_{L\_f,y,line(1),max,i_2} \cdot \tau^P_{y,line(1),max,i_2} \cdot k^P_{n,y,line(1),i_2}}{1000000} \quad (23)$$

$P^P_{y,line(1),max,i_2}$ – Power of ETL «i_2» during maximum load (kW);
$U^P_{y,line(1),max,i_2}$ – Voltage of ETL «i_2» during maximum load (kV);
$cos\varphi^P_{y,line(1),i_2}$ – Cosine of the angle between active and gross power in ETL;
$R^P_{L\_f,y,line(1),max,i_2}$ - Resistance of phase wire in ETL (Ohm);

$\tau^{P}_{y,line(1),max,i_2}$ – time of maximum electricity losses in ETL (hour);
$k^{P}_{n,y,line(1),i_2}$ – unsymmetry factor in electrical grids with zero wire;
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – index, which corresponds to the project scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{L\_f,y,line(1),max,i_2} = R^{P}_{f,y,line(1),max,i_2} \cdot L^{P}_{y,line(1),max,i_2} \quad (24)$$

$R^{P}_{f,y,line(1),max,i_2}$ – Specific resistance of phase wire in ETL (Ohm/km);
$L^{P}_{y,line(1),max,i_2}$– Length of ETL (km);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – index, which corresponds to the project scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[y]$ – index which corresponds to the monitoring period.

$$\tau^{P}_{y,line(1),max,i_2} = 2 \cdot T^{M}_{y,line(1),i_2} - 8760 + \frac{8760 - T^{M}_{y,line(1),i_2}}{1 + \frac{T^{M}_{y,line(1),i_2}}{8760} - 2 \cdot \frac{P^{P}_{y,line(1),min,i_2}}{P^{P}_{y,line(1),max,i_2}}} \cdot \left(1 - \frac{P^{P}_{y,line(1),min,i_2}}{P^{P}_{y,line(1),max,i_2}}\right) \quad (25)$$

$P^{P}_{y,line(1),max,i_2}$ – Power that is transported by ETL «i_2» in an hour of maximum load (kW);
$P^{P}_{y,line(1),min,i_2}$ – Power that is transported by ETL «i_2» in an hour of minimum load (kW);
$T^{M}_{y,line(1),i_2}$ – Annual number of hours of maximum active power use in ETL «i_2» (hour);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – index, which corresponds to the project scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[max]$ – index, which corresponds to maximum;
$[min]$ – index, which corresponds to minimum;
$[y]$ – index which corresponds to the monitoring period.

$$k^{\mathrm{P}}_{\mathrm{n},y,line(1),i_2} = 3 \cdot \frac{I^{2P}_{A,y,line(1),i_2} + I^{2P}_{B,y,line(1),i_2} + I^{2P}_{C,y,line(1),i_2}}{\left(I^{P}_{A,y,line(1),i_2} + I^{P}_{B,y,line(1),i_2} + I^{P}_{C,y,line(1),i_2}\right)^2} \cdot 1 + 1.5 \cdot \frac{R^{P}_{0,y,line(1),i_2}}{R^{P}_{L\_f,y,line(1),max,i_2}} - 1.5 \cdot \frac{R^{P}_{0,y,line(1),i_2}}{R^{P}_{L\_f,y,line(1),max,i_2}} \quad (26)$$

$I^{P}_{A,y,line(1),i_2}$ - Current of phase A of ETL «i_2» (A);
$I^{P}_{B,y,line(1),i_2}$ - Current of phase B of ETL «i_2» (A);
$I^{P}_{C,y,line(1),i_2}$ - Current of phase C of ETL «i_2» (A);

$R^{P}_{0,y,line(1),i_2}$ - Specific resistance of zero wire of corresponding section of ETL «i_2» (Ohm);
$R^{B}_{L\_f,y,line(1),max,i_2}$- Resistance of phase wire of corresponding section of ETL «i_2» (Ohm);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,line(1),i_2} = R^{P}_{0n,y,line(1),i_2} \cdot L^{P}_{y,line(1),i_2} \quad (27)$$

$R^{P}_{0n,y,line(1),i_2}$ - Specific resistance of zero wire in ETL (Ohm / km);
$L^{P}_{y,line(1),i_2}$ - Length of electricity transmission line (km);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in insulation due to implementation of new or reconstruction of existing wires of cable electricity transmission lines which are implemented under the project

$$W^{P}_{y,cable} = \sum_{i_3=1}^{I_3} W^{P}_{y,cable,i_3} \quad (28)$$

$W^{P}_{y,cable,i3}$ – Electricity losses in insulation due to implementation of new or reconstruction of existing wires of cable electricity transmission lines, in period «y» in the project scenario (ths. kWh);
$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – – index, which corresponds to the project scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

$$W^{P}_{y,cable,i_3} = \Delta W^{P}_{\text{п},F,y,cable,i_3} \cdot L^{P}_{y,cable,i_3} \quad (29)$$

$\Delta W^{P}_{\text{п},F,y,cable,i_3}$ – Actual specific losses of insulation of cable «i_3» (ths. kWh/km);

$L^{P}_{y,cable,i_3}$ – Length of cable electricity transmission line (km);

$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – – index, which corresponds to the project scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta W^{P}_{\text{п},F,y,cable,i_3} = \Delta W^{P}_{\text{п},P,y,cable,i_3} \cdot K\Pi^{P}_{R,y,cable,i_3} \quad (30)$$

$\Delta W^{P}_{\text{п},P,y,cable,i_3}$ - Rated specific losses of insulation of cable «i_3» (ths. kWh/km);
$K\Pi^{P}_{R,y,cable,i_3}$ - Degradation factor of cable insulation;
$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – – index, which corresponds to the project scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to replacement of defected insulators of ETL, which are implemented under the project

$$W^{P}_{y,insul} = \sum_{i_4=1}^{I_4} W^{P}_{y,insul,i_4} \quad (31)$$

$W^{P}_{y,insul}$ – Electricity losses due to replacement of defected insulators of ETL, in period «y» in the project scenario (ths. kWh);
$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^{P}_{y,insul,i_4} = \frac{W^{P}_{F,y,insul,i_4} \cdot N^{P}_{y,insul,i_4}}{1000} \quad (32)$$

$W^{P}_{F,y,insul,i_4}$- Actual electricity losses in insulator (kWh per year);
$N^{P}_{y,insul,i_4}$– number of replaced insulators (units);
$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^{P}_{F,y,insul,i_4} = W^{P}_{P,y,insul,i_4} \cdot K\Pi^{P}_{R,y,insul,i_4} \quad (33)$$

$W^{P}_{P,y,insul,i_4}$ - Rated electricity losses in insulator (kWh);
$K\Pi^{P}_{R,y,insul,i_4}$- Magnification factor of losses in insulator;
$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to replacement of signalling lamps with emitting diode, which are implemented under the project

$$W^P_{y,lamp} = \sum_{i_5=1}^{I_5} W^P_{y,lamp,i_5} \tag{34}$$

$W^P_{y,lamp,i_5}$ - Electricity losses due to replacement of signalling lamps with emitting diodes, in period «y» in the project scenario (ths. kWh);
$[lamp]$ – index that corresponds to replacement of signaling lamps with emitting diodes;
$[i_5]$ – index, that corresponds to type of emitting diode that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^P_{y,lamp,i_5} = \frac{P^P_{y,lamp,i_5} \cdot N^P_{y,lamp,i_5} \cdot T^P_{y,lamp,i_5}}{1000} \tag{35}$$

$P^P_{y,lamp,i_5}$ – Power of once signaling lamp or emitting diode (kW);
$N^P_{y,lamp,i_5}$ – Number of replaced signaling lamps (units);
$T^P_{y,lamp,i_5}$ – Operational period of signaling lamps (hour).
$[lamp]$ – index that corresponds to replacement of signaling lamps with emitting diodes;
$[i_5]$ – index, that corresponds to type of emitting diode that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to implementation of reactive power compensation devices at customers place, which are implemented under the project

$$W^P_{y,comp} = \sum_{i_6=1}^{I_6} W^P_{y,comp,i_6} \tag{36}$$

$W^P_{y,comp,i_6}$ – Specific reduction of electricity losses due to implementation of reactive power compensation devices at customers place, in period «y» in the project scenario (kWh/kVAr);
[comp] – index that corresponds to implementation of reactive power compensation device at customers place;
$[i_6]$ –index that corresponds to reactive power compensation device that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^P_{y,comp,i_6} = 0 \tag{37}$$

[comp] – index that corresponds to implementation of reactive power compensation device at customers place;
$[i_6]$ –index that corresponds to reactive power compensation device that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to electricity meters replacement, which are implemented under the project

$$W^P_{y,meter} = \sum_{i_7=1}^{I_7} W^P_{y,meter,i_7} \quad (38)$$

$W^P_{y,meter}$ - Electricity losses due to electricity meters replacement, in period «y» in the project scenario (ths. kWh);

$$W^P_{y,meter,i_7} = \frac{N^P_{y,meter,i_7} \cdot A^P_{F,y,meter,i_7} \cdot T^P_{y,meter,i_7}}{1000} \quad (39)$$

$N^P_{y,meter,i_7}$ – number of replaced meters (units);
$A^P_{F,y,meter,i_7}$ - Actual electricity losses per hour in one meter (kWh);
$T^P_{y,meter,i_7}$ – Operational period of a meter per year (hour);
$[meter]$ –index that corresponds to implemented meters;
$[i_7]$ – index that corresponds to voltage class and type of meter that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$A^P_{F,y,meter,i_7} = A^P_{P,y,meter,i_7} \cdot K\Pi^P_{R,y,meter,i_7} \quad (40)$$

$A^P_{P,y,meter,i_7}$ – Rated electricity losses per hour in one meter (kWh);
$K\Pi^P_{R,y,meter,i_7}$ - Degradation factor of electrical characteristics of a meter;
$[meter]$ –index that corresponds to implemented meters;
$[i_7]$ – index that corresponds to voltage class and type of meter that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to replacement of oil switches with vacuum and sulful hexafluoride switches, which are implemented under the project

$$W^P_{y,switch} = \sum_{i_8=1}^{I_8} W^P_{y,switch,i_8} \quad (41)$$

$W^P_{y,switch}$ - Electricity losses due to replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the project scenario (ths. kWh);

$$W^P_{y,switch,i_8} = \frac{N^P_{y,switch,i_8} \cdot P^P_{y,switch,i_8} \cdot T^P_{y,switch,i_8}}{1000} \quad (42)$$

$N^P_{y,switch,i_8}$ – Number of replaced switches (units.);
$P^P_{y,switch,i_8}$ - Rated power of switch (kW);
$T^P_{y,switch,i_8}$ – Lengh of operation of switch heating system (hour);
$[switch]$ – index that corresponds to implemented switches;

$[i_8]$ – – index that corresponds to voltage class and type of switch that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$T^P_{y,switch,i_8} = N^P_{d,y,switch,i_8} \cdot 24 \quad (43)$$

$N^P_{d,y,switch,i_8}$ – number of days (of switch operation) with temperature below 5 ^{0}C (unts);
$[switch]$ – index that corresponds to implemented switches;
$[i_8]$ – index that corresponds to voltage class and type of switch that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to implementation of new or reconstruction of existing electric motors of power transformers blower cooling, which are implemented under the project

$$W^P_{y,motors} = \sum_{i_9=1}^{I_9} W^P_{y,motors,i_9} \quad (44)$$

$W^P_{y,motors}$ - Electricity losses due to implementation of new or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the project scenario (ths. kWh);

$$W^P_{y,motors,i_9} = \frac{N^P_{y,motors,i_9} \cdot P^P_{y,motors,i_9} \cdot T^P_{y,motors,i_9}}{1000} \quad (45)$$

$N^P_{y,motors,i_9}$ – Number of replaced or reconstructed electrical motors (units);
$P^P_{y,motors,i_9}$ - Power of electrical motor (kW);
$T^p_{y,motors,i_9}$ – Average number of operational hours of electrical motor per year;
$[motors]$ – index that corresponds to implemented or reconstructed electrical motors;
$[i_9]$ – index that corresponds to voltage class and type of electric motor that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$T^P_{y,motors,i_9} = N^P_{d,y,motors,i_9} \cdot 24 \quad (46)$$

$N^P_{d,y,motors,i_9}$ - Number of days (of electrical motor operation) with a temperature below 5 ^{0}C (units);
$[motors]$ – index that corresponds to implemented or reconstructed electrical motors;
$[i_9]$ – index that corresponds to voltage class and type of electric motor that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to replacement or reconstruction of existing electricity lines with distributed load, which are implemented under the project

$$W^P_{y,line(2)} = \sum_{i_{10}=1}^{I_{10}} W^P_{y,line(2),i_{10}} \quad (47)$$

$W^P_{y,line(2),i_{10}}$ – в Electricity losses due to replacement of existing electricity lines with distributed load, in period «y» in the project scenario, (ths. kWh);
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period.

Phase calculation of electricity losses for lines with distributed load

$$W^P_{y,line(2),i_{10}} = \frac{\Delta P^P_{y,line(2),i_{10}} \cdot \tau^P_{y,line(2),i_{10}}}{1000} \quad (48)$$

$\Delta P^P_{y,line(2),i_{10}}$- total power losses in line with distributed load per hour of maximum load (kWh);
$\tau^P_{y,line(2),i_{10}}$ - Number of hours of maximum lossed (hour);
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta P^P_{y,line(2),i_{10}} = \left(\frac{\left(I^P_{y,a,d,line(2),i_{10},(n=1)}\right)^2 \cdot R^P_{y,a,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_A}\left(I^P_{y,a,d,line(2),i_{10},n}\right)^2 \cdot R^P_{y,a,d,line(2),i_{10}} + \sum_{n=1}^{N\_A}\left(I^P_{y,a,v,line(2),i_{10},n}\right)^2 \cdot R^P_{y,a,v,line(2),i_{10}} + \frac{\left(I^P_{y,b,d,line(2),i_{10},n=1}\right)^2 \cdot R^P_{y,b,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_B}\left(I^P_{y,b,d,line(2),i_{10},n}\right)^2 \cdot R^P_{y,b,d,line(2),i_{10}} + \sum_{n=1}^{N\_B}\left(I^P_{y,b,v,line(2),i_{10},n}\right)^2 \cdot R^P_{y,b,v,line(2),i_{10}} + \frac{\left(I^P_{y,c,d,line(2),i_{10},n=1}\right)^2 \cdot R^P_{y,c,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_C}\left(I^P_{y,c,d,line(2),i_{10},n}\right)^2 \cdot R^P_{y,c,d,line(2),i_{10}} + \sum_{n=1}^{N\_C}\left(I^P_{y,c,v,line(2),i_{10},n}\right)^2 \cdot R^P_{y,c,v,line(2),i_{10}}\right) \cdot k^P_{n,y,line(2),i_{10}} \quad (49)$$

$I^P_{y,a,d,line(2),i_{10},n=1}$ – current of section, phase A at hours of maximum load (A);
$R^P_{y,a,d,line(2),i_{10}}$ – resistance of section, phase A at hours of maximum loads (Ohm/km);
$I^P_{y,a,d,line(2),i_{10},n}$ – current of section, phase A at hours of maximum load (A);
$I^P_{y,a,v,line(2),i_{10},n}$ – current of branch, phase A at hours of maximum load (A);
$R^P_{y,a,v,line(2),i_{10},n}$ – average resistance of branch, phase A at hours of maximum loads (Ohm/km);

$I^P_{y,b,d,\,line(2),i_{10},n=1}$ – current of section, phase B at hours of maximum load (A);
$R^P_{y,b,d,line(2),i_{10}}$ – resistance of section, phase B at hours of maximum loads (Ohm/km);
$I^P_{y,b,d,\,line(2),i_{10},n}$ – current of section, phase B at hours of maximum load (A);
$I^P_{y,b,v,line(2),i_{10},n}$ - current of branch, phase B at hours of maximum load (A);
$R^P_{y,b,v,\,line(2),i_{10},n}$ - average resistance of branch, phase B at hours of maximum loads (Ohm/km);
$I^P_{y,c,d,\,line(2),i_{10},n=1}$ – current of section, phase C at hours of maximum load (A);
$R^P_{y,c,d,line(2),i_{10}}$ – resistance of section, phase C at hours of maximum loads (Ohm/km);
$I^P_{y,c,d,\,line(2),i_{10},n}$ – current of section, phase C at hours of maximum load (A);
$I^P_{y,c,v,line(2),i_{10},n}$ - current of branch, phase C at hours of maximum load (A);
$R^P_{y,c,v,\,line(2),i_{10}}$ - average resistance of branch, phase C at hours of maximum loads (Ohm/km);
$k^P_{n,y,line(2),i_{10}}$ – unsymmetry factor.

$$I^P_{y,a,d,\,line(2),i_{10},(n=1)} = I^P_{y,a,d,\,line(2,),i_{10},gd} \qquad (50)$$

$I^P_{y,a,d,\,line(2),i_{10},gd}$ – Current of the main area (at the outlet of a transformer) of phase wire of phase A (A);

$$R^P_{y,a,d,\,line(2),i_{10}} = \frac{R^P_{y,a,d\;line(2),i_{10},\,droty} \cdot L^P_{y,a,\,line(2),i_{10}}}{N^P_{y,a,d,\,line(2),i_{10}}} \qquad (51)$$

$R^P_{y,a,d\;line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase A (Ohm/km);
$L^P_{y,a,line(2),i_{10}}$ – Length of line with distributed load of phase A (km);
$N^P_{y,a,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase A (units);

$$I^P_{y,a,d,\,line(2),i_{10},\,n} = I^P_{y,a,d,\,line(2),i_{10},(n\text{-}1)} - I^P_{y,a,v,\,line(2),i_{10},(n\text{-}1)} \qquad (52)$$

$I^P_{y,a,d,\,line(2),i_{10},(n\text{-}1)}$ – Current of a previous section, phase wire of phase A of a line with distributed load (A);
$I^P_{y,a,v,\,line(2),i_{10},(n\text{-}1)}$ – Current of branch, phase wire of phase A of a line with distributed load (A);

$$I^P_{y,a,v,line(2),i_{10},\,n} = \frac{U^P_{y,a,v,\,line(2),i_{10},\,n}}{\left(R^P_{y,a,v,\,line(2),i_{10}} + R^P_{y,a,nav,\,line(2),i_{10}}\right)} \qquad (53)$$

$U^P_{y,a,v,\,line(2),i_{10},\,n}$ - Voltage of branch “n”, phase wire of phase A (kV);
$R^P_{y,a,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase A (Ohm/km);
$R^P_{y,a,nav,\,line(2),i_{10}}$ – Load resistance of phase wire of phase A (kW);

$$U^P_{y,a,d,\,line(2),i_{10},\,n} = U^P_{y,a,d,\,line(2),i_{10}(n\text{-}1)} - I^P_{y,a,d,\,line(2),i_{10},\,n} \cdot R^P_{y,a,d,\,line(2),i_{10}} \;(\text{для } n > 1) \qquad (54)$$

$U^{P}_{y,a,d,\,line(2),i_{10}(n\text{-}1)}$ - Voltage of a previous section, phase wire of phase A (kV);

$I^{P}_{y,a,d,\,line(2),i_{10},\,n}$ – Current of branch «n», phase wire of phase A (A);

$R^{P}_{y,a,d,\,line(2),i_{10}}$ – Resistance of section, phase wire of phase A (Ohm);

$$U^{P}_{y,a,d,\,line(2),i_{10},\,n=1} = U^{P}_{y,a,d,\,line(2),i_{10},\,vh} - I^{P}_{y,a,d,\,line(2),i_{10},\,n=1} \cdot R^{P}_{y,a,d,\,line(2),i_{10}} \quad (55)$$

$U^{P}_{y,a,d,\,line(2),i_{10},\,vh}$ - Voltage at the entrance of the first section, phase wire of phase A (kV);

$I^{P}_{y,a,d,\,line(2),i_{10},\,n=1}$ – Current of the first section, phase wire of phase A (A);

$[i_{10}]$ – index that corresponds to certain scheme;

$[P]$ – index, which corresponds to the project scenario;

$[line(2)]$ – index, which corresponds to line with distributed load;

$[y]$ – index which corresponds to the monitoring period;

[a] – index that corresponds to phaseA (ETL);

$[n]$ – index that corresponds to number of section;

$[d]$ – index that corresponds to calculation of section;

$[v]$ – index that corresponds to calculation of branch.

$$I^{P}_{y,b,d,\,line(2),i_{10},(n=1)} = I^{P}_{y,b,d,\,line(2,),i_{10},gd} \quad (56)$$

$I^{P}_{y,b,d,\,line(2),i_{10},gd}$ – Current of the main area (at the outlet of a transformer) of phase wire of phase B (A);

$$R^{P}_{y,b,d,\,line(2),i_{10}} = \frac{R^{P}_{y,b,d\,line(2),i_{10},\,droty} \cdot L^{P}_{y,b,\,line(2),i_{10}}}{N^{P}_{y,b,d,\,line(2),i_{10}}} \quad (57)$$

$R^{P}_{y,b,d\,line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase B (Ohm/km);

$L^{P}_{y,b,line(2),i_{10}}$ – Length of line with distributed load of phase B (km);

$N^{P}_{y,b,,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase B (units);

$$I^{P}_{y,b,d,\,line(2),i_{10},\,n} = I^{P}_{y,b,d,\,line(2),i_{10},(n\text{-}1)} - I^{P}_{y,b,v,\,line(2),i_{10},(n\text{-}1)} \quad (58)$$

$I^{P}_{y,b,d,\,line(2),i_{10},(n\text{-}1)}$ – Current of a previous section, phase wire of phase B of a line with distributed load (A);

$I^{P}_{y,b,v,\,line(2),i_{10},(n\text{-}1)}$ – Current of branch, phase wire of phase B of a line with distributed load (A);

$$I^{P}_{y,b,v,line(2),i_{10},\,n} = \frac{U^{P}_{y,b,v,\,line(2),i_{10},\,n}}{\left(R^{P}_{y,b,v,\,line(2),i_{10}} + R^{P}_{y,b,nav,\,line(2),i_{10}}\right)} \quad (59)$$

$U^{P}_{y,b,v,\,line(2),i_{10},\,n}$ - Voltage of branch “n”, phase wire of phase B (kV);

$R^{P}_{y,b,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase B (Ohm/km);

$R^{P}_{y,b,nav,\, line(2),i_{10}}$ – Load resistance of phase wire of phase B (kW);

$$U^{P}_{y,b,d,\, line(2),i_{10},\, n} = U^{P}_{y,b,d,\, line(2),i_{10}(n-1)} - I^{P}_{y,b,d,\, line(2),i_{10},\, n} \cdot R^{P}_{y,b,d,\, line(2),i_{10}} \text{ (для } n > 1) \quad (60)$$

$U^{P}_{y,b,d,\, line(2),i_{10}(n-1)}$ - Voltage of a previous section, phase wire of phase B (kV)

$I^{P}_{y,b,d,\, line(2),i_{10},\, n}$ - Current of branch «n», phase wire of phase B (A);

