# MONITORING REPORT OF JI PROJECT

**Monitoring period:**
**01/01/2008 – 31/12/2011**

**Version 02**
**January 31, 2012**

**«Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC »**

**CONTENTS**



**ANNEXES**

## SECTION A. General project activity and monitoring information

### A.1. Name of the project:

**«Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC »**
Sectoral scope: 2 – **"**Energy distribution".

### A.2. Information about registration and approval of the project:

The project obtained written approval from Ukraine (the Host country) on 21/12/2011 (Letter of Approval № 3700/23/7, issued by the State Environmental Investment Agency). The project was also approved by Poland, the country – buyer of GHG emission reductions (Letter of Approval № DZKiOApek – 350-2/21931/11/TK issued by the Minister of Environment of Poland dated 16/05/2011p).

### A.3. Brief description of the project:

The main purpose of the Joint Implementation Project (hereinafter - JIP) implementation Vinnytsyaoblenergo PJSC power distribution system modernization" 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, transmission and distribution of electric energy.

Implementation of the measures under the Project allows for improvement of the reliability and efficiency of distribution electrical grids of Public joint stock company Vinnytsyaoblenergo (hereinafter – Vinnytsyaoblenergo PJSC ) and this helps reduce the amount of electricity that is lost during transportation thereof to the consumers of all forms of ownership, so the production of electricity at thermal power plants decreases and correspondingly GHG emissions are reduced.

*The baseline scenario* provides for the further use of existing equipment and routine repairs and recovery works 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 at the pre-project level.

*The project scenario* provides for implementation of new energy efficient equipment and complex of organizational and technical measures aimed at reduction of process losses of electricity (hereinafter – TVE). The Project provides for creation of the TVE management system at the Company that is aimed at efficient implementation of a set of organizational and technical measures as well as and improvement of methodological support of TVE reduction in the course of implementation of licensed types of activity of electricity supply and transfer. The list of these measures is provided below:

- Modernization activity and introduction of new energy efficient equipment;
- Improvement of the reliability of electricity supply;
- Introduction of automated systems of electricity consumption commercial accounting (ASECCA) in the perimeter of energy supply company, ASECCA of consumers and substations;
- Introduction of a complex Program on electricity process losses reductions.

### A.4. Monitoring period:

- Date of commencement of the monitoring period: 01/01/2008.
- Date of termination of the monitoring period: 31/12/2011.

## A.5. Methodology applied to the project:

### A.5.1. Baseline methodology:

**Dynamic baseline** was selected according to a specific approach based on the Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 03.0.0).
The baseline scenario provides for 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 are determined for each project year when monitoring of project activity takes place. These losses are calculated for each project measure based on the data on the grid state before the measure implementation.
Detailed information on the algorithm of baseline emissions calculation is given in determined PDD, version 3.0. 01/11/2011.

### A.5.2. Monitoring methodology:

The proposed project uses a specific approach for Joint Implementation projects on Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality" (Version 03.0.0). The monitoring plan is designed for accurate and clear greenhouse gas emissions measurements and calculation and conducted according to practices established at Vinnytsyaoblenergo PJSC to measure the transmitted and consumed electricity. Monitoring of the project does not require changes in existing metering and data collection system. All monitoring data are calculated, recorded and stored within two years after emission reduction units generated by the project are delivered.

The project «Reduction of Process Losses in Power Lines Vinnytsyaoblenergo PJSC » is aimed at reducing of electricity process losses in the course of electricity transportation to consumers of all forms of ownership. However, it is impossible to assume that in the absence of the project (baseline scenario) the percentage of losses would have remained constant (at the level that is the same as the pre-project level) because it is also affected by other factors that don't depend of the project activities (eg, increase or decrease in the number of consumers, etc.). At the same time one can not provide accurate estimation or foresee the future impact of other factors than those proposed in the project.