$R^{P}_{y,b,d,\, line(2),i_{10}}$ - Resistance of section, phase wire of phase B (Ohm);

$$U^{P}_{y,b,d,\, line(2),i_{10},\, n=1} = U^{P}_{y,b,d,\, line(2),i_{10},\, vh} - I^{P}_{y,b,d,\, line(2),i_{10},\, n=1} \cdot R^{P}_{y,b,d,\, line(2),i_{10}} \quad (61)$$

$U^{P}_{y,b,d,\, line(2),i_{10},\, vh}$ - Voltage at the entrance of the first section, phase wire of phase B (kV);

$I^{P}_{y,b,d,\, line(2),i_{10},\, n=1}$ – Current of the first section, phase wire of phase B (A);

$[i_{10}]$ – index that corresponds to certain scheme;

$[P]$ – index, which corresponds to the project scenario;

$[line(2)]$ – index, which corresponds to line with distributed load;

$[y]$ – index which corresponds to the monitoring period;

[в] – index that corresponds to phaseB (ETL);

$[n]$ – index that corresponds to number of section;

$[d]$ – index that corresponds to calculation of section;

$[v]$ – index that corresponds to calculation of branch.

$$I^{P}_{y,c,d,\, line(2),i_{10},(n=1)} = I^{P}_{y,c,d,\, line(2,),i_{10},gd} \quad (62)$$

$I^{P}_{y,c,d,\, line(2),i_{10},gd}$ – Current of the main area (at the outlet of a transformer) of phase wire of phase C (A);

$$R^{P}_{y,c,d,\, line(2),i_{10}} = \frac{R^{P}_{y,c,d\, line(2),i_{10},\, droty} \cdot L^{P}_{y,c,\, line(2),i_{10}}}{N^{P}_{y,c,d,\, line(2),i_{10}}} \quad (63)$$

$R^{P}_{y,c,d\, line(2),i_{10},\, droty}$ - Resistance of one kilometre of wire of corresponding mark of phase C (Ohm/km);

$L^{P}_{y,c,line(2),i_{10}}$ – Length of line with distributed load of phase C (km);

$N^{P}_{y,c,d,\, line(2),i_{10}}$ – Number of sections (branch connections) of phase C (units);

$$I^{P}_{y,c,d,\, line(2),i_{10},\, n} = I^{P}_{y,c,d,\, line(2),i_{10},(n-1)} - I^{P}_{y,c,v,\, line(2),i_{10},(n-1)} \quad (64)$$

$I^{P}_{y,c,d,\, line(2),i_{10},(n-1)}$ – Current of a previous section, phase wire of phase C of a line with distributed load (A);

$I^{P}_{y,c,v,\, line(2),i_{10},(n-1)}$ – Current of branch, phase wire of phase C of a line with distributed load (A);

$$I^{P}_{y,c,v,line(2),i_{10},\, n} = \frac{U^{P}_{y,c,v,\, line(2),i_{10},\, n}}{\left(R^{P}_{y,c,v,\, line(2),i_{10}} + R^{P}_{y,c,nav,\, line(2),i_{10}}\right)} \quad (65)$$

$U^{P}_{y,c,v,\, line(2),i_{10},\, n}$ - Voltage of branch "n", phase wire of phase C (kV);
$R^{P}_{y,c,v,\, line(2),i_{10}}$ - Average resistance of a branch, phase C (Ohm/km);
$R^{P}_{y,c,nav,\, line(2),i5}$ – Load resistance of phase wire of phase C (kW);

$$U^{P}_{y,c,d,\, line(2),i_{10},\, n} = U^{P}_{y,c,d,\, line(2),i_{10},(n-1)} - I^{P}_{y,c,d,\, line(2),i_{10},\, n} \cdot R^{P}_{y,c,d,\, line(2),i_{10}} \text{ (для } n > 1) \quad (66)$$

$U^{P}_{y,c,d,\, line(2),i_{10},(n-1)}$ - Load resistance of phase wire of phase C (kW);
$I^{P}_{y,c,d,\, line(2),i_{10},\, n}$ - Current of branch «n», phase wire of phase C (A);
$R^{P}_{y,c,d,\, line(2),i_{10}}$ - Resistance of section, phase wire of phase C (Ohm);

$$U^{P}_{y,c,d,\, line(2),i_{10},\, n=1} = U^{P}_{y,c,d,\, line(2),i_{10},\, vh} - I^{P}_{y,c,d,\, line(2),i_{10},\, n=1} \cdot R^{P}_{y,c,d,\, line(2),i_{10}} \quad (67)$$

$U^{P}_{y,c,d,\, line(2),i_{10},\, vh}$ - Voltage at the entrance of the first section, phase wire of phase C (kV);
$I^{P}_{y,c,d,\, line(2),i_{10},\, n=1}$ – Current of the first section, phase wire of phase C (A);
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period;
[c] – index that corresponds to phase C (ETL);
$[n]$ – index that corresponds to number of section;
$[d]$ – index that corresponds to calculation of section;
$[v]$ – index that corresponds to calculation of branch.

$$k^{P}_{n,y,line(2),i_{10}} = 3 \cdot \frac{I^{2P}_{A,y,line(2),i_{10}} + I^{2P}_{B,y,line(2),i_{10}} + I^{2P}_{C,y,line(2),i_{10}}}{\left(I^{P}_{A,y,line(2),i_{10}} + I^{P}_{B,y,line(2),i_{10}} + I^{P}_{C,y,line(2),i_{10}}\right)^{2}} \cdot 1 + 1.5 \cdot \frac{R^{P}_{0,y,line(2),i_{10}}}{R^{P}_{\phi,y,line(2),i_{10}}} - 1.5 \cdot \frac{R^{P}_{0,y,line(2),i_{10}}}{R^{P}_{\phi,y,line(2),i_{10}}} \quad (68)$$

$I^{P}_{A,y,line(2),i_{10}}$ – current of phase A ETL «i_{10}» (A);
$I^{P}_{B,y,line(2),i_{10}}$ – current of phase B ETL «i_{10}» (A);
$I^{P}_{C,y,line(2),i_{10}}$ – current of phase C ETL «i_{10}» (A);
$R^{P}_{0,y,line(2),i_{10}}$ – resistance of zero wire of corresponding section «i_{10}» ETL (Ohm);
$R^{P}_{\phi,y,line(2),i_{10}}$- resistance of phase wire of corresponding section «i_{10}» ETL (Ohm);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,line(2),i_{10}} = R^{P}_{0n,y,line(2),i_{10}} \cdot L^{P}_{y,line(2),i_{10}} \quad (69)$$

$R^{P}_{0n,y,line(2),i_{10}}$ - Specific resistance of zero wire of line with distributed load (Ohm/km);
$L^{P}_{y,line(2),i_{10}}$ - Length of line with distributed load (km);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{\phi,y,line(2),i_{10}} = R^{P}_{\phi n,y,line(2),i_{10}} \cdot L^{P}_{y,line(2),i_{10}} \quad (70)$$

$R^{P}_{\phi n,y,line(2),i_{10}}$ - Specific resistance of phase wire of line with distributed load (Ohm/km);
$L^{P}_{y,line(2),i_{10}}$ - Length of line with distributed load (km);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$\tau^{P}_{y,line(2),max,i_{10}} = 2 \cdot T^{M}_{y,line(2),i_{10}} - 8760 + \frac{8760 - T^{M}_{y,line(2),i_{10}}}{1 + \frac{T^{M}_{y,line(2),i_{10}}}{8760} - 2 \cdot \frac{P^{P}_{y,line(2),min,i_{10}}}{P^{P}_{y,line(2),max,i_{10}}}} \cdot \left(1 - \frac{P^{P}_{y,line(2),min,i_{10}}}{P^{P}_{y,line(2),max,i_{10}}}\right) \quad (71)$$

$T^{M}_{y,line(2),i_{10}}$ - Annual number of hours of use of maximum active power of line with distributed load (hour);
$P^{P}_{y,line(2),max,i_{10}}$ - Power that is transported by «i» (lines with distributed load) in an hour of maximum load (kW);
$P^{P}_{y,line(2),min,i_{10}}$ - Power that is transported by «i» (lines with distributed load) in an hour of minimum load (kW);
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[y]$ – index which corresponds to the monitoring period.

Calculation of electricity losses with the help of equivalent resistance of line with distributed load

$$W^{P}_{y,line(2),i_{10}} = \frac{\left(\frac{P^{P}_{y,line(2),max,i_{10}}}{U^{P}_{y,line(2),max,i_{10}} \cdot cos\varphi^{P}_{y,line(2),i_{10}}}\right)^{2} \cdot R^{P}_{ekv,y,line(2),i_{10}} \cdot k^{P}_{n,y,line(2),i_{10}} \cdot \tau^{P}_{y,line(2),max,i_{10}}}{1000} \quad (72)$$

$P^{P}_{y,line(2),max,i_{10}}$ – power during maximum load (kW);

$U^{P}_{y,line(2),max,i_{10}}$ - Voltage at the entrance of line during maximum load (V);
$cos\varphi^{P}_{y,line(2),i_{10}}$ - Cosine of the angle between active and gross power during maximum load of line with distributed load;
$R^{P}_{ekv,y,line(2),i_{10}}$ – equivalent resistance of electricity transmission line with distributed load (Ohm);
$k^{P}_{n,y,line(2),i_{10}}$ – unsymmetry factor (for one phase branch is equal to 1);
$\tau^{P}_{y,line(2),max,i_{10}}$ – period of maximum losses in line with distributed load (hour).
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[max]$ – index that corresponds to maximum;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{ekv,y,line(2),i_{10}} = 1.33\frac{\rho^{P}_{Al,y,line(2),i_{10}} \cdot k^{P}_{Cu,y,line(2),i_{10}}}{P^{2\,P}_{l,y,line(2),i_{10}}} \cdot \sum_{n=1}^{N} \frac{P^{2\,P}_{n,y,line(2),i_{10}} \cdot L^{P}_{n,y,line(2),i_{10}}}{F^{P}_{n,y,line(2),i_{10}}} \qquad (73)$$

1.33 – coefficient that accounts for systemic lowering of result of equivalent resistance calculation;
$\rho^{P}_{Al,y,line(2),i_{10}}$ – specific resistance of alluminium for lines with distributed load (Ohm·mm^2/m);
$k^{P}_{Cu,y,line(2),i_{10}}$ - Factor that accounts partial use of copper wires in lines with distributed load;
$P^{P}_{l,y,line(2),i_{10}}$ - Power at the entrance of electricity transmission line (kW);
$P^{P}_{n,y,line(2),i_{10}}$ - Power than runs in the section "n" (kW);
$F^{P}_{n,y,line(2),i_{10}}$ – section of wire of section n for lines with distributed load (mm^2);
$L^{P}_{n,y,line(2),i_{10}}$ - Length between the beginning of a line and point of consumer connection (m).
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses due to implementation of new or reconstruction of existing branches, which are implemented under the project

$$W^{P}_{y,branch} = \sum_{i_{11}=1}^{I_{11}} W^{P}_{y,branch,i_{11}} \qquad (74)$$

$W^{P}_{y,branch,i_{11}}$ – Electricity losses due to implementation of new or reconstruction of existing branches, in period «y» in the project scenario (ths. kWh);
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;

$[branch]$ – index that corresponds to new or reconstructed branches;
$[y]$ – index which corresponds to the monitoring period.

$$W^P_{y,branch,i_{11}} = \frac{\left(\frac{P^P_{y,branch,max,i_{11}}}{U^P_{y,branch,max,i_{11}} \cdot cos\varphi^P_{y,branch,i_{11}}}\right)^2 \cdot R^P_{y,branch,i_{11}} \cdot k^P_{n,y,branch,i_{11}} \cdot \tau^P_{y,branch,max,i_{11}}}{1000} \quad (75)$$

$P^P_{y,branch,max,i_{11}}$ - Power that is transported by "i_{11}" (branch) in hour of maximum load (kW);
$U^P_{y,branch,max,i_{11}}$ - Voltage at the entrance of line during maximum load (V);
$cos\varphi^P_{y,branch,i_{11}}$ - Cosine of the angle between active and gross power in branch during maximum load;
$R^P_{y,branch,i_{11}}$ – Resistance of branch of electricity transmission line (Ohm);
$k^P_{n,y,branch,i_{11}}$ – Unsymmetry factor (for one-phase branch is equal to 1);
$\tau^P_{y,branch,max,i_{11}}$ – Duration of maximum losses in branches (hour).
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[branch]$ – index that corresponds to new or reconstructed branches;
$[max]$ – index that corresponds to maximum;
$[y]$ – index which corresponds to the monitoring period.

$$R^P_{ekv,y,branch,i_{11}} = 1.33 \frac{\rho^P_{Al,y,branch,i_{11}} \cdot k^P_{Cu,y,branch,i_{11}}}{P^{2\,P}_{l,y,branch,i_{11}}} \cdot \sum_{n=1}^{N} \frac{P^{2\,P}_{n,y,branch,i_{11}} \cdot L^P_{n,y,branch,i_{11}}}{F^P_{n,y,branch,i_{11}}} \quad (76)$$

1.33 - coefficient that accounts for systemic lowering of result of equivalent resistance calculation;
$\rho^P_{Al,y,branch,i_{11}}$ - specific resistance of alluminium for branches (Ohm·mm^2/m);
$k^P_{Cu,y,branch,i_{11}}$ - Factor that accounts partial use of copper wires in branches;
$P^P_{l,y,branch,i_{11}}$ - Power at the entrance of electricity transmission line (kW);
$P^P_{n,y,branch,i_{11}}$ - Power than runs in the section "n" for branches (kW);
$F^P_{n,y,branch,i_{11}}$ - section of wire of section n (mm^2);
$L^P_{n,y,branch,i_{11}}$ - Length between the beginning of a line and point of consumer connection (m).
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[branch]$ – index that corresponds to new or reconstructed branches;
$[y]$ – index which corresponds to the monitoring period.

$$k^P_{n,y,branch,i_{11}} = 3 \cdot \frac{I^{2P}_{A,y,branch,i_{11}} + I^{2P}_{B,y,branch,i_{11}} + I^{2P}_{C,y,branch,i_{11}}}{\left(I^P_{A,y,branch,i_{11}} + I^P_{B,y,branch,i_{11}} + I^P_{C,y,branch,i_{11}}\right)^2} \cdot 1 + 1.5 \cdot \frac{R^P_{0,y,branch,i_{11}}}{R^P_{\phi,y,branch,i_{11}}} - 1.5 \cdot \frac{R^P_{0,y,branch,i_{11}}}{R^P_{\phi,y,branch,i_{11}}} \quad (77)$$

$I^{P}_{A,y,branch,i_{11}}$ - Current of phase A of ETL «i_{11}» (A);
$I^{P}_{B,y,branch,i_{11}}$ - Current of phase B of ETL «i_{11}» (A);
$I^{P}_{C,y,branch,i_{11}}$ - Current of phase C of ETL «i_{11}» (A);
$R^{P}_{0,y,branch,i_{11}}$ – resistance of zero wire of corresponding section «i_{11}» ETL (Ohm);
$R^{P}_{\phi,y,branch,i_{11}}$- – resistance of phase wire of corresponding section «i_{11}» ETL (Ohm);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new or reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,branch,i_{11}} = R^{P}_{0n,y,branch,i_{11}} \cdot L^{P}_{y,branch,i_{11}} \quad (78)$$

$R^{P}_{0n,y,branch,i_{11}}$ - Specific resistance of zero wire of branch (Ohm/km);
$L^{P}_{y,branch,i_{11}}$ - Length of branches (km);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new or reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{\phi,y,branch,i_{11}} = R^{P}_{\phi n,y,branch,i_{11}} \cdot L^{P}_{y,branch,i_{11}} \quad (79)$$

$R^{P}_{\phi n,y,branch,i_{11}}$ - Specific resistance of phase wire of branches (Ohm/km);
$L^{P}_{y,branch,i_{11}}$ - Length of branches (km);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new or reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$\tau^{P}_{y,branch,max,i_{11}} = 2 \cdot T^{M}_{y,branch,i_{11}} - 8760 + \frac{8760 - T^{M}_{y,branch,i_{11}}}{1 + \frac{T^{M}_{y,branch,i_{11}}}{8760} - 2 \cdot \frac{P^{P}_{y,branch,min,i_{11}}}{P^{P}_{y,branch,max,i_{11}}}} \cdot \left(1 - \frac{P^{P}_{y,branch,min,i_{11}}}{P^{P}_{y,branch,max,i_{11}}}\right) \quad (80)$$

$T^{M}_{y,branch,i_{11}}$ - Annual number of hours of maximum active power use in ETL «i» (hour);
$P^{P}_{y,branch,max,i_{11}}$ - Power that is transported by «i_{11}» (branch) in an hour of maximum load (kW);
$P^{P}_{y,branch,min,i_{11}}$ - Power that is transported by «i_{11}» (branch) in an hour of minimum load (kW);
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;

$[branch]$ – index that corresponds to to new or reconstructed branches;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[y]$ – index which corresponds to the monitoring period.

GHG emissions due to reconstruction of existing segments of electrical grids in period «y» in the project scenario

$$PE^{P}_{y,segm} = \sum_{i_{12}=1}^{I_{12}} \sum_{n=1}^{N} W^{P}_{y.n.(segm\,n).i_{12}} \cdot EF \qquad (81)$$

$W^{P}_{y.n.(segm\,n).i_{12}}$- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[i_{12}]$ – index that corresponds to certain scheme;
$[segm\,n]$ – index of grid element belonging to the set of elements considered in the project, that identifies it in terms of methods of calculating energy losses in the network elements identified in the project
$[P]$ – index, which corresponds to the project scenario;
$[n]$ – number of element of grid segment, that existed before reconstruction of segment in it;
$[y]$ – index which corresponds to the monitoring period.

GHG emissions due to systemic effect from implementation of new or reconstruction of existing elements and segments of electrical grid that are implemented under the project

$$PE^{P}_{y,system} = W^{P}_{y,system} \cdot \mathrm{EF} \qquad (82)$$

$W^{P}_{y,system}$ - Electricity losses due to systemic effect due to implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the project scenario (ths. kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID Number (Please use numbers to ease cross-referencing to D.2.)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
16	$S^{P}_{T,y,tran(2),i}$ - Nominal load of a double-winding transformer "i" on the side of high voltage	Nameplate data of equipment	(kVA)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
16.1	$\Delta P^{B}_{XX,P,y,tran(2),i}$ - Rated power losses of no-load run in a double-winding transformer «i»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
16.2	$K\Pi^{B}_{XX,y,tran(2),i}$ - Degradation factor of no-load run losses in a double-winding transformer "i"	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
16.3	$\Delta P^{B}_{кз,P,y,tran(2),i}$ - Rated power losses of short circuit in a double-winding transformer «i»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Фіксоване значення, яке не змінюється протягом реалізації проектної діяльності
16.4	$K\Pi^{B}_{кз,y,tran(2),i}$ -	Determined with the help of		e	annually	100%	In	Determined

	Degradation factor of short-circuit losses in a double-winding transformer "i"	«Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»					electronic and paper forms	according to company data
16.5	$P^{P}_{y,tran(2),max,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
16.6	$cos\varphi^{P}_{y,tran(2),i}$ - Cosine of the angle between active and gross power in a double-winding transformer «i»	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
16.7	$T^{M}_{y,tram(2),i}$ – Annual number of hours of maximum power use in transformer "i"		(hour)	m	annually	100%	In electronic and paper forms	Company data
16.8	$P^{P}_{y,tran(2),min,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
16.9	$I^{P}_{A,y,tran(2),i}$- Current of phase A in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
16.10	$I^{P}_{B,y,tran(2),i}$- Current of phase B in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data

16.11	$I^{P}_{C,y,tran(2),i}$- Current of phase C in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
16.12	$R^{P}_{0n,y,tran(2),i}$ - Specific resistance of zero wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
16.13	$L^{P}_{y,tran(2),i}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
16.14	$R^{P}_{\phi n,y,tran(2),i}$ - Specific resistance of phase wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
17	$S^{P}_{T,y,tran(3),i_1}$ - Nominal load of a three-winding transformer «i_1»	Nameplate data of equipment	(kVA)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
17.1	$\Delta P^{B}_{XX,P,y,tran(3),i_1}$ - Rated power losses of no-load run in a three-winding transformer «i_1»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
17.2	$K\Pi^{B}_{XX,y,tran(3),i_1}$ -	Determined with the help of		e	annually	100%	In	Determined

	Degradation factor of no-load run losses in a three-winding transformer	«Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»					electronic and paper forms	according to company data
17.3	$\Delta P^{B}_{кз,P,y,tran(3.1),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of high voltage	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
17.4	$\Delta P^{B}_{кз,P,y,tran(3.2),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of medium voltage, nameplate	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
17.5	$\Delta P^{B}_{кз,P,y,tran(3.3),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of low voltage, nameplate	Nameplate data of equipment	(kW)	m	Once at the beginning of the project	100%	In electronic and paper forms	Company data
17.6	$K\Pi^{B}_{кз,y,tran(3),i_1}$ - Degradation factor of short-circuit losses in a three-winding transformer	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
17.7	$P^{P}_{y,tran(3),max,i_1}$ – Power of a three-winding transformer "i_1" in an hour	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data

	of maximum load							
17.8	$cos\varphi^{P}_{y,tran(3.1),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of high voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
17.9	$cos\varphi^{P}_{y,tran(3.2),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of medium voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
17.10	$cos\varphi^{P}_{y,tran(3.3),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of low voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
17.11	$P^{P}_{y,tran(3),min,i_1}$– Power of a three-winding transformer "i_1" in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
17.12	$T^{M}_{y,tran(3),i_1}$– Number of hours of maximum power use of windings of a three-winding transformer	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
18	$P^{P}_{y,line(1),max,i_2}$– Power of ETL «$i_2$» during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data

18.1	$U^{P}_{y,line(1),max,i_2}$– Voltage of ETL «*i*» during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
18.2	$cos\varphi^{P}_{y,line(1),i_2}$ – Cosine of the angle between active and gross power in ETL	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
18.3	$R^{B}_{f,y,line(1),max,i_2}$ – Specific resistance of phase wire in ETL	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
18.4	$L^{B}_{y,line(1),max,i_2}$– Length of ETL	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
18.5	$P^{P}_{y,line(1),min,i_2}$ – Power that is transported by ETL «i_2» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
18.6	$T^{M}_{y,line(1),i_2}$ – річна Annual number of hours of maximum active power use in ETL «i_2»	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
18.7	$I^{P}_{A,y,line(1),i_2}$ - Current of	To measure current ammeter or galvanometer	(A)	m	annually	100%	In electronic	Company data

	phase A of ETL «i_2»	are used					and paper forms	
18.8	$I^P_{B,y,line(1),i_2}$ - Current of phase B of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
18.9	$I^P_{C,y,line(1),i_2}$ - Current of phase C of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
18.10	$R^P_{0n,y,line(1),i_2}$ - Specific resistance of zero wire in ETL	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
19	$L^B_{y,cable,i_3}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
19.1	$\Delta W^B_{\text{п},P,y,cable,i_3}$ - Rated specific losses of insulation of cable «i_3», nameplate	Nameplate data of equipment	(ths. kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
19.2	$K\Pi^B_{R,y,cable,i_3}$ - Degradation factor of cable insulation	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data

20	$N^{B}_{y,insul,i_4}$ – Number of replaced insulators	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
20.1	$W^{B}_{P,y,insul,i_4}$ - Rated electricity losses in insulator, nameplate	Nameplate data of equipment	(kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
20.2	$K\Pi^{B}_{R,y,insul,i_4}$ - Magnification factor of losses in insulator	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
21	$P^{B}_{y,lamp,i_5}$ – power of on signaling lanm or emitting diode	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
21.1	$N^{B}_{y,lamp,i_5}$ - Number of replaced signalling lamps	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
21.2	$T^{P}_{y,lamp,i_5}$ - Operational period of signalling lamps	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
22.1	$\Delta W^{B}_{0.38,y,comp,i_6}$ - Specific reduction of losses at voltage of 0,38 kV,	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the	100%	In electronic and paper forms	Company data

					project			
22.2	$\Delta W^{B}_{6-20,y,comp,i_6}$ - Specific reduction of losses at voltage of 6 – 20 kV	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
22.3	$\Delta W^{B}_{35-154,y,comp,i_6}$ - Specific reduction of losses at voltage of 35 – 154 kV	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
23	$N^{B}_{y,meter,i_7}$ – Number of replaced meters	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
23.1	$T^{P}_{y,meter,i_7}$ – Operational period of a meter per year	Hour-based schedule of power of a working day in a month	(unit)	m	annually	100%	In electronic and paper forms	Company data
23.2	$A^{B}_{P,y,meter,i_7}$ – Rated electricity losses per hour in one meter	Nameplate data of equipment	(kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
23.3	$K\Pi^{B}_{R,y,meter,i_7}$ - Degradation factor of electrical characteristics of a meter	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Determined according to company data
24	$N^{B}_{y,switch,i_8}$ – Number of replaced switches	Act of working technical commission on acceptance	(unit)	m	annually	100%	In electronic	Company data

		into operation of distribution electrical grids facilities					and paper forms	
24.1	$P^{B}_{y,switch,i_8}$ - Rated power of a switch	Nameplate data of equipment	(kW)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
24.2	$N^{B}_{d,y,switch,i_8}$ - Number of days (of switches operation) with a temperature below 5 ^{0}C	Data on meteorological phenomena that were observed by a meteorological station	(unit)	m	annually	100%	In electronic and paper forms	Company data
25	$N^{B}_{y,motors,i_9}$ – Number of replaced or reconstructed electrical motors	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
25.1	$P^{B}_{y,motors,i_9}$ - Power of a motor	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
25.2	$N^{B}_{d,y,motors,i_9}$ - Number of days (of electric motors operation) with a temperature below 5 ^{0}C	Data on meteorological phenomena that were observed by a meteorological station	(unit)	m	annually	100%	In electronic and paper forms	Company data
26	$R^{B}_{y,a,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase A per hour og maximum load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.1	$R^{B}_{y,b,v,\,line(2),i_{10}}$ - Average resistance of a branch,	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper	If it is impossible to carry out

	phase B, per hour of maximum load						forms	measurements passport data of equipment are used
26.2	$R^{B}_{y,c,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase C, per hour of maximum load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.3	$R^{B}_{y,a,nav,\,line(2),i_{10}}$ - Load resistance of phase wire of phase A	To measure voltage of ETL ohmmeter is used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.4	$R^{B}_{y,a,d\ line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase A	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.5	$L^{B}_{y,a,line(2),i_{10}}$ – Length of line with distributed load of phase A	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
26.6	$N^{B}_{y,a,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase A	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
26.7	$I^{B}_{y,a,d,\,line(2),i_{10},(n+1)}$ – Current of a previous section, phase wire of	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper	Company data

	phase B of a line with distributed load						forms	
26.8	$U^{B}_{y,a,d,\ line(2),i_{10}}(n+1)$ – voltage of the next branch «n», phase wire of phase A	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.9	$I^{B}_{y,a,d,\ line(2),i_{10},\ (n+1)}$ – Current of the next branch «n», phase wire of phase A	To measure current voltmeter is used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.10	$U^{P}_{y,a,v,\ line(2),i_{10},\ n=N}$ – Voltage of the last branch, phase wire of phase A in the time of maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.11	$R^{B}_{y,b,nav,\ line(2),i_{10}}$ - Load resistance, phase wire of phase B	To measure Load resistance at ETL ohmmeter is used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.12	$R^{B}_{y,b,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase B	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.13	$L^{B}_{y,b,line(2),i_{10}}$ – Length of line with distributed load of phase B	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
26.14	$N^{B}_{y,b,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase B	Act of working technical commission on acceptance into operation of distribution electrical grids	(unit)	m	annually	100%	In electronic and paper forms	Company data

		facilities						
26.15	$I^{B}_{y,b,d,\ line(2),i_{10},(n+1)}$ – Current of the next section, phase wire of phase B of line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.16	$U^{B}_{y,b,d,\ line(2),i_{10}\,(n+1)}$ – Voltage of the next branch «n», phase wire of phase B	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.17	$I^{B}_{y,b,d,\ line(2),i_{10},\ (n+1)}$ – current of the next branch «n», phase wire of phase B	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.18	$U^{P}_{y,b,v,\ line(2),i_{10},\ n=N}$ - Voltage of the last branch, phase wire of phase B in the time of manimum loads	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.19	$R^{P}_{y,c,nav,\ line(2),i_{10}}$ - Load resistance of phase wire of phase C	To measure Load resistance at ETL ohmmeter is used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.20	$R^{B}_{y,c,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase C	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.21	$L^{B}_{y,c,line(2),i_{10}}$ – Length of line with distributed load of phase C	Act of state acceptance commission on the acceptance into operation of the completed construction	(km)	m	annually	100%	In electronic and paper forms	Company data

		of a facility						
26.22	$N^{B}_{y,c,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase C	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually	100%	In electronic and paper forms	Company data
26.23	$I^{B}_{y,c,d,\ line(2),i_{10},(n+1)}$ – Current of the next section, phase wire of phase C of line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.24	$U^{B}_{y,c,d,\ line(2),i_{10}(n+1)}$ – Voltage of the next branch «n», phase wire of phase C	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.25	$I^{B}_{y,c,d,\ line(2),i_{10},\ (n+1)}$ – current of the next branch «n», phase wire of phase C	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.26	$U^{P}_{y,c,v,\ line(2),i_{10},\ n=N}$ – Voltage of the last branch, phase wire of phase C in the time of manimum loads	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.27	$I^{P}_{A,y,line(2),i_{10}}$ - Current of phase A of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.28	$I^{P}_{B,y,line(2),i_{10}}$ - Current of phase B of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data

26.29	$I^{P}_{C,y,line(2),i_{10}}$ - Current of phase C of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
26.30	$R^{P}_{0n,y,line(2),i_{10}}$ - Specific resistance of zero wire of line with distributed load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.31	$L^{P}_{y,line(2),i_{10}}$ - Length of line with distributed load	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
26.32	$R^{P}_{\phi n,y,line(2),i_{10}}$ - Specific resistance of phase wire of line with distributed load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
26.33	$T^{M}_{y,line(2),i_{10}}$ - Annual number of hours of use of maximum active power of line with distributed load	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
26.34	$P^{P}_{y,line(2),max,i_{10}}$ - Power that is transported by ETL «i» in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.35	$P^{P}_{y,line(2),min,i_{10}}$ - Power that is transported by ETL «i» in an hour of	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper	Company data

	minimum load						forms	
26.36	$U^{P}_{y,line(2),max,i_{10}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
26.37	$cos\varphi^{P}_{y,line(2),i_{10}}$ - Cosine of the angle between active and gross power during maximum load of line with distributed load	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
26.38	$\rho^{B}_{Al,y,line(2),i_{10}}$ - Specific resistance of aluminium for line with distributed load	Nameplate data of equipment	(Ohm·mm^2/m)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
26.39	$k^{P}_{Cu,y,line(2),i_{10}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data
26.40	$P^{P}_{l,y,line(2),i_{10}}$ - Power at the entrance of electricity transmission line	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.41	$P^{P}_{n,y,line(2),i_{10}}$ - Power than runs in the section "n"	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
26.42	$F^{B}_{n,y,line(2),i_{10}}$ – section of wire of section n for line with distributed load	Nameplate data of equipment	(mm^2)	e	Once at the beginning of the	100%	In electronic and paper forms	Company data

					project			
26.43	$L^{B}_{n,y,line(2),i_{10}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually	100%	In electronic and paper forms	Company data
27	$P^{P}_{y,branch,max,i_{11}}$ - Power during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
27.1	$U^{P}_{y,branch,max,i_{11}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually	100%	In electronic and paper forms	Company data
27.2	$cos\varphi^{P}_{y,branch,i_{11}}$ - Cosine of the angle between active and gross power during maximum load	To measure cosine of the angle between active and gross power phase meter is used		m	annually	100%	In electronic and paper forms	Company data
27.3	$\rho^{B}_{Al,y,branch,i_{11}}$ - Specific resistance of aluminium for branches	Nameplate data of equipment	(Ohm·mm^2/m)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
27.4	$k^{P}_{Cu,y,branch,i_{11}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data
27.5	$P^{P}_{l,y,branch,i_{11}}$ - Power at the entrance of electricity transmission line	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data

27.6	$P^{P}_{n,y,branch,i_{11}}$ - Power than runs in the section "n"	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
27.7	$F^{B}_{n,y,branch,i_{11}}$ – section of wire of section n for branches	Nameplate data of equipment	(mm^2)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data
27.8	$L^{B}_{n,y,branch,i_{11}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(m)	m	annually	100%	In electronic and paper forms	Company data
27.9	$I^{P}_{A,y,branch,i_{11}}$ - Current of phase A of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
27.10	$I^{P}_{B,y,branch,i_{11}}$ - Current of phase B of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
27.11	$I^{P}_{C,y,branch,i_{11}}$ - Current of phase C of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually	100%	In electronic and paper forms	Company data
27.12	$R^{P}_{0n,y,branch,i_{11}}$ - Specific resistance of zero wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used

27.13	$L^{P}_{y,branch,i_{11}}$ - Length of electricity transmission line of branches	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(m)	m	annually	100%	In electronic and paper forms	Company data
27.14	$R^{P}_{\phi n,y,branch,i_{11}}$ - Specific resistance of phase wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually	100%	In electronic and paper forms	If it is impossible to carry out measurements passport data of equipment are used
27.15	$T^{M}_{y,branch,i_{11}}$ - Annual number of hours of maximum active power use in ETL «i»	Hour-based schedule of power of a working day in a month	(hour)	m	annually	100%	In electronic and paper forms	Company data
27.16	$P^{P}_{y,branch,min,i_{11}}$ - Power that is transported by ETL «i» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually	100%	In electronic and paper forms	Company data
28	$W^{B}_{y.n.(segm\ n).i_{12}}$- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction	Determined with the help of calculated values of segment of the grid operating mode after its reconstruction	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29	$W^{P,C}_{y,system,n}$ – Volume of electricity consumed in period "y" by all consumers connected to	To measure electricity electric meter is used	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data

	grids of voltage class with index n (net consumption), in the project scenario (ths. kWh)							
29.1	$\Delta W^{P}_{1\div(y-1),elem,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period (1 ÷ (y-1)), in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids"	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.2	$\Delta W^{P}_{y,system,n}$ Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period "y", in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids"	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.3	$\Delta W^{P}_{(y-1),segm,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y-1", in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids"	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.4	$\Delta W^{P}_{y,segm,n}$ - Reduction of	Departmental reporting	(ths. kWh)	m	annually	100%	In	Company data

	electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y", in the project scenario (ths. kWh).	form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids"					electronic and paper forms	
29.5	$K^{P,L}_{y,system,m}$ - electricity losses factor in grids of voltage class with index m (without losses in transformers) for period y, in the project scenario	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data
29.6	$K^{P,T,n/m}_{y,system}$ - electricity losses factor in transformer for period y, that takes place due to its conversion from grids of voltage class with indext n in grids of voltage class with index m, here $n > m$	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually	100%	In electronic and paper forms	Company data
29.7	$W^{P,T}_{y,system,n.yp}$ – electricity losses on no-load run in transformer for period y, that takes place due to its conversion from grids of voltage class with indext n in grids of voltage class with index m, here	Nameplate data of equipment	(ths. kWh)	e	Once at the beginning of the project	100%	In electronic and paper forms	Company data

	$n > m$							
29.8	$W^{P,T,n}_{y,system,m}$ - обсяг Volume of electricity that outflew in period «y» from transformer for its consumption in the grid of voltage class with index m, after its conversion from voltage networks with index n, here $n > m$, in the project scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.9	$W^{P}_{y,system,m}$ - Volume of electricity, which has to be transfered in period y to the grids of voltage class with the index m for all consumers connected to them (gross consumption), in the project scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.10	$W^{P,I}_{y,system,m}$ - Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data

	consumers, in the project scenario (ths. kWh)							
29.11	$W^{B}_{y,system,m}$ - Volume of electricity, which has to be transfered in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), in the baseline scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually	100%	In electronic and paper forms	Company data
29.12	$W^{P}_{y,system,0.38}$ - Volume of electricity, which has to be transfered in period «y» to grids of voltage class with index «n» for all consumers connected to them (gross consumption), in the project scenario (ths. kW)	To measure volume of electricity electric meter is used	(ths. kW)	m	annually	100%	In electronic and paper forms	Company data
30	(EF) - Carbon dioxide emission factor (t CO_{2e}/kWh)	Officially approved values for Ukrainian energy system	(t CO_2e/kWh)	e	annually	100%	In electronic and paper forms	If data approved at the national level is absent data taken from “Ukraine - Assessment of new calculation of CEF”[50] or

[50] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

								ERUPT[51] will be used

D.1.1.4. Description of formulas used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO2 equivalent):

$$BE_y^B = BE_{y,elem}^B + BE_{y,segm}^B + BE_{y,system}^B \quad (75)$$

$BE_{y,elem}^B$ - GHG emissions in the absence of the introduction of new or reconstruction of existing elements of the power grid in period *"y"* of the baseline scenario (tCO_{2e});
$BE_{y,segm}^B$ - GHG emissions in the absence of the reconstruction of existing segments of the power grid in period *"y"* of the baseline scenario (tCO_{2e});
$BE_{y,system}^B$ - GHG emissions due to systemic effects in the absence of the introduction of new or reconstruction of existing elements, as well as segments of the power grid in period *"y"* of the baseline scenario (t CO_{2e});
$[B]$ – index, which corresponds to the baseline scenario;
$[elem]$ – index, which corresponds to electricity transmission lines;
$[segm]$ – index, which corresponds to segments of power grid;
$[system]$ – index, which corresponds to systemic effect;
$[y]$ – index, that corresponds to monitoring period.

GHG emissions in the absence of the introduction of new or reconstruction of existing elements of the power grid in the baseline scenario

$$BE_{y,elem}^B = (W_{y,tran(2)}^B + W_{y,tran(3)}^B + W_{y,line(1)}^B + W_{y,cable}^B + W_{y,insul}^B + W_{y,lamp}^B + W_{y,comp}^B + W_{y,meter}^B + W_{y,switch}^B + W_{y,motors}^B + W_{y,line(2)}^B + W_{y,branch}^B) \cdot EF \quad (84)$$

$W_{y,tran(2)}^B$ - Electricity losses in the absence of the introduction of new or reconstruction of existing double-winding transformers, in period *"y"*, of the baseline scenario (ths. kWh);
$W_{y,tran(3)}^B$ - Electricity losses in the absence of the introduction of new or reconstruction of existing three-winding transformers, in period *"y"*, of the baseline scenario (ths. kWh);
$W_{y,line(1)}^B$ – Electricity losses in the absence of the introduction of new or reconstruction of existing wires of electricity transmission lines in period *"y"* of the baseline scenario (ths. kWh);
$W_{y,cable}^B$- Electricity losses in insulation in the absence of the introduction introduction of new or reconstruction of existing wires of electricity transmission lines in period *"y"*, of the baseline scenario (ths. kWh);

[51] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

$W^B_{y,insul}$ - Electricity losses in the absence of the replacement of defected insulators of electricity transmission lines, in period "y" of the baseline scenario (ths. kWh);
$W^B_{y,lamp}$ - Electricity losses in the absence of the replacement of signaling lamps with light emittind diodes, in period "y" of the baseline scenario (ths. kWh);
$W^B_{y,comp}$ - Electricity losses in the absence of the implementation of reactive power compensation devices at consumer's place, in period «y» in the baseline scenario (ths. kWh.);
$W^B_{y,meter}$ - Electricity losses in the absence of the replacement of electric meters, in period "y" of the baseline scenario (kWh);
$W^B_{y,switch}$ - Electricity losses in the absence of the replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,motors}$ - Electricity losses in the absence of replacement or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,line(2)}$ - Electricity losses in the absence of the replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,branch}$ - Electricity losses in the absence of the implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – monitoring period.

Electricity losses in the absence of the introduction of new or reconstruction of existing double-winding transforemers in the baseline scenario

$$W^B_{y,tran(2)} = \sum_{i=1}^{I} W^B_{y,tran(2),i} \qquad (85)$$

$W^B_{y,tran(2),i}$ – electricity losses in a double-winding transformer "i" in period "y" of the baseline scenario (ths. kWh);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$W^P_{y,tran(2),i} = \frac{\Delta P^B_{XX,F,y,tran(2),i} \cdot 8760 \cdot + \Delta P^B_{кз,F,y,tran(2),i} \cdot \left(\frac{S^P_{y,tran(2),max,i}}{S^P_{T,y,tran(2),i}}\right)^2 \cdot \tau^P_{y,tran(2),max,i} \cdot k^P_{n,y,tran(2),i}}{1000} \qquad (86)$$

$\Delta P^B_{XX,F,y,tran(2),i}$ - Actual power losses of no-load run in a double-winding transformer «*i*» (kW);
$\Delta P^B_{кз,F,y,tran(2),i}$ - Actual power losses of short circuit in a double-winding transformer «*i*» (kW);
$S^P_{y,tran(2),max,i}$ - Load of a double-winding transformer at the side of high voltage in an hour of maximum load in transformer "i" (kVA);

$S^P_{T,y,tran(2),i}$ - Rated load of a double-winding transformer "*i*" at the side of high voltage (kVA);
$\tau^P_{y,tran(2),max,i}$ - time of maximum electricity losses in a double-winding transformer (hous);
$k^P_{n,y,tran(2),i}$- unssymetry coefficient in electrical grids with zero wire;
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta P^B_{XX,F,y,tran(2),i} = \Delta P^B_{XX,P,y,tran(2),i} \cdot K\Pi^B_{XX,y,tran(2),i} \quad (87)$$

$\Delta P^B_{XX,P,y,tran(2),i}$ - Rated power losses of no-load run in a double-winding transformer «*i*» (kW);
$K\Pi^B_{XX,y,tran(2),i}$ - Degradation factor of no-load run losses in a double-winding transformer "*i*";
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[tran(2)]$ – index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period

$$\Delta P^B_{кз,F,y,tran(2),i} = \Delta P^B_{кз,P,y,tran(2),i} \cdot K\Pi^B_{кз,y,tran(2),i} \quad (88)$$

$\Delta P^B_{кз,P,y,tran(2),i}$ - Rated power losses of short circuit in a double-winding transformer «i» (kW);
$K\Pi^B_{кз,y,tran(2),i}$ - Degradation factor of short-circuit losses in a double-winding transformer "*i*";
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[y]$ – index which corresponds to the monitoring period

$$S^P_{y,tran(2),max,i} = \frac{P^P_{y,tran(2),max,i}}{cos\varphi^P_{y,tran(2),i}} \quad (89)$$

$P^P_{y,tran(2),max,i}$ – power of a double-winding transformer "*i*" at the side of high voltage in an hour of maximum load (kW);
$cos\varphi^P_{y,tran(2),i}$ - Cosine of the angle between active and gross power in a double-winding transformer "*i*";
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;

$[y]$ – index which corresponds to the monitoring period;
$[max]$ – index, which corresponds to maximum load;

$$\tau^{P}_{y,tran(2),max,i} = 2 \cdot T^{M}_{y,tran(2),i} - 8760 + \frac{8760 - T^{M}_{y,tran(2),i}}{1 + \frac{T^{M}_{y,tran(2),i}}{8760} - 2 \cdot \frac{P^{P}_{y,tran(2),min,i}}{P^{P}_{y,tran(2),max,i}}} \cdot \left(1 - \frac{P^{P}_{y,tran(2),min,i}}{P^{P}_{y,tran(2),max,i}}\right)^{2} \quad (90)$$

$T^{M}_{y,tram(2),i}$ – Annual number of hours of maximum power use in a double-winding transformer "i" (hour);
$P^{P}_{y,tran(2),max,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of maximum load (kW);
$P^{P}_{y,tran(2),min,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of minimum load (kW);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[y]$ – index which corresponds to the monitoring period.

$$k^{\mathrm{P}}_{\mathrm{n,y,tran(2)},i} = 3 \cdot \frac{I^{2P}_{A,y,tran(2),i} + I^{2P}_{B,y,tran(2),i} + I^{2P}_{C,y,tran(2),i}}{\left(I^{P}_{A,y,tran(2),i} + I^{P}_{B,y,tran(2),i} + I^{P}_{C,y,tran(2),i}\right)^{2}} \cdot 1 + 1.5 \cdot \frac{R^{P}_{0,y,tran(2),i}}{R^{P}_{\phi,y,tran(2),i}} - 1.5 \cdot \frac{R^{P}_{0,y,tran(2),i}}{R^{P}_{\phi,y,tran(2),i}} \quad (91)$$

$I^{P}_{A,y,tran(2),i}$- Current of phase A in double-winding transformer "i" (A);
$I^{P}_{B,y,tran(2),i}$- Current of phase B in double-winding transformer "i" (A);
$I^{P}_{C,y,tran(2),i}$- Current of phase C in double-winding transformer "i" (A);
$R^{P}_{0,y,tran(2),i}$ - Resistance of zero wire of corresponding section in double-winding transformer "i" (Ohm);
$R^{P}_{\phi,y,tran(2),i}$- Resistance of phase wire of corresponding section in double-winding transformer "i" (Ohm);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,tran(2),i} = R^{P}_{0n,y,tran(2),i} \cdot L^{P}_{y,tran(2),i} \quad (92)$$

$R^{P}_{0n,y,tran(2),i}$ – specific resistance of zero wire in double winding transformer «i» (Ohm/km);
$L^{P}_{y,tran(2),i}$ - Length of electricity transmission line (km);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^P_{\phi,y,tran(2),i} = R^P_{\phi n,y,tran(2),i} \cdot L^P_{y,tran(2),i} \qquad (93)$$