"Methodology of determination of the scope of technological power consumption TVE in electrical networks of the power supply power company with voltage of 0,38-150 kW to calculate indirect emissions of carbon dioxide" developed by JSC "LvivORGRES" ( hereinafter the Methodology) under the regulation of " Methodology of calculation of the specific carbon dioxide emissions during the production of the electric power at thermal power plants and during its consumption ", approved by the National Environmental Investment Agency of March 21, 2011 № 39 (hereinafter - DAEI Methodology) and used for calculation of the scope of technological power consumption in electrical networks with voltage 0,38-150 kV of the power company when calculating indirect emissions of carbon dioxide during the transmission and electricity supply. The procedure for monitoring of the TVE volume in electrical systems with voltage 0,38-150 kV of the power company that used to calculate indirect emissions of carbon dioxide for the relevant billing periods by the method is very **simple as there is used only data according to the forms of official and mandatory reporting 1B-TVE, 67 energy and 68 energy**. When the monitoring one must be aware of measurement means and methods of data collection in all directions of transmission and supply, the efficiency of sales departments of energy, only with the purpose of testing the accuracy of measurements, and display of the ones in reporting documentation. Accuracy of measuring means, their timely verification are checked by the organizations of State Standard and the inspection of the State supervision of labor protection, that are responsible for the proper responsibility of their duties. Therefore, the including of the more solid information about measuring devices in the monitoring report is inappropriate.

Calculation of ERUs generated by the project is performed according "The methodology of technical power losses amount determination, in 0.38-150 kV power grids power supply company for the indirect carbon dioxide emissions estimation».
According to the Methodology calculation of process losses of electricity is based on the provisions of the following industry-specific regulatory documents:
Law of Ukraine «On electric power engineering» as of October, 16 1997, № 575/97-VR with subsequent amendments.
NST 6570-96 Electric counters of active and reactive power, motor meter. General technical conditions.
ISO 14064-1:2006 Greenhouse gases - Part 1: Specification with guidance at the organizational level for quantification and reporting of greenhouse gas emissions and removals.
Electrical equipment arrangement regulations. Chapter 1.5 Electric power calculation.
Regulations of electric power usage, are sanctioned by Electric power engineering regulation national committee decree as of 31.07.96 №28 (with supplements and changes as of 17.10.2005 № 910)
The methodology of carbon dioxide specific emissions, during power production and its consumption, estimation is sanctioned by the National agency of ecological investments decree of March, 21 2011 № 39
GND 34.09.104-2003 Power balance structure in the 0,38-150 kV power grids, arrangement methodology, balance components analyses and technological power losses normalization.
Alteration № 1 to GND 34.09.104-2003 Power balance structure in the 0,38-150 kW power grids, arrangement methodology, balance components analyses and technological power losses normalization.
GND 34.09.203-2004 Power losses for 35-750 kW substations personal needs normalization and 6-10 kW distributive points.
Instructions to the power accounting procedure (Appendix 10 to the Contract between Wholesale Power Market members) approved by the Annual assembly on 21.02.2003 and by NCER Decree dated 30.05.2003 with subsequent amendments.
Instruction on compilation, reporting, and analyses of departmental 1B-TVE reporting form data "Power balance structure and technological power losses for the transition on power grids ", sanctioned by the Ministry of electrification and power engineering of Ukraine, on September, 09 1997.
Form № 67 – "Report on consumers electric power accounting system organization as of 01.01.20__ and about establishment in the consumers power grids and power transition organizations of automated power accounting systems and local data collecting and processing equipment (LDCPE)", sanctioned by the Ministry of fuels and energy of Ukraine decree of July, 01 2008 № 352 in the concordance with Ukrainian State Committee on Statistics.
The provisions of these documents are binding on all energy companies (EC) of Ukraine, which have the distribution grids of the specified voltage classes.
The monitoring of TVE amount in 0.38-150 kV power grids of a power supply company used for estimation of indirect carbon dioxide emissions for respective periods is performed by checking:
- compliance of the official statistic reports of the power supply company in 1-B TVE form, form No. 67 as well as annual report of the company for the respective year with the data used for calculation;
- compliance of the TVE amount calculation procedure to that of the given methodology.
The monitoring plan includes measures (measurements, maintenance, registration and calibration) that satisfies the requirements of the chosen monitoring methodology and guarantees the possibility of checking the calculations of emission reductions.

**A.6. Status of implementation including project milestones:**

Project implementation status in the reporting period of 01/01/2008 – 31/12/2011, including the project milestones is provided in Table 1.

*Table 1. Project implementation status*

| № | Name of activities | Measurement unit | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 5 | 6 | 7 | |
| | Replacing PL wire by a wire with a bigger section | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | To PL-10kV<br>To PL-0,4 kV | km<br>km | 89<br>162 | 125<br>190 | 63<br>266 | 80<br>394,2 |
| 2 | Replacement of overloaded and installation of additional power transformers | pcs | 40 | 38 | 40 | 43 |
| 3 | Construction of PL-10kV;<br>PL-0,4 kV | km<br>km | 30,43<br>145,1 | 11,35<br>15,3 | 9,89<br>92,91 | 22,2<br>162,6 |
| 4 | Replacing the single-phase meters with high accuracy meters | pcs | 58669 | 54460 | 48769 | 48180 |
| 5 | Repair of electric meters | pcs | 25634 | 19715 | 24697 | 30270 |
| 6 | Replacement of steel wires on the PL-0,4kV by wires with biggest section of A and AC grade | km | 67 | - | - | - |
| 7 | Change of bare wire inputs into isolated wire inputs | pcs | 19996 | 19511 | 17727 | 21111 |
| 8 | Construction of unloading substations | pcs | 10 | 12 | 23 | 32 |
| 9 | Replacement and installation of meters in front of buildings | pcs | 19996 | 19511 | 17727 | 21111 |
| 10 | Replacement of worn-out oil switches with vacuum ones | pcs | 95 | 99 | 76 | 173 |
| 11 | Change of the cable lines 10- 0,4 kV | km | 14,06 | 17,73 | 11,291 | 26,1 |
| 12 | Installation of 3 –phase multifunctional meters | pcs | 4768 | 1834 | 3713 | 3387 |
| 13 | Change of inputs of 110kV with rigid insulation | pcs. | 9 | 6 | 6 | 3 |
| 14 | Introduction of ASKOE | | 8 | 32 | 19 | 56 |

Implementation of project measures is carried out according to the project plan that is included in the determined PDD version 3.0.

Since the determined PDD version 3.0 contains miscalculated ERUs for the period of 2008 – 2010 years, and the monitoring was conducted at the beginning of 2012, then according to Ltd «EES» there had been conducted calculations of ERUs for the year 2011 inclusive. The results of calculations for 2008-2011 years are listed in the Excel file «VIN-1BTWE-2002-2011-31-01-2012-Km-ok-KP», and included in the report on monitoring. Therefore, the value of the ERUs for reductions for the year and an average value of the ERUs from 2012 to 2025rr, in the determined PDD version 3.0 and in the the Report of monitoring somewhat differ.

The information presented in table number 1, are based exclusively on official and public reporting on the implementation of annual investment programs andactivities to reduce TVE Vinnytsyaoblenergo PJSC.

**A.7. Deviations from or change of registered PDD:**

Since the determined PDD version 3.0 contains miscalculated ERUs for the period of 2008 – 2010 years, and the monitoring was conducted at the beginning of 2012, then according to Ltd «EES» there had been conducted calculations of ERUs for the year 2011 inclusive. Therefore, the value of the ERUs for reductions for the year and an average value of the ERUs from 2012 to 2025rr, in the determined PDD version 3.0 and in the the Report of monitoring somewhat differ. The results of calculations for 2008-2011 years are listed in the Excel file «VIN-1BTWE-2008-2011-31-01-2012-Km-ok-KP», and included in the report on monitoring.

**A.8. Deviations from or change of the registered monitoring plan:**

There aren’t any deviations from or changes in the registered monitoring plan.

**A.9. Persons responsible for preparation and submitting of the monitoring report:**

Vinnytsyaoblenergo PJSC
1Travnya Street ,№2
Vinnytsia
Vinnytsia Region
21050
Ukraine
(0432) 52-50-59
(0432) 52-50-11
Hrushko  Borys
Leading engineer, distribution network department
Phone/Fax: (0432) 52-50-12
kanc@voe.com.ua
Public joint stock company Vinnytsiaoblenergo PJSC  is the project participant.

Ltd «EES»

Project developer - personal information

| | |
|---|---|
| Organisation: | Ltd “Ekologichni Energetychni Systemy” |
| Street/P.O.Box: | Mitskevycha |
| Building: | 8 |
| City: | Lviv |
| State/Region: | Lviv region |
| Postal code: | 79000 |
| Country: | Ukraine |
| Phone: | 0324 451601, 0322 427545 |
| Fax: | 0324 451601, 0322 444462 |
| E-mail: | ecoees@mail.ru, peklviv@meta.ua |
| Title: | Director |
| Last Name: | Shpak |
| First Name: | Yaroslav |
| Middle Name: | Fedorovych |
| Phone (direct): | 0324 451601, 0322 427545 |
| Fax (direct): | 0324 451601, 0322 444462 |
| Mobile: | 0504315929 |

Ltd «EES» is not Project Participant.