$R^P_{\phi n,y,tran(2),i}$ - Specific resistance of phase wire in double-winding transformer "i" (Ohm/km);
$L^P_{y,tran(2),i}$ - Length of electricity transmission line (km);
$[i]$ – index, which corresponds to reconstructed or new double-winding transformer;
$[tran(2)]$– index which corresponds to reconstruction or replacement of a double-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of introduction of new or reconstruction of existing three-winding transformers that are implemented in the baseline scenario

$$W^B_{y,tran(3)} = \sum_{i_1=1}^{I_1} W^B_{y,tran(3),i_1} \qquad (94)$$

$W^B_{y,tran(3),i_1}$ – Electricity losses in three-winding transformer «i_1», in period «y» in the baseline scenario (ths. kWh);
$[i_1]$ – index, which corresponds to reconstructed or new three-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$W^B_{y,tran(3),i_1} = \frac{\Delta P^B_{XX,F,y,tran(3),i_1} \cdot 8760 + \Delta P^B_{\text{кз},F,y,tran(3.1),i_1} \cdot \left(\frac{S^P_{y,tran(3.1),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2 \cdot \tau^P_{y,tran(3.1),max,i_1} + \Delta P^B_{\text{кз},F,y,tran(3.2),i_1} \cdot \left(\frac{S^P_{y,tran(3.2),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2 \cdot \tau^P_{y,tran(3.2),max,i_1} + \Delta P^B_{\text{кз},F,y,tran(3.3),i_1} \cdot \left(\frac{S^P_{y,tran(3.3),max,i_1}}{S^P_{T,y,tran(3),i_1}}\right)^2 \cdot \tau^P_{y,tran(3.3),max,i_1}}{1000} \qquad (95)$$

$\Delta P^B_{XX,F,y,tran(3),i_1}$ - Actual power losses of no-load run in a three-winding transformer «i_1» (kW);
$\Delta P^B_{\text{кз},F,y,tran(3,1),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of high voltage (kW);
$S^P_{y,tran(3.1),max,i_1}$ – Load of a three-winding transformer at the side of high voltage in an hour of maximum loads in transformer «i_1» (kVA);
$\tau^P_{y,tran(3.1),max,i_1}$ – Time of maximum electricity losses for windings of high voltage in a three-winding transformer (hour);
$\Delta P^B_{\text{кз},F,y,tran(3.2),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of medium voltage (kW);
$S^P_{y,tran(3.2),max,i_1}$ – Load of a three-winding transformer at the side of medium voltage in an hour of maximum loads in transformer «i_1» (kVA);
$\tau^P_{y,tran(3.2),max,i_1}$ - Time of maximum electricity losses for windings of medium voltage in a three-winding transformer (hour);
$\Delta P^B_{\text{кз},F,y,tran(3,3),i_1}$– Actual power losses of short circuit in a three-winding transformer «i_1», of low voltage (kW);
$S^P_{y,tran(3.3),max,i_1}$ – Load of a three-winding transformer at the side of low voltage in an hour of maximum loads in transformer «i_1» (kVA);

$\tau^{P}_{y,tran(3.3),max,i_1}$ - Time of maximum electricity losses for windings of low voltage in a three-winding transformer (hour);
$S^{P}_{T,y,tran(3),i_1}$ – Nominal load of a three-winding transformer «i_1» (kVA);
$[i_1]$ – index, which corresponds to reconstructed or new three-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$\Delta P^{B}_{XX,F,y,tran(3),i_1} = \Delta P^{B}_{XX,P,y,tran(3),i_1} \cdot K\Pi^{B}_{XX,y,tran(3),i_1} \qquad (96)$$

$\Delta P^{B}_{XX,P,y,tran(3),i_1}$ - Rated power losses of no-load run in a three-winding transformer «i_1» (kW);
$K\Pi^{B}_{XX,y,tran(3),i_1}$ - Degradation factor of no-load run losses in a three-winding transformer;
$[i_1]$ –index, which corresponds to reconstructed or new three-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$\Delta P^{B}_{кз,F,y,tran(3.1),i_1} = \Delta P^{B}_{кз,P,y,tran(3.1),i_1} \cdot K\Pi^{B}_{кз,y,tran(3),i_1} \qquad (97)$$

$$\Delta P^{B}_{кз,F,y,tran(3.2),i_1} = \Delta P^{B}_{кз,P,y,tran(3.2),i_1} \cdot K\Pi^{B}_{кз,y,tran(3),i_1} \qquad (98)$$

$$\Delta P^{B}_{кз,F,y,tran(3.3),i_1} = \Delta P^{B}_{кз,P,y,tran(3.3),i_1} \cdot K\Pi^{B}_{кз,y,tran(3),i_1} \qquad (99)$$

$\Delta P^{B}_{кз,P,y,tran(3.1),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of high voltage (kW);
$\Delta P^{B}_{кз,P,y,tran(3.2),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of medium voltage (kW);
$\Delta P^{B}_{кз,P,y,tran(3.3),i_1}$ - Rated power losses of short circuit in a three-winding transformer « i_1» of low voltage (kW);
$K\Pi^{B}_{кз,y,tran(3),i_1}$ - Degradation factor of short-circuit losses in a three-winding transformer;
$[i_1]$ – index, which corresponds to reconstructed or new three-winding transformer;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.

$$S^{P}_{y,tran(3.1),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.1),i_1}} \qquad (100)$$

$$S^{P}_{y,tran(3.2),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.2),i_1}} \qquad (101)$$

$$S^{P}_{y,tran(3.3),max,i_1} = \frac{P^{P}_{y,tran(3),max,i_1}}{cos\varphi^{P}_{y,tran(3.3),i_1}} \qquad (102)$$

$P^{P}_{y,tran(3),max,i_1}$ – Power of a three-winding transformer "i_1" in an hour of maximum load (kW);
$cos\varphi^{P}_{y,tran(3.1),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of high voltage;
$cos\varphi^{P}_{y,tran(3.2),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of medium voltage;
$cos\varphi^{P}_{y,tran(3.3),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of low voltage;
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[y]$ – index that corresponds to monitoring period.
$[max]$ – index that corresponds to maximum load.

$$\tau^{P}_{y,tran(3.1),max,i_1} = \tau^{P}_{y,tran(3.2),max,i_1} = \tau^{P}_{y,tran(3.3),max,i_1} = 2 \cdot T^{M}_{y,tran(3),i_1} - 8760 + \frac{8760 - T^{M}_{y,tran(3),i_1}}{1 + \frac{T^{M}_{y,tran(3),i_1}}{8760} - 2 \cdot \frac{P^{P}_{y,tran(3),min,i_1}}{P^{P}_{y,tran(3),max,i_1}}} \cdot \left(1 - \frac{P^{P}_{y,tran(3),min,i_1}}{P^{P}_{ytran(3),max,i_1}}\right) \qquad (103)$$

$P^{P}_{y,tran(3),max,i_1}$– Power of a three-winding transformer "i_1" in an hour of maximum load (kW);
$P^{P}_{y,tran(3),min,i_1}$– Power of a three-winding transformer "i_1" in an hour of minimum load (kW);
$T^{M}_{y,tran(3),i_1}$– Number of hours of maximum power use of windings of a three-winding transformer (hour);
$[i_1]$ – iindex, which corresponds to reconstructed or new three-winding transformer;
$[tran(3)]$ – index which corresponds to reconstruction or replacement of a three-winding transformer;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[y]$ – index that corresponds to monitoring period.

Electricity losses in the absence of introduction of new or reconstruction of existing wires of electricity transition lines, in the baseline scenario

$$W^{B}_{y,line(1)} = \sum_{i_2=1}^{I_2} W^{B}_{y,line(1),i_2} \qquad (104)$$

$W^{B}_{y,line(1),i_2}$ – Electricity losses caused by implementation of new or reconstruction of existing wires of electricity transmission lines, in period «y» in the baseline scenario (ths. kWh);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL, that are considered as an element in the project;
$[B]$ – index, which corresponds to the baseline scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[y]$ – index that corresponds to monitoring period.

$$W^{B}_{y,line(1),i_2} = \left(\frac{P^{P}_{y,line(1),max,i_2}}{U^{P}_{y,line(1),max,i_2} \cdot cos\varphi^{P}_{y,line(1),i_2}}\right)^2 \cdot \frac{R^{B}_{L\_f,y,line(1),max,i_2} \cdot \tau^{P}_{y,line(1),max,i_2} \cdot k^{P}_{n,y,line(1),i_2}}{1000000} \quad (105)$$

$P^{P}_{y,line(1),max,i_2}$ – Power of ETL «i_2» during maximum load (kW);
$U^{P}_{y,line(1),max,i_2}$ – Voltage of ETL «i_2» during maximum load (kV);
$cos\varphi^{P}_{y,line(1),i_2}$ – Cosine of the angle between active and gross power in ETL;
$R^{B}_{L\_f,y,line(1),max,i_2}$ - Resistance of phase wire in ETL (Ohm);
$\tau^{P}_{y,line(1),max,i_2}$ – time of maximum electricity losses in ETL (hour);
$k^{P}_{n,y,line(1),i_2}$ – unsymmetry factor in electrical grids with zero wire;
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[max]$ – index, which corresponds to maximum load;
$[min]$ – index, which corresponds to minimum load;
$[y]$ – index which corresponds to the monitoring period.

$$R^{B}_{L\_f,y,line(1),max,i_2} = R^{B}_{f,y,line(1),max,i_2} \cdot L^{B}_{y,line(1),max,i_2} \quad (106)$$

$R^{B}_{f,y,line(1),max,i_2}$ – Specific resistance of phase wire in ETL (Ohm/km);
$L^{B}_{y,line(1),max,i_2}$ – Length of ETL (km);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[B]$ – index, which corresponds to the baseline scenario;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[y]$ – index which corresponds to the monitoring period.

$$\tau^{P}_{y,line(1),max,i_2} = 2 \cdot T^{M}_{y,line(1),i_2} - 8760 + \frac{8760 - T^{M}_{y,line(1),i_2}}{1 + \frac{T^{M}_{y,line(1),i_2}}{8760} - 2 \cdot \frac{P^{P}_{y,line(1),min,i_2}}{P^{P}_{y,line(1),max,i_2}}} \cdot \left(1 - \frac{P^{P}_{y,line(1),min,i_2}}{P^{P}_{y,line(1),max,i_2}}\right) \quad (107)$$

$P^{P}_{y,line(1),max,i_2}$ – Power that is transported by ETL «i_2» in an hour of maximum load (kW);
$P^{P}_{y,line(1),min,i_2}$ – Power that is transported by ETL «i_2» in an hour of minimum load (kW);
$T^{M}_{y,line(1),i_2}$ – Annual number of hours of maximum active power use in ETL «i_2» (hour);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[P]$ – index, which corresponds to the project scenario;
$[max]$ – index, which corresponds to maximum;
$[min]$ – index, which corresponds to minimum;

$[y]$ – index which corresponds to the monitoring period.

$$k^{P}_{n,y,line(1),i_2} = 3 \cdot \frac{I^{2P}_{A,y,line(1),i_2}+I^{2P}_{B,y,line(1),i_2}+I^{2P}_{C,y,line(1),i_2}}{\left(I^{P}_{A,y,line(1),i_2}+I^{P}_{B,y,line(1),i_2}+I^{P}_{C,y,line(1),i_2}\right)^2} \cdot 1 + 1.5 \cdot \frac{R^{P}_{0,y,line(1),i_2}}{R^{B}_{L\_f,y,line(1),max,i_2}} - 1.5 \cdot \frac{R^{P}_{0,y,line(1),i_2}}{R^{B}_{L\_f,y,line(1),max,i_2}} \quad (108)$$

$I^{P}_{A,y,line(1),i_2}$ - Current of phase A of ETL «i_2» (A);
$I^{P}_{B,y,line(1),i_2}$ - Current of phase B of ETL «i_2» (A);
$I^{P}_{C,y,line(1),i_2}$ - Current of phase C of ETL «i_2» (A);
$R^{P}_{0,y,line(1),i_2}$ - Specific resistance of zero wire of corresponding section of ETL «i_2» (Ohm);
$R^{B}_{L\_f,y,line(1),max,i_2}$- Resistance of phase wire of corresponding section of ETL «i_2» (Ohm);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^{P}_{0,y,line(1),i_2} = R^{P}_{0n,y,line(1),i_2} \cdot L^{P}_{y,line(1),i_2} \quad (109)$$

$R^{P}_{0n,y,line(1),i_2}$ - Specific resistance of zero wire in ETL (Ohm / km);
$L^{P}_{y,line(1),i_2}$ - Length of electricity transmission line (km);
$[i_2]$ – index that corresponds to a certain section of reconstructed ETL;
$[line(1)]$ – index that corresponds to reconstructed ETL of voltage 3, 6, 10, 35, 110 and 154 (kV);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in insulation in the absence of implementation of new or reconstruction of existing wires of cable electricity transmission lines in the baseline scenario

$$W^{B}_{y,cable} = \sum_{i_3=1}^{I_3} W^{B}_{y,cable,i_3} \quad (110)$$

$W^{B}_{y,cable,i3}$ – Electricity losses in insulation in the absence of implementation of new or reconstruction of existing wires of cable electricity transmission lines, in period «y» in the baseline scenario (ths. kWh);
$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[B]$ – index, which corresponds to the baseline scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

$$W^{B}_{y,cable,i_3} = \Delta W^{B}_{п,F,y,cable,i_3} \cdot L^{B}_{y,cable,i_3} \quad (111)$$

$\Delta W^{B}_{п,F,y,cable,i_3}$ – Actual specific losses of insulation of cable «i_3» (ths. kWh/km);

$L^B_{y,cable,i_3}$ - Length of cable electricity transmission line (km);

$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[B]$ – index, which corresponds to the baseline scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta W^B_{\text{п},F,y,cable,i_3} = \Delta W^B_{\text{п},P,y,cable,i_3} \cdot K\Pi^B_{R,y,cable,i_3} \quad (112)$$

$\Delta W^B_{\text{п},P,y,cable,i_3}$ - Rated specific losses of insulation of cable «i_3» (ths. kWh/km);
$K\Pi^B_{R,y,cable,i_3}$ - Degradation factor of cable insulation;
$[i_3]$ – index that corresponds to a certain section of reconstructed ETL;
$[B]$ – index, which corresponds to the baseline scenario;
$[cable]$ – index that corresponds to reconstruction or replacement of cable electricity transmission line;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of replacement of defected insulators of ETL, in the baseline scenario

$$W^B_{y,insul} = \sum_{i_4=1}^{I_4} W^B_{y,insul,i_4} \quad (113)$$

$W^B_{y,insul}$ – Electricity losses in the absence of replacement of defected insulators of ETL, in period «y» in the baseline scenario (ths. kWh);
$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^B_{y,insul,i_4} = \frac{W^B_{F,y,insul,i_4} \cdot N^B_{y,insul,i_4}}{1000} \quad (114)$$

$W^B_{F,y,insul,i_4}$- Actual electricity losses in insulator (kWh per year);
$N^B_{y,insul,i_4}$– number of replaced insulators (units);
$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^B_{F,y,insul,i_4} = W^B_{P,y,insul,i_4} \cdot K\Pi^B_{R,y,insul,i_4} \quad (115)$$

$W^B_{P,y,insul,i_4}$ - Rated electricity losses in insulator (kWh);
$K\Pi^B_{R,y,insul,i_4}$- Magnification factor of losses in insulator;

$[insul]$ – index that corresponds implemented insulators at ETL;
$[i_4]$ – index that corresponds to voltage class and type of insulator that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of replacement of signalling lamps with emitting diode, which are in the baseline scenario

$$W^B_{y,lamp} = \sum_{i_5=1}^{I_5} W^B_{y,lamp,i_5} \qquad (116)$$

$W^B_{y,lamp,i_5}$ - Electricity losses in the absence of replacement of signalling lamps with emitting diodes, in period «y» in the baseline scenario (ths. kWh);
$[lamp]$ – index that corresponds to replacement of signaling lamps with emitting diodes;
$[i_5]$ – index, that corresponds to type of emitting diode that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

$$W^B_{y,lamp,i_5} = \frac{P^B_{y,lamp,i_5} \cdot N^B_{y,lamp,i_5} \cdot T^P_{y,lamp,i_5}}{1000} \qquad (117)$$

$P^B_{y,lamp,i_5}$ – Power of once signaling lamp or emitting diode (kW);
$N^B_{y,lamp,i_5}$ – Number of replaced signaling lamps (units);
$T^P_{y,lamp,i_5}$ – Operational period of signaling lamps (hour);
$[lamp]$ – index that corresponds to replacement of signaling lamps with emitting diodes;
$[i_5]$ – index, that corresponds to type of emitting diode that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of implementation of reactive power compensation devices at customers place, in the baseline scenario

$$W^B_{y,comp} = \sum_{i_6=1}^{I_6} W^B_{y,comp,i_6} \qquad (118)$$

$W^B_{y,comp,i_6}$ – Specific reduction of electricity losses in the absence of implementation of reactive power compensation devices at customers place, in period «y» in the baseline scenario (kWh/kVAr);
[comp] – index that corresponds to implementation of reactive power compensation device at customers place;
$[i_6]$ –index that corresponds to reactive power compensation device that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;

$[y]$ – index which corresponds to the monitoring period.

$$W^{B}_{y,comp,i_6} = \Delta W^{B}_{0.38,y,comp,i_6} + \Delta W^{B}_{6-20,y,comp,i_6} + \Delta W^{B}_{35-154,y,comp,i_6} \quad (119)$$

$\Delta W^{B}_{0.38,y,comp,i_6}$- specific reduction of losses at voltage of 0,38 kV (kW/kVAr);
$\Delta W^{B}_{6-20,y,comp,i_6}$ - specific reduction of losses at voltage of 6-20 kV (kW/kVAr);
$\Delta W^{B}_{35-154,y,comp,i_6}$ - specific reduction of losses at voltage of 35-154 kV (kW/kVAr);
$[\mathrm{comp}]$ – index that corresponds to implementation of reactive power compensation device at customers place;
$[i_6]$ –index that corresponds to reactive power compensation device that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

$$\Delta W^{B}_{6-20,y,comp,i_6} = 0 \quad (120)$$

$$\Delta W^{B}_{35-154,y,comp,i_6} = 0 \quad (121)$$

Electricity losses in the absence of electricity meters replacement, in the baseline scenario

$$W^{B}_{y,meter} = \sum_{i_7=1}^{I_7} W^{B}_{y,meter,i_7} \quad (122)$$

$W^{B}_{y,meter}$ - Electricity losses in the absence of electricity meters replacement, in period «y» in the baseline scenario (ths. kWh);

$$W^{B}_{y,meter,i_7} = \frac{N^{B}_{y,meter,i_7} \cdot A^{B}_{F,y,meter,i_7} \cdot T^{P}_{y,meter,i_7}}{1000} \quad (123)$$

$N^{B}_{y,meter,i_7}$– Number of replaced meters (units);
$A^{B}_{F,y,meter,i_7}$- Actual electricity losses per hour in one meter (kWh);
$T^{P}_{y,meter,i_7}$– Operational period of a meter per year (hour);
$[meter]$ –index that corresponds to implemented meters;
$[i_7]$ – index that corresponds to voltage class and type of meter that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$A^{B}_{F,y,meter,i_7} = A^{B}_{P,y,meter,i_7} \cdot K\Pi^{B}_{R,y,meter,i_7} \quad (124)$$

$A^{B}_{P,y,meter,i_7}$– Rated electricity losses per hour in one meter (kWh);
$K\Pi^{B}_{R,y,meter,i_7}$- Degradation factor of electrical characteristics of a meter;
$[meter]$ –index that corresponds to implemented meters;

$[i_7]$ – index that corresponds to voltage class and type of meter that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of replacement of oil switches with vacuum and sulful hexafluoride switches, in the baseline scenario

$$W^B_{y,switch} = \sum_{i_8=1}^{I_8} W^B_{y,switch,i_8} \quad (125)$$

$W^B_{y,switch}$ - Electricity losses in the absence of replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);

$$W^B_{y,switch,i_8} = \frac{N^B_{y,switch,i_8} \cdot P^B_{y,switch,i_8} \cdot T^P_{y,switch,i_8}}{1000} \quad (126)$$

$N^B_{y,switch,i_8}$ – Number of replaced switches (units.);
$P^B_{y,switch,i_8}$ - Rated power of switch (kW);
$T^P_{y,switch,i_8}$ – Lengh of operation of switch heating system (hour);
$[switch]$ – index that corresponds to implemented switches;
$[i_8]$ – – index that corresponds to voltage class and type of switch that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$T^P_{y,switch,i_8} = N^B_{d,y,switch,i_8} \cdot 24 \quad (127)$$

$N^B_{d,y,switch,i_8}$ - number of days (of switches operation) with temperature below 5 ^{0}C (unts);
$[switch]$ – index that corresponds to implemented switches;
$[i_8]$ – – index that corresponds to voltage class and type of switch that is implemented;
$[P]$ – index, which corresponds to the project scenario;
$[B]$ – index, which corresponds to the baseline scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of implementation of new or reconstruction of existing electric motors of power transformers blower cooling, in the baseline scenario

$$W^B_{y,motors} = \sum_{i_9=1}^{I_9} W^B_{y,motors,i_9} \quad (128)$$

$W^B_{y,motors}$ - Electricity losses in the absence of implementation of new or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the baseline scenario (ths. kWh);

$W^B_{y,motors,i_9} = \frac{N^B_{y,motors,i_9} \cdot P^B_{y,motors,i_9} \cdot T^P_{y,motors,i_9}}{1000}$ *(129)*

$N^B_{y,motors,i_9}$ – Number of replaced or reconstructed electrical motors (units);
$P^B_{y,motors,i_9}$ - Power of electrical motor (kW);
$T^p_{y,motors,i_9}$ – Average number of operational hours of electrical motor per year;
$[motors]$ – index that corresponds to implemented or reconstructed electrical motors;
$[i_9]$ – index that corresponds to voltage class and type of electric motor that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$T^P_{y,motors,i_9} = N^B_{d,y,motors,i_9} \cdot 24$ *(130)*

$N^B_{d,y,motors,i_9}$ - Number of days (of electric motors operation) with a temperature below 5 ^{0}C (units);
$[motors]$ – index that corresponds to implemented or reconstructed electrical motors;
$[i_9]$ – index that corresponds to voltage class and type of electric motor that is implemented;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of replacement or reconstruction of existing electricity lines with distributed load, in the baseline scenario

$W^B_{y,line(2)} = \sum_{i_{10}=1}^{I_{10}} W^B_{y,line(2),i_{10}}$ *(131)*

$W^B_{y,line(2),i_{10}}$ – в Electricity losses in the absence of replacement of existing electricity lines of 0.35 kV with distributed load, in period «y» in the baseline scenario (ths. kWh);
$[i_{10}]$ – index that corresponds to certain scheme;
$[B]$ – index, which corresponds to the baseline scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period.