## SECTION B. Key monitoring activities

Methodology of the specific emissions of carbon dioxide in the process of the power production by the thermal electric power stations and its consumption determines the procedure and is used for carbon dioxide in the process of the power production by the thermal electric power station and its consumption by the final consumer specific emissions estimation, is lost while transmitting and supplying during GHG emission reduction estimation in the course of JI projects realization according the article 6 of the Kyoto protocol to UN framework convention on climate changes and other projects, directed on the GHG emissions reduction.

DAEI methodology contains directions as to the indicated indices values calculation arrangement and output data sources that are used in these calculations. Calculation of the indicated indices is carried out according thermal power stations activity actual results, transnational power grids operator, and power supply companies. Carbon dioxide emissions in the process of power consumption calculation or while its transfer and supply is based on the data concerning technological power consumption in the power grids.

According to DAEI methodology the data concerning technological power consumption in the power grids are accepted on the bases of annual report according the form 1B- TVE "Power balance structure and technological power consumption for the power transfer through the grids " (1B-TVE form). Specific indirect carbon dioxide emissions for the electric power unit calculation that is used by the consumer and is lost for its transfer and supply should be carried out separately.

Specific indirect carbon dioxide for the electric power unit, that are lost for the its transfer and supply by the power supply company, are determined according the formula (6) of DAEI Methodology, in which the data as to the TVE in the 800-220 kV transnational grids are used, in the percent to the issue (consolidated income) of power into the network and data concerning TVE in the 150-0.38 kV power grids of power supply companies in the percent to the issue (consolidated income) of power into the grid according the form data 1-B TVE form for the respective year. So the use of the data of line 19 is expected “RVTVE percent from the power issue into the grid” form 1-B TVE.

GHG emission reduction estimation in the course of JI projects realization for the current calculated period (year) according to DAEI methodology is made through the means of difference calculation between the basic emissions (for the basic year) and project emissions (for the current calculated year).

The peculiarity of the process of transmission and distribution is that the balance of power structure indicators (income and output power (total value and significance of voltage levels), transformation of energy between degrees of , RVTVE (total value and significance of voltage levels), NVTVE (total value and significance levels of voltage), calculated on the bypass power LEP and transformers for voltage levels and releasing (saldovane revenues) in the electricity network in different accounting periods (baseline and current) differ significantly among themselves, because changing the supply of electricity to consumers and the mutual flow of electricity between neighboring distribution companies. During the insignificant changes of technical characteristics of grids in the calculated periods, the scopes of transfer and power supply structure can change essentially, that is energetic characteristics of the object, concerning which the estimation of GHG emissions reduction in the course of JI projects realization should be made. Such estimation may be done correctly only under condition of object energetic characteristics providing, for the calculated periods to equal conditions. Object energetic characteristic, that is to be provided is the power balance structure according the form 1-B TVE “Power balance structure and TVE for the power transfer through the grids” for the respective year.

That important to note that chapter 8 data “Technical calculated power losses”, chapter 9 “Normative power losses for substations personal needs”, and chapter 10 “Normative TVE value” of forms 1-B TVE in different calculating periods were figured out according to requirements, that were in effect on that time, normative documents and should be adjusted to the normative base that is on effect nowadays.

Chapter 8 data “Technical calculated power losses” to March, 31 2004 were calculated according the requirements GKD 34.09.104-96 “TVE normalization for transference through 154-0.38 kV power grids. Methodical directions”. In the period since April, 1 2004 till March, 31 2009 – according the requirements GND 34.09.104-2003, since April, 1 2009 and till present day - according the requirements GND 34.09.104-2003 with the consideration Change № 1 to GND 34.09.104-2003.

Chapter 9 data “Normative power losses for substations personal needs” to March, 31 2004, calculated according the requirements RD 34.09.208-81 «Instruction on the power consumption for 35-500 kV substations personal needs normalization», since April, 1 2004 and till present day - according the requirements GND 34.09.203-2004.

So, power balance structure on the form 1-B TVE for the respective years should be made according the data of form 1-B TVE 2010.

Power balance structure bringing to equal conditions on the form 1-B TVE should be made with the use of scoping coefficient, that is equal to 1 for the year 2010, being the reference year.