$W^B_{y,line(2),i_{10}} = \frac{\Delta P^B_{y,line(2),i_{10}} \cdot \tau^P_{y,line(2),max,i_{10}}}{1000}$ *(132)*

$\Delta P^B_{y,line(2),i_{10}}$- total power losses in line with distributed load per hour of maximum load (kWh);
$\tau^P_{y,line(2),i_{10}}$ - Number of hours of maximum lossed (hour);

$$\Delta P^B_{y,line(2),i_{10}} = \left(\frac{\left(I^B_{y,a,d,\,line(2),i_{10},(n=1)}\right)^2 \cdot R^B_{y,a,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_A}\left(I^B_{y,a,d,\,line(2),i_{10},n}\right)^2 \cdot R^B_{y,a,d,line(2),i_{10}} + \sum_{n=1}^{N\_A}\left(I^B_{y,a,v,line(2),i_{10},n}\right)^2 \cdot R^B_{y,a,v,\,line(2),i_{10}} + \frac{\left(I^B_{y,b,d,\,line(2),i_{10},n=1}\right)^2 \cdot R^B_{y,b,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_B}\left(I^B_{y,b,d,\,line(2),i_{10},n}\right)^2 \cdot R^B_{y,b,d,line(2),i_{10}} + \sum_{n=1}^{N\_B}\left(I^B_{y,b,v,line(2),i_{10},n}\right)^2 \cdot R^B_{y,b,v,\,line(2),i_{10}} + \frac{\left(I^B_{y,c,d,\,line(2),i_{10},n=1}\right)^2 \cdot R^B_{y,c,d,line(2),i_{10}}}{1000} + \sum_{n=1}^{N\_C}\left(I^B_{y,c,d,\,line(2),i_{10},n}\right)^2 \cdot R^B_{y,c,d,line(2),i_{10}} + \sum_{n=1}^{N\_C}\left(I^B_{y,c,v,line(2),i_{10},n}\right)^2 \cdot R^B_{y,c,v,\,line(2),i_{10}}\right) \cdot k^P_{n,y,line(2),i_{10}} \qquad (133)$$

$I^B_{y,a,d,\,line(2),i_{10},n=N}$ – current of section, phase A at hours of maximum load (A);

$R^B_{y,a,d,line(2),i_{10}}$ – resistance of section, phase A at hours of maximum loads (Ohm/km);

$I^B_{y,a,d,\,line(2),i_{10},n}$ – current of section, phase A at hours of maximum load (A);

$I^B_{y,a,v,line(2),i_{10},n}$– current of branch, phase A at hours of maximum load (A);

$R^B_{y,a,v,\,line(2),i_{10}}$ – average resistance of branch, phase A at hours of maximum loads (Ohm/km);

$I^B_{y,b,d,\,line(2),i_{10},n=N}$ – current of section, phase B at hours of maximum load (A);

$R^B_{y,b,d,line(2),i_{10}}$ – resistance of section, phase B at hours of maximum loads (Ohm/km);

$I^B_{y,b,d,\,line(2),i_{10},n}$ – current of section, phase B at hours of maximum load (A);

$I^B_{y,b,v,line(2),i_{10},n}$ - current of branch, phase B at hours of maximum load (A);

$R^B_{y,b,v,\,line(2),i_{10}}$ - average resistance of branch, phase B at hours of maximum loads (Ohm/km);

$I^B_{y,c,d,\,line(2),i_{10},n=N}$– current of section, phase C at hours of maximum load (A);

$R^B_{y,c,d,line(2),i_{10}}$– resistance of section, phase C at hours of maximum loads (Ohm/km);

$I^B_{y,c,d,\,line(2),i_{10},n}$ – current of section, phase C at hours of maximum load (A);

$I^B_{y,c,v,line(2),i_{10},n}$ - current of branch, phase C at hours of maximum load (A);

$R^B_{y,c,v,\,line(2),i_{10}}$ - average resistance of branch, phase C at hours of maximum loads (Ohm/km);

$k^P_{n,y,line(2),i_{10}}$ – unsymmetry factor.

$$I^B_{y,a,d,\,line(2),i_{10},(n=N)} = I^B_{y,a,v,\,line(2),i_{10},(n=N)} = \frac{U^B_{y,a,v,\,l,i_{10},i5,\,n=N}}{\left(R^B_{y,a,v,\,line(2),i_{10}} + R^B_{y,a,nav,\,line(2),i_{10}}\right)} \qquad (134)$$

$I^B_{y,a,v,\,line(2),i_{10},(n=N)}$– current of the last branch, phase wire of phase A (A);

$U^B_{y,a,v,\,line(2),i_{10},\,n=N}$– voltage of the last branch, phase wire of phase A (kV);

$R^B_{y,a,nav,\,line(2),i_{10}}$ - load resistance, phase wire of phase A (kW);

$$R^B_{y,a,d,\,line(2),i_{10}} = \frac{R^B_{y,a,d\;line(2),i_{10},\,droty} \cdot L^B_{y,a,\,line(2),i_{10}}}{N^B_{y,a,d,\,line(2),i_{10}}} \qquad (135)$$

$R^B_{y,a,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase A (Ohm/km);
$L^B_{y,a,line(2),i_{10}}$ – Length of line with distributed load of phase A (km);
$N^B_{y,a,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase A(units);

$$I^B_{y,a,d,\ line(2),i_{10},\ n} = I^B_{y,a,d,\ line(2),i_{10},(n+1)} + I^B_{y,a,v,\ line(2),i_{10},n} \quad (136)$$

$I^B_{y,a,d,\ line(2),i_{10},(n+1)}$ – Current of a next section, phase wire of phase A of a line with distributed load (A);
$I^B_{y,a,v,\ line(2),i_{10},n}$ – Current of branch “n”, phase wire of phase A of a line with distributed load (A);

$$I^B_{y,a,v,line(2),i_{10},\ n} = \frac{U^B_{y,a,v,\ line(2),i_{10},\ n}}{\left(R^B_{y,a,v,\ line(2),i_{10}} + R^B_{y,a,nav,\ line(2),i_{10}}\right)} \quad (137)$$

$U^B_{y,a,v,\ line(2),i_{10},\ n}$ - Voltage of branch “n”, phase wire of phase A (kV);
$R^B_{y,a,v,\ line(2),i_{10}}$ - Average resistance of a branch, phase A (Ohm/km);
$R^B_{y,a,nav,\ line(2),i_{10}}$ – Load resistance of phase wire of phase A (kW);

$$U^B_{y,a,v,\ line(2),i_{10},\ n} = U^B_{y,a,v,\ line(2),i_{10}(n+1)} + I^B_{y,a,v,\ line(2),i_{10},\ (n+1)} \cdot R^B_{y,a,d,\ line(2),i_{10}} \quad (138)$$

$U^B_{y,a,d,\ line(2),i_{10}(n+1)}$ – Voltage of a next branch “n”, phase wire of phase A (kV);
$I^B_{y,a,d,\ line(2),i_{10},\ (n+1)}$ – Current of a next branch «n», phase wire of phase A (A);
$R^B_{y,a,d,\ line(2),i_{10}}$ - Resistance of section, phase wire of phase A (Ohm);

$$U^B_{y,a,v,\ line(2),i_{10},\ n=N} = U^P_{y,a,v,\ line(2),i_{10},\ n=N} \quad (139)$$

$U^P_{y,a,v,\ line(2),i_{10},\ n=N}$ - Voltage of the last branch, phase wire of phase A in time of maximum load (kV);
[i_{10}] – index that corresponds to certain scheme;
[B] – index, which corresponds to the baseline scenario;
[P] – index, which corresponds to the project scenario;
[$line(2)$] – index, which corresponds to line with distributed load;
[y] – index which corresponds to the monitoring period;
[a] – index that corresponds to phaseA (ETL);
[n] – index that corresponds to number of section;
[N] – index that corresponds to the last section;
[d] – index that corresponds to calculation of section;
[v] – index that corresponds to calculation of branch.

$$I^B_{y,b,d,\ line(2),i_{10},(n=N)} = I^B_{y,b,v,\ line(2),i_{10},(n=N)} = \frac{U^B_{y,b,v,\ line(2),i_{10},\ n=N}}{\left(R^B_{y,b,v,\ line(2),i_{10}} + R^B_{y,b,nav,\ line(2),i_{10}}\right)} \quad (140)$$

$I^B_{y,b,v,\ line(2),i_{10},(n=N)}$– current of the last branch, phase wire of phase B (A);

$U^B_{y,b,v,\,line(2),i_{10},\,n=N}$ – voltage of the last branch, phase wire of phase B (kV);
$R^B_{y,b,nav,\,line(2),i_{10}}$ - load resistance, phase wire of phase A (kW);

$$R^B_{y,b,d,\,line(2),i_{10}} = \frac{R^B_{y,b,d\,line(2),i_{10},\,droty} \cdot L^B_{y,b,\,line(2),i_{10}}}{N^B_{y,b,d,\,line(2),i_{10}}} \quad (141)$$

$R^B_{y,b,d\,line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase B (Ohm/km);
$L^B_{y,b,line(2),i_{10}}$ – Length of line with distributed load of phase B (km);
$N^B_{y,b,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase B (units);

$$I^B_{y,b,d,\,line(2),i_{10},\,n} = I^B_{y,b,d,\,line(2),i_{10},(n+1)} + I^B_{y,b,v,\,line(2),i_{10},n} \quad (142)$$

$I^B_{y,b,d,\,line(2),i_{10},(n+1)}$ – Current of a next section, phase wire of phase B of a line with distributed load (A);
$I^B_{y,b,v,\,line(2),i_{10},n}$ – Current of branch "n", phase wire of phase B of a line with distributed load (A);

$$I^B_{y,b,v,line(2),i_{10},\,n} = \frac{U^B_{y,b,v,\,line(2),i_{10},\,n}}{\left(R^B_{y,b,v,\,line(2),i_{10}} + R^B_{y,b,nav,\,line(2),i_{10}}\right)} \quad (143)$$

$U^B_{y,b,v,\,line(2),i_{10},\,n}$ - Voltage of branch "n", phase wire of phase B (kV);
$R^B_{y,b,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase B (Ohm/km);
$R^B_{y,b,nav,\,line(2),i_{10}}$ – Load resistance of phase wire of phase B (kW);

$$U^B_{y,b,v,\,line(2),i_{10},\,n} = U^B_{y,b,v,\,line(2),i_{10}(n+1)} + I^B_{y,b,v,\,line(2),i_{10},\,(n+1)} \cdot R^B_{y,b,d,\,line(2),i_{10}} \quad (144)$$

$U^B_{y,b,d,\,line(2),i_{10}(n+1)}$ – Voltage of a next branch "n", phase wire of phase B (kV);
$I^B_{y,b,d,\,line(2),i_{10},\,(n+1)}$ – Current of a next branch «n», phase wire of phase B (A);
$R^B_{y,b,d,\,line(2),i_{10}}$ - Resistance of section, phase wire of phase B (Ohm);

$$U^B_{y,b,v,\,line(2),i_{10},\,n=N} = U^P_{y,b,v,\,line(2),i_{10},\,n=N} \quad (145)$$

$U^P_{y,a,v,\,line(2),i_{10},\,n=N}$ - Voltage of the last branch, phase wire of phase B in time of maximum load (kV);
$[i_{10}]$ – index that corresponds to certain scheme;
[B] – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period;
[a] – index that corresponds to phaseA (ETL);
$[n]$ – index that corresponds to number of section;
$[N]$ – index that corresponds to the last section;
$[d]$ – index that corresponds to calculation of section;

$[v]$ – index that corresponds to calculation of branch.

$$I^B_{y,c,d,\,line(2),i_{10},(n=N)} = I^B_{y,c,v,\,line(2),i_{10},(n=N)} = \frac{U^B_{y,c,v,\,line(2),i_{10},\,n=N}}{\left(R^B_{y,c,v,\,line(2),i_{10}} + R^B_{y,c,nav,\,line(2),i_{10}}\right)} \quad (146)$$

$I^B_{y,c,v,\,line(2),i_{10},(n=N)}$ – current of the last branch, phase wire of phase C (A);
$U^B_{y,c,v,\,line(2),i_{10},\,n=N}$ – voltage of the last branch, phase wire of phase C (kV);
$R^P_{y,c,nav,\,line(2),i_{10}}$ - load resistance, phase wire of phase C (kW);

$$R^B_{y,c,d,\,line(2),i_{10}} = \frac{R^B_{y,c,d\,line(2),i_{10},\,droty} \cdot L^B_{y,c,\,line(2),i_{10}}}{N^B_{y,c,d,\,line(2),i_{10}}} \quad (147)$$

$R^B_{y,c,d\,line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase C (Ohm/km);
$L^B_{y,c,line(2),i_{10}}$ – Length of line with distributed load of phase C (km);
$N^B_{y,c,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase C (units);

$$I^B_{y,c,d,\,line(2),i_{10},\,n} = I^B_{y,c,d,\,line(2),i_{10},(n+1)} + I^B_{y,c,v,\,line(2),i_{10},n} \quad (148)$$

$I^B_{y,c,d,\,line(2),i_{10},(n+1)}$ – Current of a next section, phase wire of phase C of a line with distributed load (A);
$I^B_{y,c,v,\,line(2),i_{10},n}$ – Current of branch "n", phase wire of phase C of a line with distributed load (A);

$$I^B_{y,c,v,line(2),i_{10},\,n} = \frac{U^B_{y,c,v,\,line(2),i_{10},\,n}}{\left(R^B_{y,c,v,\,line(2),i_{10}} + R^B_{y,c,nav,\,line(2),i_{10}}\right)} \quad (149)$$

$U^B_{y,c,v,\,line(2),i_{10},\,n}$ - Voltage of branch "n", phase wire of phase C (kV);
$R^B_{y,c,v,\,line(2),i_{10}}$ - Average resistance of a branch, phase C (Ohm/km);
$R^B_{y,c,nav,\,line(2),i_{10}}$ – Load resistance of phase wire of phase C (kW);

$$U^B_{y,c,v,\,line(2),i_{10},\,n} = U^B_{y,c,v,\,line(2),i_{10}(n+1)} + I^B_{y,c,v,\,line(2),i_{10},\,(n+1)} \cdot R^B_{y,c,d,\,line(2),i_{10}} \quad (150)$$

$U^B_{y,c,d,\,line(2),i_{10}(n+1)}$ - Voltage of a next branch "n", phase wire of phase C (kV);
$I^B_{y,c,d,\,line(2),i_{10},\,(n+1)}$ – Current of a next branch «n», phase wire of phase C (A);
$R^B_{y,c,d,\,line(2),i_{10}}$ - Resistance of section, phase wire of phase C (Ohm);

$$U^B_{y,c,v,\,line(2),i_{10},\,n=N} = U^P_{y,c,v,\,line(2),i_{10},\,n=N} \quad (151)$$

$U^P_{y,a,v,\,line(2),i_{10},\,n=N}$ - Voltage of the last branch, phase wire of phase C in time of maximum load (kV);
$[i_{10}]$ – index that corresponds to certain scheme;
[B] – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;

$[y]$ – index which corresponds to the monitoring period;
[a] – index that corresponds to phaseA (ETL);
$[n]$ – index that corresponds to number of section;
$[N]$ – index that corresponds to the last section;
$[d]$ – index that corresponds to calculation of section;
$[v]$ – index that corresponds to calculation of branch.

$$k^P_{n,y,line(2),i_{10}} = 3 \cdot \frac{I^{2P}_{A,y,line(2),i_{10}} + I^{2P}_{B,y,line(2),i_{10}} + I^{2P}_{C,y,line(2),i_{10}}}{\left(I^P_{A,y,line(2),i_{10}} + I^P_{B,y,line(2),i_{10}} + I^P_{C,y,line(2),i_{10}}\right)^2} \cdot 1 + 1.5 \cdot \frac{R^P_{0,y,line(2),i_{10}}}{R^P_{\phi,y,line(2),i_{10}}} - 1.5 \cdot \frac{R^P_{0,y,line(2),i_{10}}}{R^P_{\phi,y,line(2),i_{10}}} \quad (152)$$

$I^P_{A,y,line(2),i_{10}}$ – current of phase A ETL «i_{10}» (A);
$I^P_{B,y,line(2),i_{10}}$ – current of phase B ETL «i_{10}» (A);
$I^P_{C,y,line(2),i_{10}}$ – current of phase C ETL «i_{10}» (A);
$R^P_{0,y,line(2),i_{10}}$ – resistance of zero wire of corresponding section «i_{10}» ETL (Ohm);
$R^P_{\phi,y,line(2),i_{10}}$- resistance of phase wire of corresponding section «i_{10}» ETL (Ohm);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to leveling of load on phases of ETL;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^P_{0,y,line(2),i_{10}} = R^P_{0n,y,line(2),i_{10}} \cdot L^P_{y,line(2),i_{10}} \quad (153)$$

$R^P_{0n,y,line(2),i_{10}}$ - Specific resistance of zero wire of line with distributed load (Ohm/km);
$L^P_{y,line(2),i_{10}}$ - Length of line with distributed load (km);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^P_{\phi,y,line(2),i_{10}} = R^P_{\phi n,y,line(2),i_{10}} \cdot L^P_{y,line(2),i_{10}} \quad (154)$$

$R^P_{\phi n,y,line(2),i_{10}}$ - Specific resistance of phase wire of line with distributed load (Ohm/km);
$L^P_{y,line(2),i_{10}}$ - Length of line with distributed load (km);
$[i_{10}]$ – index that corresponds to certain section of reconstructed ETL;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$\tau^{P}_{y,line(2),max,i_{10}} = 2 \cdot T^{M}_{y,line(2),i_{10}} - 8760 + \frac{8760 - T^{M}_{y,line(2),i_{10}}}{1 + \frac{T^{M}_{y,line(2),i_{10}}}{8760} - 2 \cdot \frac{P^{P}_{y,line(2),min,i_{10}}}{P^{P}_{y,line(2),max,i_{10}}}} \cdot \left(1 - \frac{P^{P}_{y,line(2),min,i_{10}}}{P^{P}_{y,line(2),max,i_{10}}}\right) \qquad (155)$$

$T^{M}_{y,line(2),i_{10}}$ - Annual number of hours of use of maximum active power of line with distributed load (hour);
$P^{P}_{y,line(2),max,i_{10}}$ - Power that is transported by «i» (lines with distributed load) in an hour of maximum load (kW);
$P^{P}_{y,line(2),min,i_{10}}$ - Power that is transported by «i» (lines with distributed load) in an hour of minimum load (kW);
$[i_{10}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[y]$ – index which corresponds to the monitoring period.

Calculation of electricity losses with the help of equivalent resistance of line with distributed load

$$W^{B}_{y,line(2),i_{10}} = \frac{\left(\frac{P^{P}_{y,line(2),max,i_{10}}}{U^{P}_{y,line(2),max,i_{10}} \cdot cos\varphi^{P}_{y,line(2),i_{10}}}\right)^{2} \cdot R^{B}_{ekv,y,line(2),i_{10}} \cdot k^{P}_{n,y,line(2),i_{10}} \cdot \tau^{P}_{y,line(2),max,i_{10}}}{1000} \qquad (156)$$

$P^{P}_{y,line(2),max,i_{10}}$ – power during maximum load (kW);
$U^{P}_{y,line(2),max,i_{10}}$ - Voltage at the entrance of line during maximum load (V);
$cos\varphi^{P}_{y,line(2),i_{10}}$ - Cosine of the angle between active and gross power during maximum load of line with distributed load;
$R^{P}_{ekv,y,line(2),i_{10}}$ – equivalent resistance of electricity transmission line with distributed load, (Ohm);
$k^{P}_{n,y,line(2),i_{10}}$ – unsymmetry factor (for one phase branch is equal to 1);
$\tau^{P}_{y,line(2),max,i_{10}}$ – period of maximum losses in line with distributed load (hour).
$[i_{10}]$ – index that corresponds to certain scheme;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[max]$ – index that corresponds to maximum;
$[y]$ – index which corresponds to the monitoring period.

$$R^{B}_{ekv,y,line(2),i_{10}} = 1.33\frac{\rho^{B}_{Al,y,line(2),i_{10}}\cdot k^{P}_{Cu,y,line(2),i_{10}}}{P^{2\,P}_{l,y,line(2),i_{10}}}\cdot\sum_{n=1}^{N}\frac{P^{2\,P}_{n,y,line(2),i_{10}}\cdot L^{B}_{n,y,line(2),i_{10}}}{F^{B}_{n,y,line(2),i_{10}}} \quad (157)$$

1.33 – coefficient that accounts for systemic lowering of result of equivalent resistance calculation;
$\rho^{P}_{Al,y,line(2),i_{10}}$ – specific resistance of alluminium for line with distributed load (Ohm·mm^2/m);
$k^{P}_{Cu,y,line(2),i_{10}}$ - Factor that accounts partial use of copper wires in lines with distributed load;;
$P^{P}_{l,y,line(2),i_{10}}$ - Power at the entrance of electricity transmission line (kW);
$P^{P}_{n,y,line(2),i_{10}}$ - Power than runs in the section "n" for lines with distributed load (kW);
$F^{P}_{n,y,line(2),i_{10}}$ – section of wire of section n (mm^2);
$L^{P}_{n,y,line(2),i_{10}}$ - Length between the beginning of a line and point of consumer connection (m).
$[i_{10}]$ – index that corresponds to certain scheme;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[line(2)]$ – index, which corresponds to line with distributed load;
$[y]$ – index which corresponds to the monitoring period.

Electricity losses in the absence of implementation of new or reconstruction of existing branches, in the baseline scenario

$$W^{B}_{y,branch} = \sum_{i_{11}=1}^{I_{11}} W^{B}_{y,branch,i_{11}} \quad (158)$$

$W^{P}_{y,branch,i_{11}}$ – Electricity losses in the absence of implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
$[i_{11}]$ – index that corresponds to certain scheme;
$[B]$ – index, which corresponds to the baseline scenario;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[y]$ – index which corresponds to the monitoring period.

$$W^{B}_{y,branch,i_{11}} = \frac{\left(\frac{P^{P}_{y,branch,max,i_{11}}}{U^{P}_{y,branch,max,i_{11}}\cdot cos\varphi^{P}_{y,branch,i_{11}}}\right)^{2}\cdot R^{B}_{y,branch,i_{11}}\cdot k^{P}_{n,y,branch,i_{11}}\cdot \tau^{P}_{y,branch,max,i_{11}}}{1000} \quad (159)$$

$P^{P}_{y,branch,max,i_{11}}$ - Power that is transported by "i_{11}" (branch) in hour of maximum load (kW);
$U^{P}_{y,branch,max,i_{11}}$ - Voltage at the entrance of line during maximum load (V);
$cos\varphi^{P}_{y,branch,i_{11}}$ - Cosine of the angle between active and gross power in branches during maximum load;
$R^{P}_{y,branch,i_{11}}$ – Resistance of branch of electricity transmission line (Ohm);

$k^{P}_{n,y,branch,i_{11}}$ – Unsymmetry factor (for one-phase branch is equal to 1);
$\tau^{P}_{y,branch,max,i_{11}}$ – Duration of maximum losses in branches (hour).
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[max]$ – index that corresponds to maximum;
$[y]$ – index which corresponds to the monitoring period.

$$R^{B}_{y,branch,i_{11}} = 1.33\frac{\rho^{B}_{Al,y,branch,i_{11}}\cdot k^{P}_{Cu,y,branch,i_{11}}}{P^{2\,P}_{l,y,branch,i_{11}}}\cdot\sum_{n=1}^{N}\frac{P^{2\,P}_{n,y,branch,i_{11}}\cdot L^{B}_{n,y,branch,i_{11}}}{F^{B}_{n,y,branch,i_{11}}} \quad (160)$$

1.33 - coefficient that accounts for systemic lowering of result of equivalent resistance calculation;
$\rho^{P}_{Al,y,branch,i_{11}}$ - specific resistance of alluminium for branches (Ohm·mm^2/m);
$k^{P}_{Cu,y,branch,i_{11}}$ - Factor that accounts partial use of copper wires in branches;
$P^{P}_{l,y,branch,i_{11}}$ - Power at the entrance of electricity transmission line (kW);
$P^{P}_{n,y,branch,i_{11}}$ - Power than runs in the section “n” (kW);
$F^{P}_{n,y,branch,i_{11}}$ - section of wire of section n for branches (mm^2);
$L^{P}_{n,y,branch,i_{11}}$ - Length between the beginning of a line and point of consumer connection (m).
$[i_{11}]$ – index that corresponds to certain scheme;
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[y]$ – index which corresponds to the monitoring period.

$$k^{P}_{n,y,branch,i_{11}} = 3\cdot\frac{I^{2P}_{A,y,branch,i_{11}}+I^{2P}_{B,y,branch,i_{11}}+I^{2P}_{C,y,branch,i_{11}}}{\left(I^{P}_{A,y,branch,i_{11}}+I^{P}_{B,y,branch,i_{11}}+I^{P}_{C,y,branch,i_{11}}\right)^2}\cdot 1+1.5\cdot\frac{R^{P}_{0,y,branch,i_{11}}}{R^{P}_{\phi,y,branch,i_{11}}}-1.5\cdot\frac{R^{P}_{0,y,branch,i_{11}}}{R^{P}_{\phi,y,branch,i_{11}}} \quad (161)$$

$I^{P}_{A,y,branch,i_{11}}$ - Current of phase A of ETL «i_{11}» (A);
$I^{P}_{B,y,branch,i_{11}}$ - Current of phase B of ETL «i_{11}» (A);
$I^{P}_{C,y,branch,i_{11}}$ - Current of phase C of ETL «i_{11}» (A);
$R^{P}_{0,y,branch,i_{11}}$ – resistance of zero wire of corresponding section «i_{11}» ETL (Ohm);
$R^{P}_{\phi,y,branch,i_{11}}$- – resistance of phase wire of corresponding section «i_{11}» ETL (Ohm);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;

$[y]$ – index which corresponds to the monitoring period.

$$R^P_{0,y,branch,i_{11}} = R^P_{0n,y,branch,i_{11}} \cdot L^P_{y,branch,i_{11}} \quad (162)$$

$R^P_{0n,y,branch,i_{11}}$ - Specific resistance of zero wire of branches (Ohm/km);
$L^P_{y,branch,i_{11}}$ - Length of branches (km);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$R^P_{\phi,y,branch,i_{11}} = R^P_{\phi n,y,branch,i_{11}} \cdot L^P_{y,branch,i_{11}} \quad (163)$$

$R^P_{0n,y,branch,i_{11}}$ - Specific resistance of phase wire of branches (Ohm/km);
$L^P_{y,branch,i_{11}}$ - Length of electricity transmission line (km);
$[i_{11}]$ – index that corresponds to certain scheme;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index which corresponds to the monitoring period.

$$\tau^P_{y,branch,max,i_{11}} = 2 \cdot T^M_{y,branch,i_{11}} - 8760 + \frac{8760 - T^M_{y,branch,i_{11}}}{1 + \frac{T^M_{y,branch,i_{11}}}{8760} - 2 \cdot \frac{P^P_{y,branch,min,i_{11}}}{P^P_{y,branch,max,i_{11}}}} \cdot \left(1 - \frac{P^P_{y,branch,min,i_{11}}}{P^P_{y,branch,max,i_{11}}}\right) \quad (164)$$

$T^M_{y,branch,i_{11}}$ - Annual number of hours of maximum active power use in ETL «i» (hour);
$P^P_{y,branch,max,i_{11}}$ - Power that is transported by «i_{11}» (branch) in an hour of maximum load (kW);
$P^P_{y,branch,min,i_{11}}$ - Power that is transported by «i_{11}» (branch in an hour of minimum load (kW);
$[i_{11}]$ – index that corresponds to certain scheme;
$[P]$ – index, which corresponds to the project scenario;
$[branch]$ – index that corresponds to new and reconstructed branches;
$[max]$ – index that corresponds to maximum;
$[min]$ – index that corresponds to minimum;
$[y]$ – index which corresponds to the monitoring period.

GHG emissions in the absence of reconstruction of existing segments of electrical grids in period «y» in the baseline scenario

$$BE^B_{y,segm} = \sum_{i_{12}=1}^{I_{12}} \sum_{n=1}^{N} W^B_{y.n.(segm\ n).i} \cdot EF \quad (165)$$

$W^{B}_{y.n.(segm\,n).i_{12}}$-- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[i_{12}]$ – index that corresponds to certain scheme;
$[segm\,n]$ – index of grid element belonging to the set of elements considered in the project, that identifies it in terms of methods of calculating energy losses in the network elements identified in the project
$[B]$ – index, which corresponds to the baseline scenario;
$[n]$ – number of element of grid segment, that existed before reconstruction of segment in it;
$[y]$ – index which corresponds to the monitoring period.

GHG emissions in the absence of systemic effect from implementation of new or reconstruction of existing elements and segments of electrical grid in the baseline scenario

$$BE^{B}_{y,system}=W^{B}_{y,system}\cdot \mathrm{EF} \qquad (166)$$

$W^{B}_{y,system}$ - Electricity losses in the absence of systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the baseline scenario (ths. kWh)
EF – carbon dioxide emission factor (t CO_2e/kWh);
n , m — indexes that correspond to a certain voltage class from the range U , for example $n=1$ corresponds to voltage class of 0.38 kV; $n=2$ corresponds to voltage class of 3 kV and so on; comparisons of index m and range U are similar.

Volume of electricity, which has to be transferred in period y to the grids of voltage class with the index m for all consumers connected to them is calculated as follows:

$$W^{B}_{y,system}=\left(\sum_{n\in\{n/\forall m\}}W^{B,T,n}_{y,system,n/m}+W^{P,C}_{y,system,n}+\Delta W^{P}_{1\div(y-1),elem,n}+\Delta W^{P}_{(y-1),segm,n}+\frac{1}{2}\cdot(\Delta W^{P}_{y,system,n}+\Delta W^{P}_{y,segm,n})\right)\cdot\left(1+K^{P,L}_{y,system,n}\right) \qquad (167)$$

$W^{B,T,n}_{y,system,n/m}$ - Volume of electricity, which was transferred in period y to transformer from the grids of voltage class with the index n for transformation of electricity for consumption in the grids of voltage class with the index m , here $n>m$ (ths. kW);
$W^{P,C}_{y,system,n}$ – Volume of electricity, which was consumed in period y in the grids of voltage class with the index n by all consumers connected to them (net consumption), of the project scenario (ths. kWh)

$\Delta W^{P}_{1\div(y-1),elem,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period «$(1 \div (y-1))$, of the project scenario (ths. kWh);
$\Delta W^{P}_{y,system,n}$ Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period «*y*» of the project scenario (ths kWh);
$\Delta W^{P}_{(y-1),segm,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period «*y-1*» of the project scenario (ths kWh);
$\Delta W^{P}_{y,segm,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period «*y*» of the project scenario (ths kWh);
$K^{P,L}_{y,system,m}$ - Electricity loss coefficient in grids of voltage type with index m (without losses in transformers) in period «*y*», of the project scenario;

If in the previous period that is in period $(y-1)$, the measures on electricity losses reduction in grids when transporting thereof took place the will lead to reduction of electricity losses in the grids of voltage class with index m by the value $\Delta W^{P}_{(y-1),system,n}, \Delta W^{P}_{y,system,n}$, and the measures implemented in the period - y - $\frac{1}{2} * \Delta W^{P}_{(y-1),segm,n}$, $\Delta W^{P}_{y,segm,n}$.

Volume of electricity that outflew in period «y» from transformer for its consumption in the grid of voltage classe with index m, after its conversion from voltage networks with index n, here $n > m$

$$W^{B,T,n}_{y,system,n/m} = W^{B,T,m}_{y,system,\forall n/m} \cdot K^{B,T,\frac{n}{m}}_{y,system,m} \cdot \left(1 + K^{P,T,\frac{n}{m}}_{y,sys}\right) + W^{P,T}_{y,system,n.yp} \qquad (168)$$

$W^{B,T,m}_{y,system,\forall n/m}$ - Volume of electricity that outflew in period «y» from transformer for its consumption in the grid of voltage classe with index m, after its conversion from voltage networks with index n, here $n > m$ (ths. kWh);
$K^{B,T,n/m}_{y,system,m}$ -Electricity loss coefficient in transformer for period y, that takes place because of convertion of energy from the grids of voltage class with index n to grids of voltage class with index m, here $n > m$;
$K^{P,T,n/m}_{y,system}$ - Electricity loss coefficient in transformer for period y, that takes place because of convertion of energy from the grids of voltage class with index n to grids of voltage class with index m, here $n > m$;
$W^{P,T}_{y,system,n.yp}$ – No-load electricity losses in transformer for period y, that take place because of convertion of energy from the grids of voltage class with index n to grids of voltage class with index m, here $n > m$ (ths. kWh);

Electricity loss coefficient in transformer for period y, that takes place because of convertion of energy from the grids of voltage class with index n *to grids of voltage class with index* m *, here* $n > m$ *;*

$$K_{y,system,m}^{B,T,\frac{n}{m}} = \frac{W_{y,system,m}^{P,T,n}}{W_{y,system,m}^{P} - W_{y,system,m}^{P,I}} \quad (169)$$

$W_{y,system,m}^{P,T,n}$ - volume of electricity that outflew during the period y from the transformer for its consumption in the grid of voltage class with index m, after its conversion from grids of voltage class with index n, here $n > m$,in the project scenario (ths kWh);

$W_{y,system,m}^{P}$ - Volume of electricity, which has to be transferred in period y to the grids of voltage class with the index m for all consumers connected to them (gross consumption), of the project scenario(ths kWh);

$W_{y,system,m}^{P,I}$ - Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external consumers, of the project scenario (ths kWh);

$$W_{y,system,\forall n/m}^{B,T} = W_{y,system,m}^{B} - W_{y,system,m}^{B,I} \quad (170)$$

$W_{y,system,m}^{B}$ - Volume of electricity, which has to be transferred in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), in the baseline scenario (ths kWh);

$W_{y,system,m}^{B,I}$ - Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external consumers, in the baseline scenario (ths kWh);

Volume of electricity, which has to be transferred in period «y» to grids of 0.38 kV voltage class for all consumers connected to them, in the baseline scenario is calculated as follows:

$$W_{y,system,0.38}^{B} = \left(W_{y,system,0.38}^{P} + \Delta W_{1\div(y-1),elem,n}^{P} + \Delta W_{(y-1),segm,n}^{P} + \frac{1}{2} * (\Delta W_{y,system,n}^{P} + \Delta W_{y,segm,n}^{P})\right) \quad (171)$$

$W_{y,sys,0.38}^{P}$ - Volume of electricity, which has to be transferred in period y to the grids of voltage class with the index m for all consumers connected to them (gross consumption), of the project scenario (ths kW);

$\Delta W_{1\div(y-1),elem,n}^{P}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period $(1 \div (y-1))$, of the project scenario (ths kWh);

$\Delta W_{y,system,n}^{P}$ Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period «*y*» of the project scenario (ths kWh);

$\Delta W_{(y-1),segm,n}^{P}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period «*y-1*» of the project scenario (ths kWh);

$\Delta W_{y,segm,n}^{P}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period «*y*» of the project scenario (ths kWh);

$$W_{y,system,m}^{B,I} = W_{y,system,m}^{P,I} \cdot K_{y,system,m}^{B} \quad (172)$$

$W^{P,I}_{y,system,m}$ - Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external consumers, of the project scenario (ths kWh);
$K^{B}_{y,system,m}$ – change in volume of electricity transmission coefficient, in the baseline scenario;

$$K^{B}_{y,system,m} = \frac{W^{B}_{y,system,m}}{W^{P}_{y,system,m}} \qquad (173)$$

$W^{B}_{y,system,m}$ - Volume of electricity, which has to be transferred in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), in the baseline scenario (ths kWh);
$W^{P}_{y,system,m}$ - Volume of electricity, which has to be transferred in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), of the project scenario (ths kWh);
$[B]$ – index, which corresponds to the baseline scenario;
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – index, which corresponds to monitoring period.

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

D.1.2.1. Data to be collected in order to monitor emission reductions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N/A

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

N/A

D.1.3. Treatment of leakage in the monitoring plan:

There are no leakages. Dynamic baseline (is based on data collected for the monitoring) excludes all possible leakages.

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

N/A

D.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

N/A

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Estimation of emissions for the project activity (calculated for a specific approach for Joint Implementation):

$$ER^{y} = BE_{y}^{B} - PE_{y}^{P} \qquad (174)$$

ER^{y} – emission reduction due to the project activity, during the monitoring period «*y*» (tCO_2e);

BE_{y}^{B} – GHG emissions from burning fossil fuels for production of electricity that is lost in the distribution electrical grid in period «*y*» under the baseline scenario, (tCO_2e);

PE_{y}^{P} - GHG emissions from burning fossil fuels when producing electricity that is lost in the distribution electrical grid in period «*y*» under the project scenario, (tCO_2e);

y - - relates to monitoring period;

b - - relates to baseline scenario;

p - - relates to project scenario.

Accompanying document 1 contains the calculation of baseline and project emissions and emission reductions under the project for each reporting year.

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

The Project provides for replacement of electrical grids, transformers, meters and other equipment that is used in the process of electricity transmission. Equipment that will be put out from operation within the project will be written off and dismantled. “Acts of the write-off OZ-3” will be executed by a Commission and this Commission will also prepare an opinion of impossibility to further use this equipment.
The equipment is taken to the warehouse and according to the decree #408 of Cabinet of Ministers of Ukraine (dated 16/03/1999) "On the system of collection, sorting, transporting, processing and recycling of used packaging and municipal solid waste"[52] it will further be sold to companies that deal with metal waste utilization.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data *(Indicate table and ID number)*	Data *(Indicate table and ID number)*	Data *(Indicate table and ID number)*
Розділ D1.1.1 та D1.1.3: 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 3, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 4, 5, 6, 6.1, 6.2, 8, 8.1, 9, 9.2, 10, 10.1, 10.2,	Low	Measured by means of a variety of electrical appliances and data of regularly calibrated and verified electricity meters, in accordance with quality management procedure, the law of Ukraine "On metrology and metrological activity"[53]. The final results are entered in the official reports that are submitted to the regulators, where they are additionally checked

[52] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=408-99-%EF

[53] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1765-15

11, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7, 11.8, 11.9, 11.10, 11.11, 11.12, 11.13, 11.14, 11.15, 11.16, 11.17, 11.18, 11.19, 11.20, 11.21, 11.22, 11.23, 11.24, 11.25, 11.26, 11.27, 11.28, 11.29, 11.30, 11.31, 11.32, 11.33, 11.34, 11.35, 11.36, 11.37, 11.40, 11.41, 11.43, 12, 12.1, 12.2, 12.5, 12.6, 12.8, 12.9, 12.10, 12.11, 12.12, 12.13, 12.14, 12.15, 12.16, 16.5, 16.6, 16.7, 16.8, 16.9, 16.10, 16.11, 16.12, 16.14, 17.7, 17.8, 17.9, 17.10, 17.11, 17.12, 17.13, 18, 18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7, 18.8, 18.9, 18.10, 19, 20, 21, 21.1, 21.2, 23, 23.1, 24, 24.2, 25, 25.1, 25.2, 26, 26.1, 26.2, 26.3, 26.4, 26.5, 26.6, 26.7, 26.8, 26.9, 26.10, 26.11, 26.12, 26.13, 26.14, 26.15, 26.16, 26.17, 26.18, 26.19, 26.20, 26.21, 26.22, 26.23, 26.24, 26.25, 26.26, 26.27, 26.28, 26.29, 26.30, 26.31, 26.32, 26.33, 26.34, 26.35, 26.36, 26.37, 26.40, 26.41, 26.43, 27, 27.1, 27.2, 27.5, 27.6, 27.8, 27.9, 27.10, 27.11, 27.12, 27.13, 27.14, 27.15, 27.16		

Розділ D1.1.1 та D1.1.3: 1.2, 1.4, 2.2, 2.6, 4.2, 5.2, 8.3, 11.39, 12.4, 13, 14, 15 16.2, 16.4, 17.2, 17.6, 19.2, 20.2, 23.3, 26.39, 27.4, 28, 29, 30	Low	Data taken from the official methods (sources) of calculation and reduction of process losses of electricity in distribution grids that are approved at the State level and are binding on all energy companies (EC) of Ukraine that have the distribution grids.
Розділ D1.1.1 та D1.1.3: 1, 1.1, 1.3, 1.12, 1.14, 2, 2.1, 2.3, 2.4, 2.5, 3.3, 3.11, 4.1, 5.1, 7, 8.2, 9.1, 11.1, 11.5, 11.10, 11.14, 11.19, 11.23, 11.30, 11.32, 11.38, 11.42, 12.3, 12.7, 12.12, 12.14 16, 16.1, 16.3, 16.12, 16.14, 17, 17.1, 17.3, 17.4, 17.5, 18.3, 18.11, 19.1, 20.1, 22, 23.2, 24.1, 26.1, 26.5, 26.10, 26.14, 26.19, 26.23, 26.30, 26.32, 26.38, 26.42, 27.3, 27.7, 27.12, 27.14	Low	Passport data of equipment, of foreign and domestic manufacturers of electrical equipment which doesn't raise any doubt in the quality and smooth operation of equipment when providing electricity supply services to consumers of all forms of ownership. .

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

Operational structure includes Supplier's (OJSC "Odesaoblenergo") operational departments (repair-and-renewal operations, etc.) and personnel for operation of the distribution electrical grids.
Management structure includes administration departments of the Supplier and project's specialists-developers (VEMA S.A.).
Detailed operation management structure and administration structure is provided in Figure 12.
Scheme of data collection using automated system of electricity consumption commercial records (ASECCR) in the perimeter of the energy supply company is listed in Figure 13.
Scheme of data collection prior to implementation of the automated system of electricity consumption commercial records (ASECCR) is shown in Figure 14.

Measures on control of the electrical energy that is transported by OJSC "Odesaoblenergo":

1. During the settlement period (settlement month is determined by the terms of the contract on supply of electric power) the current control of the metering of electric energy is carried out;
2. On a day, stipulated by a contract, usually at 0h. 00min. on the first day of the month following the settlement month, a chief of a district or a representative authorized by him shall take the readings with the help of ASECCR of the of electric energy meters (electric energy meters are the devices, which passed state certification, registered under contractual conditions and sealed with the execution of a sealing Act);
3. "Report on electric energy meters readings" shall be made according to the readings of electric energy meters;
4. Following the "Report on electric energy meters readings the "Act of supplied electric energy" is made and approved by the company's round seal;
5. OJSC "Odesaoblenergo" submits the approved "Act of supplied electric energy" to NPC "Ukrenergo" via the SE "Energorynok", wherein it obtains invoices for payment;
6. All invoices are stored in the archive of OJSC "Odesaoblenergo" in paper form.

Recording and archiving of data

A responsible person for the joint implementation project, designated by the project owner, monitors data in electronic and paper form. Electronic documents must be printed and saved.

Project owner shall retain copies of the transmitted electricity.

All data and documents in paper form should be archived and a backup copy should be transferred to project coordinator.

All data should be kept for two years after the transfer of emission reduction units generated by the project.

Study

Before the beginning of work on the project and during the project period VEMA S.A. employees will consult people responsible for the development of monitoring at OJSC "Odesaoblenergo".