Applying the conservative approach, while it is evident, that grids technical characteristics in 2010, from the TVE point of view are more perfect, than in any previous calculated year, and to proceed from the fact that to calculate indices of chapters 8 and 9 of 1-B TVE forms for the previous calculated years with the use of data provided in chapters 1,2 and 3 and provided normative TVE (NCTVE) characteristics that is practically impossible because of necessity to develop for each previous year NCTVE according to normative bases that is in effect at present day, data providing in chapters 8 and 9 should be made in the following way:

Variable technical calculated power losses in LEP (line 8.1) are equal to the value for 2010 on the respective power level multiplied by the calculated overplus transfused square through LEP for the respective previous year on the respective voltage level and divided by the square of calculated overplus transfused through LEP for 2010 on the respective voltage level;

Variable technical calculated power losses in transformers (line 8.3.1) are equal to the value for 2010 on the respective voltage level multiplied on the calculated overplus transfused square on transformers for the respective previous year on the respective level and divided on the square of calculated overplus transfused on transformers for 2010 on the respective voltage levels;

Conditionally-stable technical calculated power losses in transformers (line 8.3.2) for the respective previous year is considered equal to the value of 2010 on the respective voltage level; (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

Other conditionally-stable technical calculated power losses in other elements (line 8.4.3) for the respective previous year is considered equal to the value of 2010 on the respective voltage level; (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

Normative power losses for substations personal needs (chapter 9) for the respective previous year is considered equal to the value of 2010 on the respective voltage level (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

Reduction to equal conditions of the data in chapters 1, 2, 3 of the balance structure shall be made by using the reduction factor equal to 1 for 2010 and for other years the quotient from the division of the power sale in 2010 by the sale in the respective year. Such reduction, made by dividing the values in Chapters 1, 2, 3 for each year by the reduction factor, will be correct only if the following two conditions are simultaneously satisfied:

- relative values of power sale structure on voltage levels, calculated by Chapter 3 data as percentage of the power sale in 2010 and each other year are similar and do not have significant differences;
- reduction factor trend in 2010 and the previous years is stable, without sharp fluctuations and tends to decrease starting with 2010;

The decision to reduce the data in Chapters 1, 2, 3 of power balance structure to equal conditions is taken when the above conditions are satisfied. If not, only the data in Chapters 8 and 9 of 1-B TVE shall be reduced.

If the decision is made to reduce the data in Chapters 1, 2, 3 of the power structure balance to equal conditions the data are divided by the reduction factor. All other data of 1-B TVE form, besides those of Chapters 8 and 9 are calculated by the formulae given in the Instructions to reporting and analysis of the 1-B TVE form data.

The criteria of the 1-B TVE form data providing correction verification are as follows:

- equality of power sale into the grid values (chapter 18) for 2010 and respective previous years;
- equality of reporting TVE percentage from the power issue into the grid (line 19) in forms 1-B TVE for the respective year before and after 1-B TVE form data providing.

In case of a change the territory of the energy supply company licensed to supply electricity at regulated tariffs, which took place as a result of its division and the formation of her new utility company

in accordance with NERC's decisions and changes as a result, the structure of the balance of power in form 1B-TVE for the year in which was a division, and subsequent years after separation, may be required during the calculation of indirect carbon dioxide emissions, accounting reporting forms 1B-TVE utility company for part of the settlement period (the year in which the division took place, and prior to the year in which the division occurred).

For the years after 2010 the reduction of the data in Chapters 1,2,3 of 1-B TVE form to equal conditions is made using the reduction factor if such reduction was made for the years prior to 2010.

If the data in Chapters 1,2,3 of 1-B TVE form are reduced to equal conditions after 2010. the data in Chapters 8 and 9 are reduced as follows:

Variable technical calculated power losses in LEP (line 8.1) are equal to the value for the subsequent period on the respective power level multiplied by the calculated overplus transfused square through LEP for the respective previous year on the respective voltage level and divided by the square of calculated overplus transfused through LEP for the subsequent period on the respective voltage level;

Variable technical calculated power losses in transformers (line 8.3.1) are equal to the value for the subsequent period on the respective voltage level multiplied on the calculated overplus transfused square on transformers for the respective previous year on the respective level and divided on the square of calculated overplus transfused on transformers for the subsequent period on the respective voltage levels;

Conditionally-stable technical calculated power losses in transformers (line 8.3.2). other conditionally-stable power losses in other elements (line 8.4.3) and normative losses for substation own usage (Chapter 9) are taken as equal to reported values.

If the data in Chapters 1, 2, 3 of 1-B TVE form for the years after 2010 are equal to reported values than the data in Chapters 8 and 9 are also equal to reported values.