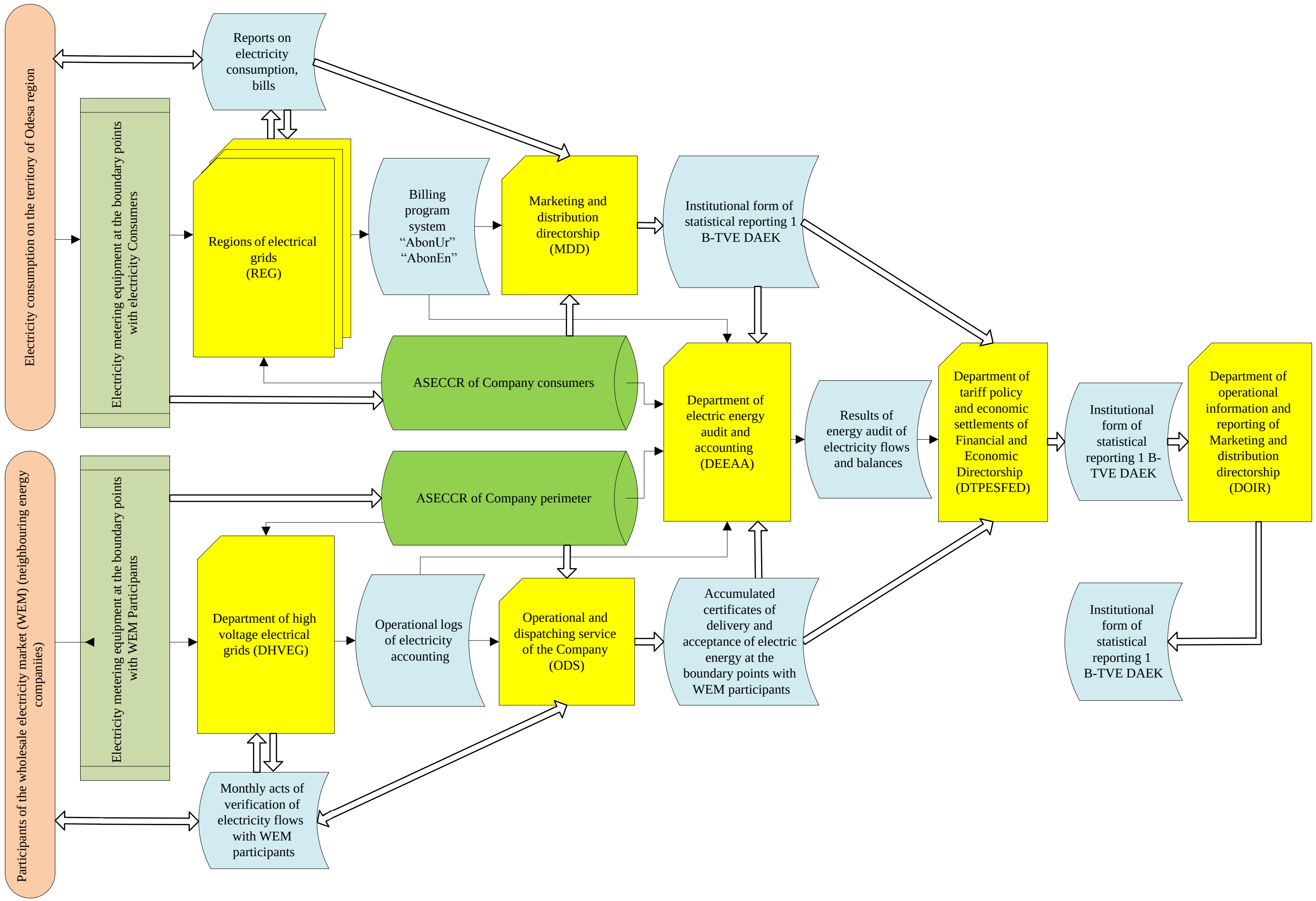


Figure 12. Scheme of operational administrative and management structure

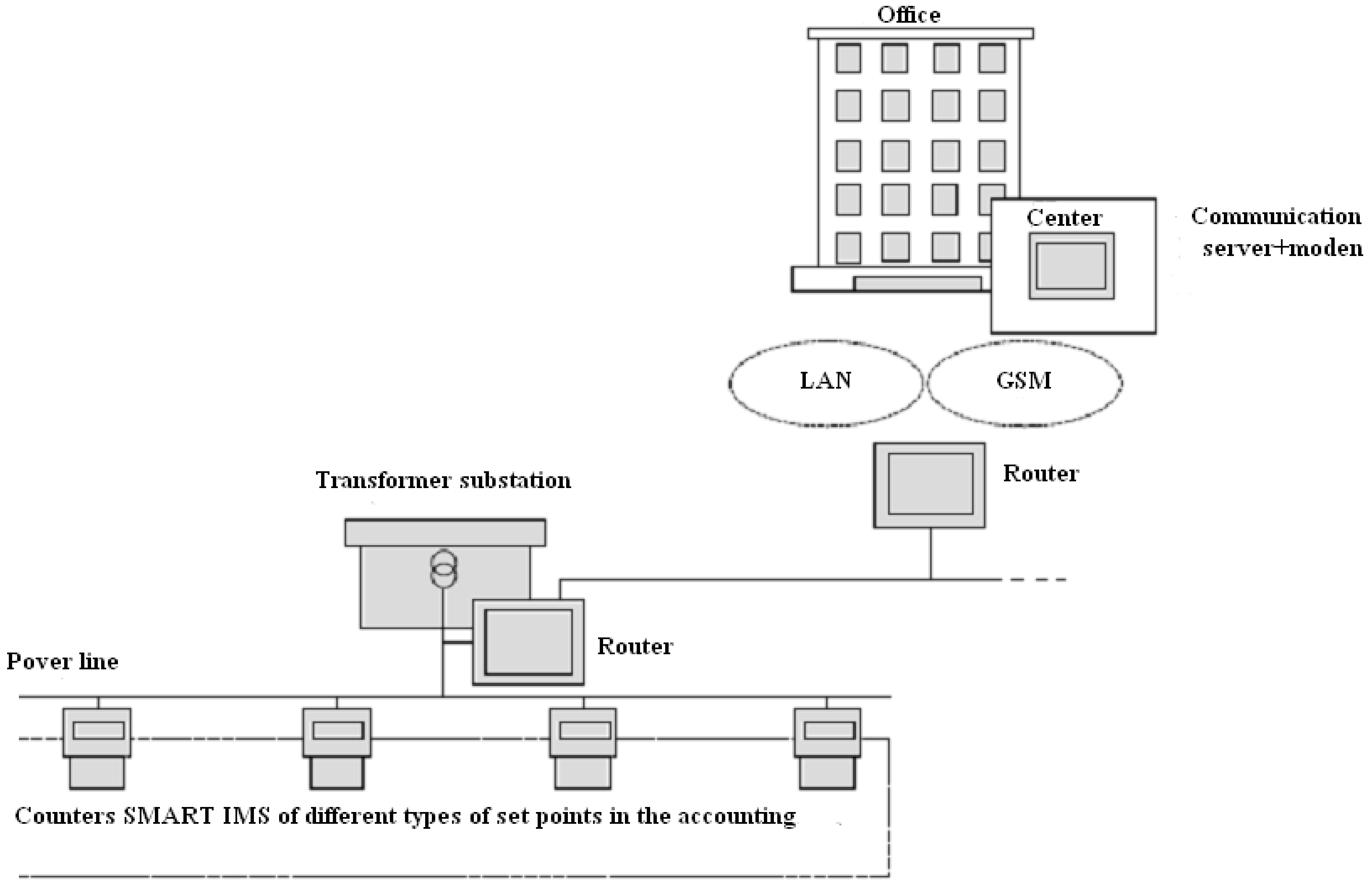
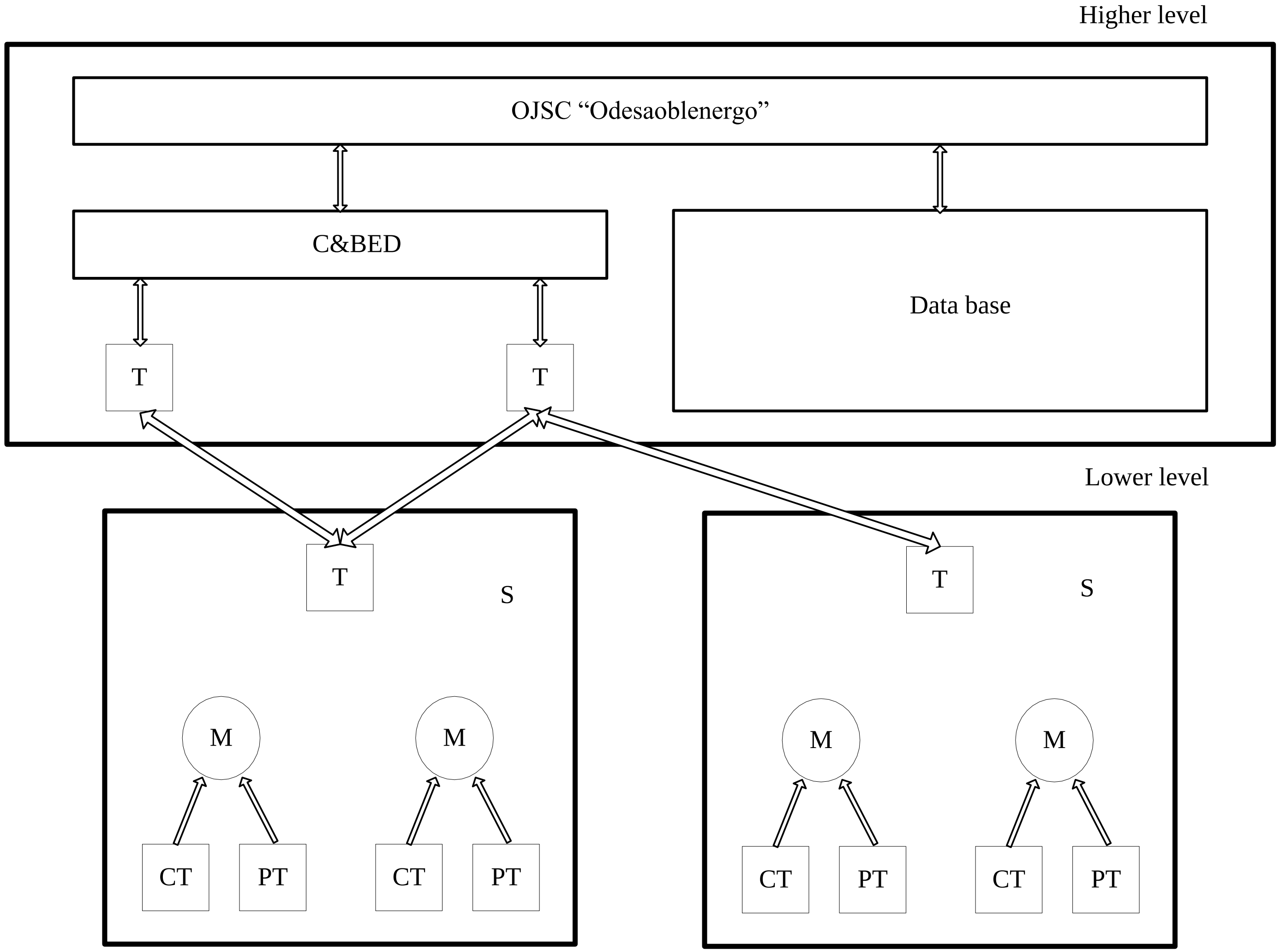


Figure 13. Scheme of data collection using automated system of electricity consumption commercial records (ASECCR) in the perimeter of the energy supply company



Legend
T - telephone;
CT - current transformer;
PT – power transformer;
S - Substation;
M - meter;
C&BED – Calculations and the balance of electricity department

Data of energy meters at the substation are taken by on-duty personnel.

Figure 14. Scheme of data collection prior to implementation of the automated system of electricity consumption commercial records (ASECCR)

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

Monitoring plan is determined by VEMA S.A., project's developer, and OJSC "Odesaoblenergo", the host of the project.

Open Joint Stock Company "Odesaoblenergo"
Odesa, Ukraine
Stryuchenko Oleksandr Mykolayovych
Financial director
Telephone/Fax: +38 (048)-705-20-59
E-mail: findir@oblenergo.odessa.ua
Open Joint Stock Company "Odesaoblenergo" is the project participant (stated in Annex 1).

VEMA S.A.:
Kyiv, Ukraine
Telephone: +38 (044) 594-48-10
Fax: +38 (044) 594-48-19
e-mail: info@vemacarbon.com
VEMA S.A is a project participant (Annex 1)

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Estimated project emissions were calculated in accordance with the formulae specified in section D.1.1.2. Results are given in the tables below. Calculations are given in the accompanying document 1, attached to the PDD.

During the period of 2004-2010 estimated project emissions are determined relying on the estimated and actual data on the amount of process losses of electricity in the distribution electrical grids of OJSC "Odesaoblenergo", and for the period of 2011-2020 - predicted by the enterprise's development plan.

Table 11. Estimated project emissions for the period from January 1, 2004 to December 31, 2007

Year	Project emissions (tCO_2 equivalent)
2004	28 856
2005	53 147
2006	86 568
2007	110 445
Total project emissions over the crediting period of 2004-2007 (tonnes of CO_2 equivalent)	**279 016**

Table 12. Estimated project emissions for the period from January 1, 2008 to December 31, 2012

Year	Project emissions (tCO_2 equivalent)
2008	189 466
2009	253 628
2010	324 342
2011	323 451
2012	323 451
Total project emissions over the crediting period of 2008-2012 (tonnes of CO_2 equivalent)	**1 414 338**

Table 13. Estimated project emissions for the period from January 1, 2013 to December 31, 2020

Year	Project emissions (tCO_2 equivalent)
2013	323 451
2014	323 451
2015	323 451
2016	323 451
2017	323 451
2018	323 451
2019	323 451
2020	323 451
Total project emissions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	**2 587 608**

E.2. Estimated leakage:

There are no expected leakages.

E.3. Sum E.1 and E.2.:

Since there are no leakages the sum of emissions from leakages and from the project activity is equal to the emissions from the project activity. The results are given in tables below.

Table 14. Table contains the sum of emissions from leakage and the project activity for the period January 1, 2004 – December 31, 2007

Year	Expected project emissions (t CO_2e)	Expected leakage (t CO_2e)	Expected emission reductions (t CO_2e)
2004	28 856	0	28 856
2005	53 147	0	53 147
2006	86 568	0	86 568
2007	110 445	0	110 445
Total emissions (t CO_2e)	**279 016**	**0**	**279 016**

Table 15. Table contains the sum of emissions from leakage and the project activity for the period January 1, 2008 – December 31, 2012

Year	Expected project emissions (t CO_2e)	Expected leakage (t CO_2e)	Expected emission reductions (t CO_2e)
2008	189 466	0	189 466
2009	253 628	0	253 628
2010	324 342	0	324 342
2011	323 451	0	323 451
2012	323 451	0	323 451
Total emissions (t CO_2e)	**1 414 338**	**0**	**1 414 338**

Table 16. Table contains the sum of emissions from leakage and the project activity for the period January 1, 2013– December 31, 2020

Year	Expected project emissions (t CO_2e)	Expected leakage (t CO_2e)	Expected emission reductions (t CO_2e)
2013	323 451	0	323 451
2014	323 451	0	323 451
2015	323 451	0	323 451
2016	323 451	0	323 451
2017	323 451	0	323 451
2018	323 451	0	323 451
2019	323 451	0	323 451
2020	323 451	0	323 451
Total emissions (t CO_2e)	**2 587 608**	**0**	**2 587 608**

E.4. Estimated baseline emissions:

Estimated baseline emissions were calculated in accordance with the formulae specified in section D.1.1.4.

Results are given in the tables below. Calculations are given in the accompanying document 1, attached to the PDD.

During the period of 2004-2010 estimated baseline emissions are calculated relying on the estimated and actual data on the amount of process losses of electricity in the distribution electrical grids of OJSC "Odesaoblenergo", and for the period of 2011-2020 - predicted by the enterprise's development plan.

Table 17. Estimated baseline emissions for the period from January 1, 2004 to December 31, 2007

Year	Estimated baseline emissions (tCO_2 equivalent)
2004	89 211
2005	158 095
2006	258 623
2007	337 031
Total baseline emissions over the crediting period of 2004-2007 (tonnes of CO_2 equivalent)	**842 960**

Table 18. Estimated baseline emissions for the period from January 1, 2008 to December 31, 2012

Year	Estimated baseline emissions (tCO_2 equivalent)
2008	572 647
2009	772 663
2010	1 005 333
2011	1 002 574
2012	1 002 574
Total baseline emissions over the crediting period of 2008-2012 (tonnes of CO_2 equivalent)	**4 355 791**

Table 19. Estimated baseline emissions for the period from January 1, 2013 to December 31, 2020

Year	Estimated baseline emissions (tCO_2 equivalent)
2013	1 002 574
2014	1 002 574
2015	1 002 574
2016	1 002 574
2017	1 002 574
2018	1 002 574
2019	1 002 574
2020	1 002 574
Total baseline emissions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	**8 020 592**

E.5. Difference between E.4. and E.3. representing the emission reductions of the project:

Emission reductions are calculated according to formula (174) described in section D.1.4. Results are given in the tables below. Calculations are given in the accompanying document 1, attached to the PDD.

Table 20. Estimated emission reductions for the period from January 1, 2004to December 31, 2007

Year	Estimated emission reductions (t CO_2 equivalent)
2004	60 355
2005	104 948
2006	172 055
2007	226 586
Total estimated emission reductions over the crediting period of 2004-2007 (tonnes of CO_2 equivalent)	**563 944**

Table 21. Estimated emission reductions for the period from January 1, 2008 to December 31, 2012

Year	Estimated emission reductions (t CO_2 equivalent)
2008	383 181
2009	519 035
2010	680 991
2011	679 123
2012	679 123
Total estimated emission reductions over the crediting period of 2008-2012 (tonnes of CO_2 equivalent)	**2 941 453**

Table 22. Estimated emission reductions for the period from January 1, 2013 to December 31, 2020

Year	Estimated emission reductions (t CO_2 equivalent)
2013	679 123
2014	679 123
2015	679 123
2016	679 123
2017	679 123
2018	679 123
2019	679 123
2020	679 123
Total estimated emission reductions over the crediting period of 2013-2020 (tonnes of CO_2 equivalent)	**5 432 984**

E.6. Table providing values obtained when applying formulae above:

Table 23. Table providing results of emission reduction estimation for the period January 1, 2004 – December 31, 2007.

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2004	28 856	0	89 211	60 355
2005	53 147	0	158 095	104 948
2006	86 568	0	258 623	172 055
2007	110 445	0	337 031	226 586
Total calculated reductions (t CO_2e)	**279 016**	0	**842 960**	**563 944**

Table 24. Table providing results of emission reduction estimation during the period of January 1, 2008 – December 31, 2012.

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2008	189 466	0	572 647	383 181
2009	253 628	0	772 663	519 035
2010	324 342	0	1 005 333	680 991
2011	323 451	0	1 002 574	679 123
2012	323 451	0	1 002 574	679 123
Total calculated reductions (t CO_2e)	**1 414 338**	0	**4 355 791**	**2 941 453**

Table 25. Table providing results of emission reduction estimation for the period January 1 2013- December 31, 2020.

Year	Estimated project emissions (tonnes of CO2 equivalent)	Estimated leakage (tonnes of CO2 equivalent)	Estimated baseline emissions (tonnes of CO2 equivalent)	Estimated emission reductions (tonnes of CO2 equivalent)
2013	323 451	0	1 002 574	679 123
2014	323 451	0	1 002 574	679 123
2015	323 451	0	1 002 574	679 123
2016	323 451	0	1 002 574	679 123
2017	323 451	0	1 002 574	679 123
2018	323 451	0	1 002 574	679 123
2019	323 451	0	1 002 574	679 123
2020	323 451	0	1 002 574	679 123
Total calculated reductions (t CO_2e)	**2 587 608**	0	**8 020 592**	**5 432 984**

SECTION F. Environmental Impacts

F.1. Documentation regarding analysis of project impact on the environment, including transboundary impacts, in accordance with procedures required by the host Party.

Under the legislative framework of Ukraine "On Environmental Protection"[54] and DBN A.2.2-1-2003[55] "Structure and Content of Environmental Impact Assessment (EIA) when Designing and Constructiing Factories, Buildings and Structures" OJSC "Odesaoblenergo" is not obliged to carry out Environmental Impact Assessment for this type of project.
Environmental effect will be caused only by dismantled equipment. It will further be used as secondary raw material.

Implementation of this project will allow for improvement of servicing the consumers of electricity services. Experienced staff of OJSC "Odesaoblenergo" and compliance with the regulations "On electric energy sector"[56] will allow for minimization of the potential emergency situations in the process of the project implementation.

Transboundary impacts from the project activity according to their definition in the text of "Convention on transboundary long-range pollution", ratified by Ukraine, will not take place.

The Project does not assume any detrimental effects on the environment.
OJSC "Odesaoblenergo" has all necessary permits and licenses for maintenance and operation of electrical grids.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

As mentioned above, when analyzing environmental impact it is clear that the project does not make any negative environmental impact.

[54] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=1264-12

[55] http://www.budinfo.com.ua/dbn/8.htm

[56] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=v8_73800-98

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

Since the project activities do not imply any negative environmental impact and negative social effect, special public discussions were not necessary. Consultations with stakeholders were held at meetings with local authorities.

PLE reduction program in the company regularly covered in local media and on television.

There have been numerous publications of Company employees in specialized national magazines. Information of PLE reduction work is covered on the official website of OJSC "Odesaoblenergo" http://www.oblenergo.odessa.ua

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation	Open Joint Stock Company "Odesaoblenergo"
Street/P.O.Box	Sadova
Building	3
City	Odesa
State/Region	
Postal code	65023
Country	Ukraine
Phone	+38 (048)-705-20-59
Fax	+38 (048)-705-20-59
E-mail	findir@oblenergo.odessa.ua
Website	
Represented by	
Title	Financial director
Salutation	
Last name	Struchenko
First name	Mykolayovych
Middle name	Oleksandr
Department	
Fax (direct)	+38 (048)-705-20-59
Phone (direct)	+38 (048)-705-20-59
Cell phone	
Personal e-mail	

Organisation	VEMA S.A.
Street/P.O.Box	Route de Tonon
Building	45
City	Geneva
State/Region	
Postal code	PC 170 CH-1222
Country	Switzerland
Phone	+38 (044) 594 48 10
Fax	+38 (044) 594 48 19
E-mail	info@vemacarbon.com
Website	www.vemacarbon.com
Represented by	
Title	director
Salutation	
Last name	Knodel
First name	Fabian
Middle name	
Department	
Fax (direct)	
Phone (direct)	+380 (44) 206 84 43
Cell phone	
Personal e-mail	

Annex 2

BASELINE INFORMATION

Calculation of the dynamic baseline

Calculation of the dynamic baseline was carried out as per specific approach for Joint Implementation (JI), relying on the "Criteria for selecting the baseline and monitoring".
When choosing a baseline for a JI project a specific approach that meets the requirements specified in Regulation 9/CMP.1. was used.
The specific approach provides a procedure to determine the following parameters:

Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e)	Recording frequency
$S^{P}_{T,y,tran(2),i}$ - Nominal load of a double-winding transformer "i" on the side of high voltage	Nameplate data of equipment	(kVA)	e	Once at the beginning of the project
$\Delta P^{B}_{XX,P,y,tran(2),i}$ - Rated power losses of no-load run in a double-winding transformer «i»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project
$K\Pi^{B}_{XX,y,tran(2),i}$ - Degradation factor of no-load run losses in a double-winding transformer "i"	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$\Delta P^{B}_{кз,P,y,tran(2),i}$ - Rated power losses of short circuit in a double-winding transformer «i»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project
$K\Pi^{B}_{кз,y,tran(2),i}$ - Degradation factor of short-circuit losses in a double-winding transformer "i"	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$P^{P}_{y,tran(2),max,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually
$cos\varphi^{P}_{y,tran(2),i}$ - Cosine of the angle between active and gross power in	To measure cosine of the angle between active and gross power phase meter is used		m	annually

a double-winding transformer «i»				
$T^{M}_{y,tram(2),i}$ – Annual number of hours of maximum power use in transformer "i"		(hour)	m	annually
$P^{P}_{y,tran(2),min,i}$ – Power of a double-winding transformer "i" at the side of high voltage in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually
$I^{P}_{A,y,tran(2),i}$- Current of phase A in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{B,y,tran(2),i}$- Current of phase B in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{C,y,tran(2),i}$- Current of phase C in double-winding transformer "i"	To measure current ammeter or galvanometer are used	(A)	m	annually
$R^{P}_{0n,y,tran(2),i}$ - Specific resistance of zero wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{P}_{y,tran(2),i}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$R^{P}_{фn,y,tran(2),i}$ - Specific resistance of phase wire in double-winding transformer "i"	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$S^{P}_{T,y,tran(3),i_1}$ - Nominal load of a three-winding transformer «i_1»	Nameplate data of equipment	(kVA)	e	Once at the beginning of the project
$\Delta P^{B}_{XX,P,y,tran(3),i_1}$ - Rated power losses of no-load run in a three-winding transformer «i_1»	Nameplate data of equipment	(kW)	e	Once at the beginning of the project
$K\Pi^{B}_{XX,y,tran(3),i_1}$ - Degradation factor of no-load run losses in a three-winding transformer	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$\Delta P^{B}_{кз,P,y,tran(3.1),i_1}$ - Rated power losses of short circuit in a three-	Nameplate data of equipment	(kW)	e	Once at the beginning of the

winding transformer «i_1», of high voltage				project
$\Delta P^{B}_{кз,P,y,tran(3.2),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of medium voltage, nameplate	Nameplate data of equipment	(kW)	e	Once at the beginning of the project
$\Delta P^{B}_{кз,P,y,tran(3.3),i_1}$ - Rated power losses of short circuit in a three-winding transformer «i_1», of low voltage, nameplate	Nameplate data of equipment	(kW)	m	Once at the beginning of the project
$К\Pi^{B}_{кз,y,tran(3),i_1}$ - Degradation factor of short-circuit losses in a three-winding transformer	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$P^{P}_{y,tran(3),max,i_1}$ – Power of a three-winding transformer "i_1" in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually
$cos\varphi^{P}_{y,tran(3.1),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of high voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$cos\varphi^{P}_{y,tran(3.2),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of medium voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$cos\varphi^{P}_{y,tran(3.3),i_1}$ - Cosine of the angle between active and gross power in a three-winding transformer "i_1" of low voltage	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$P^{P}_{y,tran(3),min,i_1}$ – Power of a three-winding transformer "i_1" in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually
$T^{M}_{y,tran(3),i_1}$ – Number of hours of maximum power use of windings of a three-winding	Hour-based schedule of power of a working day in a month	(hour)	m	annually

transformer				
$P^{P}_{y,line(1),max,i_2}$ – Power of ETL «i_2» during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually
$U^{P}_{y,line(1),max,i_2}$ – Voltage of ETL «i» during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$cos\varphi^{P}_{y,line(1),i_2}$ – Cosine of the angle between active and gross power in ETL	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$R^{B}_{f,y,line(1),max,i_2}$ – Specific resistance of phase wire in ETL	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{B}_{y,line(1),max,i_2}$ – Length of ETL	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$P^{P}_{y,line(1),min,i_2}$ – Power that is transported by ETL «i_2» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually
$T^{M}_{y,line(1),i_2}$ – річна Annual number of hours of maximum active power use in ETL «i_2»	Hour-based schedule of power of a working day in a month	(hour)	m	annually
$I^{P}_{A,y,line(1),i_2}$ - Current of phase A of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{B,y,line(1),i_2}$ - Current of phase B of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{C,y,line(1),i_2}$ - Current of phase C of ETL «i_2»	To measure current ammeter or galvanometer are used	(A)	m	annually
$R^{P}_{0n,y,line(1),i_2}$ - Specific resistance of zero wire in ETL	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{B}_{y,cable,i_3}$ - Length of electricity transmission line	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$\Delta W^{B}_{п,P,y,cable,i_3}$ - Rated specific losses of insulation of cable «i_3», nameplate	Nameplate data of equipment	(ths. kWh)	e	Once at the beginning of the project
$К\Pi^{B}_{R,y,cable,i_3}$ - Degradation factor of cable insulation	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission		e	annually

	reductions due to process losses reduction in distribution grids of Ukraine»			
$N^{B}_{y,insul,i_4}$ – Number of replaced insulators	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$W^{B}_{P,y,insul,i_4}$ - Rated electricity losses in insulator, nameplate	Nameplate data of equipment	(kWh)	e	Once at the beginning of the project
$K\Pi^{B}_{R,y,insul,i_4}$- Magnification factor of losses in insulator	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$P^{B}_{y,lamp,i_5}$ – power of on signaling lanm or emitting diode	To measure power at transformer active power meters are used	(kW)	m	annually
$N^{B}_{y,lamp,i_5}$ - Number of replaced signalling lamps	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$T^{P}_{y,lamp,i_5}$ - Operational period of signalling lamps	Hour-based schedule of power of a working day in a month	(hour)	m	annually
$\Delta W^{B}_{0.38,y,comp,i_6}$- Specific reduction of losses at voltage of 0,38 kV,	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the project
$\Delta W^{B}_{6-20,y,comp,i_6}$ - Specific reduction of losses at voltage of 6 – 20 kV	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the project
$\Delta W^{B}_{35-154,y,comp,i_6}$ - Specific reduction of losses at voltage of 35 – 154 kV	Nameplate data of equipment	(kW/kVAr)	e	Once at the beginning of the project
$N^{B}_{y,meter,i_7}$– Number of replaced meters	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$T^{P}_{y,meter,i_7}$– Operational period of a meter per year	Hour-based schedule of power of a working day in a month	(unit)	m	annually
$A^{B}_{P,y,meter,i_7}$– Rated electricity losses per hour in one meter	Nameplate data of equipment	(kWh)	e	Once at the beginning of the

				project
$K\Pi^{B}_{R,y,meter,i_7}$ - Degradation factor of electrical characteristics of a meter	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$N^{B}_{y,switch,i_8}$ – Number of replaced switches	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$P^{B}_{y,switch,i_8}$ - Rated power of a switch	Nameplate data of equipment	(kW)	e	Once at the beginning of the project
$N^{B}_{d,y,switch,i_8}$ - Number of days (of switches operation) with a temperature below 5 ^{0}C	Data on meteorological phenomena that were observed by a meteorological station	(unit)	m	annually
$N^{B}_{y,motors,i_9}$ – Number of replaced or reconstructed electrical motors	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$P^{B}_{y,motors,i_9}$ - Power of a motor	To measure power at transformer active power meters are used	(kW)	m	annually
$N^{B}_{d,y,motors,i_9}$ - Number of days (of electric motors operation) with a temperature below 5 ^{0}C	Data on meteorological phenomena that were observed by a meteorological station	(unit)	m	annually
$R^{B}_{y,a,v,\ line(2),i_{10}}$ - Average resistance of a branch, phase A per hour og maximum load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$R^{B}_{y,b,v,\ line(2),i_{10}}$ - Average resistance of a branch, phase B, per hour of maximum load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$R^{B}_{y,c,v,\ line(2),i_{10}}$ - Average resistance of a branch, phase C, per hour of maximum load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$R^{B}_{y,a,nav,\ line(2),i_{10}}$ - Load resistance of phase wire of phase A	To measure voltage of ETL ohmmeter is used	(kW)	m	annually
$R^{B}_{y,a,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase A	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{B}_{y,a,line(2),i_{10}}$ – Length of	Act of state acceptance	(km)	m	annually

line with distributed load of phase A	commission on the acceptance into operation of the completed construction of a facility			
$N^{B}_{y,a,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase A	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$I^{B}_{y,a,d,\,line(2),i_{10},(n+1)}$ – Current of a previous section, phase wire of phase B of a line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually
$U^{B}_{y,a,d,\,line(2),i_{10}(n+1)}$ – voltage of the next branch «n», phase wire of phase A	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$I^{B}_{y,a,d,\,line(2),i_{10},\,(n+1)}$ – Current of the next branch «n», phase wire of phase A	To measure current voltmeter is used	(A)	m	annually
$U^{P}_{y,a,v,\,line(2),i_{10},\,n=N}$ – Voltage of the last branch, phase wire of phase A in the time of maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$R^{B}_{y,b,nav,\,line(2),i_{10}}$ - Load resistance, phase wire of phase B	To measure Load resistance at ETL ohmmeter is used	(kW)	m	annually
$R^{B}_{y,b,d\,line(2),i_{10},\,droty}$ - Resistance of one kilometre of wire of corresponding mark of phase B	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{B}_{y,b,line(2),i_{10}}$ – Length of line with distributed load of phase B	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$N^{B}_{y,b,d,\,line(2),i_{10}}$ – Number of sections (branch connections) of phase B	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$I^{B}_{y,b,d,\,line(2),i_{10},(n+1)}$ – Current of the next section, phase wire of phase B of line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually
$U^{B}_{y,b,d,\,line(2),i_{10}(n+1)}$ – Voltage of the next branch «n», phase wire of phase B	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$I^{B}_{y,b,d,\,line(2),i_{10},\,(n+1)}$ –	To measure current ammeter or	(A)	m	annually

current of the next branch «n», phase wire of phase B	galvanometer are used			
$U^{P}_{y,b,v,\ line(2),i_{10},\ n=N}$ - Voltage of the last branch, phase wire of phase B in the time of manimum loads	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$R^{P}_{y,c,nav,\ line(2),i_{10}}$ - Load resistance of phase wire of phase C	To measure Load resistance at ETL ohmmeter is used	(kW)	m	annually
$R^{B}_{y,c,d\ line(2),i_{10},\ droty}$ - Resistance of one kilometre of wire of corresponding mark of phase C	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{B}_{y,c,line(2),i_{10}}$ – Length of line with distributed load of phase C	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$N^{B}_{y,c,d,\ line(2),i_{10}}$ – Number of sections (branch connections) of phase C	Act of working technical commission on acceptance into operation of distribution electrical grids facilities	(unit)	m	annually
$I^{B}_{y,c,d,\ line(2),i_{10},(n+1)}$ – Current of the next section, phase wire of phase C of line with distributed load	To measure current ammeter or galvanometer are used	(A)	m	annually
$U^{B}_{y,c,d,\ line(2),i_{10}\,(n+1)}$ – Voltage of the next branch «n», phase wire of phase C	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$I^{B}_{y,c,d,\ line(2),i_{10},\ (n+1)}$ – current of the next branch «n», phase wire of phase C	To measure current ammeter or galvanometer are used	(A)	m	annually
$U^{P}_{y,c,v,\ line(2),i_{10},\ n=N}$ – Voltage of the last branch, phase wire of phase C in the time of manimum loads	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$I^{P}_{A,y,line(2),i_{10}}$ - Current of phase A of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{B,y,line(2),i_{10}}$ - Current of phase B of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually

$I^{P}_{C,y,line(2),i_{10}}$ - Current of phase C of ETL «i_{10}»	To measure current ammeter or galvanometer are used	(A)	m	annually
$R^{P}_{0n,y,line(2),i_{10}}$ - Specific resistance of zero wire of line with distributed load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{P}_{y,line(2),i_{10}}$ - Length of line with distributed load	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$R^{P}_{\phi n,y,line(2),i_{10}}$ - Specific resistance of phase wire of line with distributed load	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$T^{M}_{y,line(2),i_{10}}$ - Annual number of hours of use of maximum active power of line with distributed load	Hour-based schedule of power of a working day in a month	(hour)	m	annually
$P^{P}_{y,line(2),max,i_{10}}$ - Power that is transported by ETL «i» in an hour of maximum load	To measure power at transformer active power meters are used	(kW)	m	annually
$P^{P}_{y,line(2),min,i_{10}}$ - Power that is transported by ETL «i» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually
$U^{P}_{y,line(2),max,i_{10}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$cos\varphi^{P}_{y,line(2),i_{10}}$ - Cosine of the angle between active and gross power during maximum load of line with distributed load	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$\rho^{B}_{Al,y,line(2),i_{10}}$ - Specific resistance of aluminium for line with distributed load	Nameplate data of equipment	(Ohm·mm^2/m)	e	Once at the beginning of the project
$k^{P}_{Cu,y,line(2),i_{10}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$P^{P}_{l,y,line(2),i_{10}}$ - Power at the entrance of electricity	To measure power at transformer active power meters are used	(kW)	m	annually

transmission line				
$P^{P}_{n,y,line(2),i_{10}}$ - Power than runs in the section "n"	To measure power at transformer active power meters are used	(kW)	m	annually
$F^{B}_{n,y,line(2),i_{10}}$ – section of wire of section n for line with distributed load	Nameplate data of equipment	(mm^2)	e	Once at the beginning of the project
$L^{B}_{n,y,line(2),i_{10}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(km)	m	annually
$P^{P}_{y,branch,max,i_{11}}$ - Power during maximum load	To measure power at transformer active power meters are used	(kW)	m	annually
$U^{P}_{y,branch,max,i_{11}}$ - Voltage at the entrance of line during maximum load	To measure voltage of ETL voltmeter is used	(kV)	m	annually
$cos\varphi^{P}_{y,branch,i_{11}}$ - Cosine of the angle between active and gross power during maximum load	To measure cosine of the angle between active and gross power phase meter is used		m	annually
$\rho^{B}_{Al,y,branch,i_{11}}$ - Specific resistance of aluminium for branches	Nameplate data of equipment	($Ohm \cdot mm^2/m$)	e	Once at the beginning of the project
$k^{P}_{Cu,y,branch,i_{11}}$ - Factor that accounts partial use of copper wires	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$P^{P}_{l,y,branch,i_{11}}$ - Power at the entrance of electricity transmission line	To measure power at transformer active power meters are used	(kW)	m	annually
$P^{P}_{n,y,branch,i_{11}}$ - Power than runs in the section "n"	To measure power at transformer active power meters are used	(kW)	m	annually
$F^{B}_{n,y,branch,i_{11}}$ – section of wire of section n for branches	Nameplate data of equipment	(mm^2)	e	Once at the beginning of the project
$L^{B}_{n,y,branch,i_{11}}$ - Length between the beginning of a line and point of consumer connection	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(m)	m	annually
$I^{P}_{A,y,branch,i_{11}}$ - Current of phase A of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually
$I^{P}_{B,y,branch,i_{11}}$ - Current	To measure current ammeter or	(A)	m	annually

of phase B of ETL «i_{11}»	galvanometer are used			
$I^{P}_{C,y,branch,i_{11}}$ - Current of phase C of ETL «i_{11}»	To measure current ammeter or galvanometer are used	(A)	m	annually
$R^{P}_{0n,y,branch,i_{11}}$ - Specific resistance of zero wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$L^{P}_{y,branch,i_{11}}$ - Length of electricity transmission line of branches	Act of state acceptance commission on the acceptance into operation of the completed construction of a facility	(m)	m	annually
$R^{P}_{\phi n,y,branch,i_{11}}$ - Specific resistance of phase wire of branches	Nameplate data or measurements with the help of ammeter of voltmeter	(Ohm/km)	e/m	annually
$T^{M}_{y,branch,i_{11}}$ - Annual number of hours of maximum active power use in ETL «i»	Hour-based schedule of power of a working day in a month	(hour)	m	annually
$P^{P}_{y,branch,min,i_{11}}$ - Power that is transported by ETL «i» in an hour of minimum load	To measure power at transformer active power meters are used	(kW)	m	annually
$W^{B}_{y.n.(segm\ n).i_{12}}$- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction	Determined with the help of calculated values of segment of the grid operating mode after its reconstruction	(ths. kWh)	m	annually
$W^{P,C}_{y,system,n}$ – Volume of electricity consumed in period "y" by all consumers connected to grids of voltage class with index n (net consumption), in the project scenario (ths. kWh)	To measure electricity electric meter is used	(ths. kWh)	m	annually
$\Delta W^{P}_{1\div(y-1),elem,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period (1 ÷ (y-1)), in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids"	(ths. kWh)	m	annually
$\Delta W^{P}_{y,system,n}$ Reduction	Departmental reporting form 1B-	(ths. kWh)	m	annually

of electricity losses due to introductions of new or reconstruction of existing elements of electrical grids in period "y", in the project scenario (ths. kWh).	TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids”			
$\Delta W^{P}_{(y-1),segm,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y-1", in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids”	(ths. kWh)	m	annually
$\Delta W^{P}_{y,segm,n}$ - Reduction of electricity losses due to introductions of new or reconstruction of existing segments of electrical grids in period "y", in the project scenario (ths. kWh).	Departmental reporting form 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids”	(ths. kWh)	m	annually
$K^{P,L}_{y,system,m}$ - electricity losses factor in grids of voltage class with index m (without losses in transformers) for period y, in the project scenario	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$K^{P,T,n/m}_{y,system}$ - electricity losses factor in transformer for period y, that takes place due to its conversion from grids of voltage class with indext n in grids of voltage class with index m , here $n > m$	Determined with the help of «Report on scientific and technical work «Evaluation of greenhouse gases emission reductions due to process losses reduction in distribution grids of Ukraine»		e	annually
$W^{P,T}_{y,system,n.yp}$ – electricity losses on no-load run in transformer for period y, that takes place due to its conversion from grids of voltage class with indext	Nameplate data of equipment	(ths. kWh)	e	Once at the beginning of the project

n in grids of voltage class with index m , here $n > m$				
$W^{P,T,n}_{y,system,m}$ - обсяг Volume of electricity that outflew in period «y» from transformer for its consumption in the grid of voltage class with index m, after its conversion from voltage networks with index n, here $n > m$, in the project scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually
$W^{P}_{y,system,m}$ - Volume of electricity, which has to be transfered in period y to the grids of voltage class with the index m for all consumers connected to them (gross consumption), in the project scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually
$W^{P,I}_{y,system,m}$ - Volume of electricity that is received in period y from external suppliers in a grid of regional power distribution company for voltage class with index m, with the exception of electricity that was transported through the grid for external consumers, in the project scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually
$W^{B}_{y,system,m}$ - Volume of electricity, which has to be transfered in period «y» to grids of voltage class with index «m» for all consumers connected to them (gross consumption), in the baseline scenario (ths. kWh)	To measure volume of electricity electric meter is used	(ths. kWh)	m	annually
$W^{P}_{y,system,0.38}$ - Volume of electricity, which has	To measure volume of electricity electric meter is used	(ths. kW)	m	annually

to be transfered in period «y» to grids of voltage class with index «n» for all consumers connected to them (gross consumption), in the project scenario (ths. kW)				
(EF) - Carbon dioxide emission factor (t CO_{2e}/kWh)	Carbon dioxide emission factors for 2004-2005 are taken from the document issued by the Ministry of economy of Netherland "Operational Guidelines for Project Design Documents of Joint Implementation Projects Volume 1: General guidelines" (ERUPT) [57] - Carbon dioxide emission factors for 2006-2007 are taken from the document "Carbon dioxide emission factors (for energy consumption according to the methodology "Ukraine - Assessment of new calculation of CEF", approved by TUV SUD 17.08.2007) [58]; - Carbon dioxide emission factors for 2008 are taken from Order of the National Environmental Investment Agency of Ukraine (hereinafter - NEIAU) № 62 of 15.04.2011 "On approval of specific carbon dioxide emission factors in 2008[59]"; - Carbon dioxide emission factors for 2009 are taken from the Order of NEIAU # 63 of 15.04.2011 "On approval of specific carbon dioxide emission factors in 2009" [60]; - Carbon dioxide emission factors for 2010 are taken from the Order of NEIAU # 43 of 28.03.2011. "On approval of specific carbon dioxide emission factors in 2010"[61];	t CO_2e/kWh	e	annually

[57] http://ji.unfccc.int/CallForInputs/BaselineSettingMonitoring/ERUPT/index.html

[58] http://ji.unfccc.int/UserManagement/FileStorage/46JW2KL36KM0GEMI0PHDTQF6DVI514

[59] http://www.neia.gov.ua/nature/doccatalog/document?id=127171

[60] http://www.neia.gov.ua/nature/doccatalog/document?id=127172

[61] http://www.neia.gov.ua/nature/doccatalog/document?id=126006

	- Carbon dioxide emission factors for 2011 are taken from the Order of NEIAU # 75 of 12.05.2011. "On approval of specific carbon dioxide emission factors in 2011"[62];			

[62] http://www.neia.gov.ua/nature/doccatalog/document?id=127498

Annex 3

MONITORING PLAN

The proposed project uses a specific approach for JI projects on the basis of Guidance on criteria for baseline setting and monitoring, version 2 JISC (Joint Implementation Supervisory Committee – JISC[63]) which meets the requirements of Decision 9/CMP.1, Appendix «B» «Criteria for setting the baseline and monitoring". The monitoring plan is designed for accurate and clear greenhouse gas emissions measurements and calculation and conducted according to practices established at OJSC "Odesaoblenergo" to measure the transmitted and consumed electricity. Monitoring of the project does not require changes in existing metering and data collection system. All relevant data are calculated and recorded and will be stored within two years after emission reduction units generated by the project are delivered.

The monitoring plan includes the following measures:

1. Identify all potential sources of emissions in the project.
2. Gathering information on greenhouse gas emissions within the project for "crediting" period.
3. Evaluation of project schedule.
4. Gathering information on test equipment, the date it's of inspection.
5. Collection and archiving information on the impact of project activities on the environment.
6. Data archiving
7. Determination of the structure responsible for monitoring the project.
8. Analysis of performance of staff training.

Key monitoring data and parameters:

$W^{P}_{y,tran(2)}$ - Electricity losses due to the introduction of new or reconstruction of existing double-winding transformers, in period $"y"$, of the project scenario (ths. kWh);
$W^{P}_{y,tran(3)}$ - Electricity losses due to the introduction of new or reconstruction of existing three-winding transformers, in period $"y"$, of the project scenario (ths. kWh);
$W^{P}_{y,line(1)}$ – Electricity losses due to the introduction of new or reconstruction of existing wires of electricity transmission lines in period $"y"$ of the project scenario (ths. kWh);
$W^{P}_{y,cable}$- Electricity losses in insulation due to the introduction introduction of new or reconstruction of existing wires of electricity transmission lines in period $"y"$, of the project scenario (ths. kWh);
$W^{P}_{y,insul}$ - Electricity losses due to the replacement of defected insulators of electricity transmission lines, in period $"y"$ of the project scenario (ths. kWh);
$W^{P}_{y,lamp}$ - Electricity losses due to the replacement of signaling lamps with light emittind diodes, in period $"y"$ of the project scenario (ths. kWh);
$W^{P}_{y,comp}$ - Electricity losses due to the implementation of reactive power compensation devices at consumer's place, in period «y» in the project scenario (ths. kWh.);
$W^{P}_{y,meter}$ - Electricity losses due to the replacement of electric meters, in period $"y"$ of the project scenario (kWh);

[63] *http://ji.unfccc.int/Ref/Documents/Baseline_setting_and_monitoring.pdf*

$W^P_{y,switch}$ - Electricity losses due to the replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);
$W^P_{y,motors}$ - Electricity losses due to replacement or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the project scenario (ths. kWh);
$W^P_{y,line(2)}$ - Electricity losses due to the replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the project scenario (ths. kWh);
$W^P_{y,branch}$ - Electricity losses due to the implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
$W^P_{y.n.(segm\,n).i_{12}}$ - - Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths. kWh);
$W^P_{y,system}$ - Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the project scenario (ths. kWh);
$W^B_{y,tran(2)}$ - Electricity losses in the absence of the introduction of new or reconstruction of existing double-winding transformers, in period $''y''$, of the baseline scenario (ths. kWh);
$W^B_{y,tran(3)}$ - Electricity losses in the absence of the introduction of new or reconstruction of existing three-winding transformers, in period $''y''$, of the baseline scenario (ths. kWh);
$W^B_{y,line(1)}$ – Electricity losses in the absence of the introduction of new or reconstruction of existing wires of electricity transmission lines in period $''y''$ of the baseline scenario (ths. kWh);
$W^B_{y,cable}$- Electricity losses in insulation in the absence of the introduction introduction of new or reconstruction of existing wires of electricity transmission lines in period $''y''$, of the baseline scenario (ths. kWh);
$W^B_{y,insul}$ - Electricity losses in the absence of the replacement of defected insulators of electricity transmission lines, in period $''y''$ of the baseline scenario (ths. kWh);
$W^B_{y,lamp}$ - Electricity losses in the absence of the replacement of signaling lamps with light emittind diodes, in period $''y''$ of the baseline scenario (ths. kWh);
$W^B_{y,comp}$ - Electricity losses in the absence of the implementation of reactive power compensation devices at consumer's place, in period «y» in the baseline scenario (ths. kWh.);
$W^B_{y,meter}$ - Electricity losses in the absence of the replacement of electric meters, in period $''y''$ of the baseline scenario (kWh);
$W^B_{y,switch}$ - Electricity losses in the absence of the replacement of oil switches with vacuum and sulful hexafluoride switches, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,motors}$ - Electricity losses in the absence of replacement or reconstruction of existing electric motors of power transformers blower cooling, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,line(2)}$ - Electricity losses in the absence of the replacement or reconstruction of existing electricity lines with distributed load, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y,branch}$ - Electricity losses in the absence of the implementation of new or reconstruction of existing branches, in period «y» in the baseline scenario (ths. kWh);
$W^B_{y.n.(segm\,n).i_{12}}$- Electricity losses in element n of the grid's segment before reconstruction of the element that are estimated by means of calculated values of the segment's operating mode after the reconstruction (ths. kWh);
$W^B_{y,system}$ – Electricity losses due to systemic effect in the absence of implementation of new and reconstruction of existing elements and segments of the electrical grid in period «y» in the baseline scenario (ths. kWh);
EF – carbon dioxide emission factor (t CO_2e/kWh);
$[P]$ – index, which corresponds to the project scenario;
$[y]$ – monitoring period.
Monitoring parameters are analized in detail in Section D.1.1.1 and Section D.1.1.2 .