Total value in section 8, "Technical estimated energy losses" for all billing periods should be multiplied by coefficient of deterioration in electrical indexes over time, the value of which according to statements presented in [1], and Recommendations Appendix A [1] is taken no more than 1,15.

Structure of RVTVE in the main power grids 800-220 kV, relative value of which is used in the interest of power transmission to the grid (consolidated income) according to the formula (6) “Methodology of the specific emissions of carbon dioxide in the process of the power production by the thermal electric power stations and its consumption” to calculate specific indirect emissions of carbon dioxide for the power unit, contains the technical calculated power losses in the grids, power consumption by the substations as well as the untechnical losses. Untechnical power losses in the main grids are conditioned by the metrological losses, which under the quantitative estimation of the structure of the untechnical losses are to be calculated on the basis of the actual metrological characteristics of the accounting devices. Thus RVTVE in the main power grids are such that are calculated by the power registration system with the actual metrological error and are considered as the indirect emissions of carbon dioxide.

The structure of the RVTVE in the local power grid 150-0.38 kV of the power supply company contains the technical calculation power losses in the grids, power consumption by the substations as well as the untechnical losses. Nontechnical losses in the local power grid of the power supply company are conditioned by the metrological losses as well as by others factors conditioned by the understatement (overstatement) of the power transmission to the consumers.

Metrological power losses in the process of the quantitative estimation of the structure of the untechnical losses are to be calculated on the basis of the actual metrological characteristics of the accounting devices. Peculiar feature of the system of power registration in the local grid 0.38-150 kV of the power supply company is the existence of hundreds of thousands of the accounting devices, actual metrological characteristics of which are unknown. That is why in the process of the quantitative estimation of the metrological losses only fixed metrological characteristics of the accounting devices must be used. The calculated metrological losses should be corrected taking into consideration actual metrological characteristics of the accounting devices of the same type, which are defined with the certain assumptions. As the result we obtain the component of the fixed metrological power losses.

The components of the untechnical losses, conditioned by the understatement (overstatement) of the power transmission to the consumers, arise:

- due to the power theft and to the errors in the process of calculation of the amount of the supplied power and compiling pay-lists;
- due to the technological reasons, connected with the procedure of the estimation of the amount of power supplied to the consumers, i.e. due to the calculation of the amount of power supplied to the consumers at

the actual payment using the power retail prices without the pay-lists; usage of the average amounts while compiling the pay-lists; unsumuultaneous taking of indexes from the accounting devices as well as the existence of the seasonal component;

- due to the technical reasons, i.e: due to the errors of the accounting devices, which exceed their fixed indexes.

The first two components of the non-technical losses are conditioned by the power theft and by the drawbacks in the organization of the control over the power consumption and the payment. These losses form the part of RVTVE, conditioned by the faults of power supply organization. They are very difficult to formalize as this component of the nontechnical power losses is predetermined by the social and organizational factors.

The component of the nontechnical power losses, conditioned by the faults of power supply organization cannot be considered as the indirect carbon dioxide emissions, because it is of untechnical nature.

The third component of the nontechnical power losses, connected with the work of the accounting devices with the measuring errors that exceed their fixed indexes, are to be estimated separately, according to the actual metrological characteristics of the accounting devices of the same type, which are defined with the certain assumptions.

Thus, RVTVE in the local power grid of the power supply company (data of the line 19 “The percentage of reporting TVE (RVTVE) from the power supply to the grid” form 1-B TVE) in the process of calculation should be transferred to the indirect carbon dioxide emissions taking into consideration the fixed metrological power losses and the component of the nontechnical power losses, conditioned by the faults of power supply organization.

According to the above mentioned the scheme of the putting of the power balance structure of the form 1B-TVE for the accounting periods to the equal condition and the scheme of RVTVE correction in the local power grid 150-0.38 kV of the power supply company to ensure the possibility of usage of the provided corrected RVTVE for the transmission of them to the indirect losses of carbon dioxide are to be worked out.

In the process of the development of the RVTVE correcting scheme the fact that NPL cannot be measured should be taken into consideration. They may be only calculated but with some error. The error depends not only of the power supply and transmission measurement errors in the process of RVTVE calculation, of the component of the nontechnical power losses, conditioned by the faults of power supply organization, etc, but also of the NVTVE calculation errors, and of the technical calculation power losses in the grids. The technical calculation power losses in the grids as well as the losses, conditioned by the measurement errors are the components of the power balance, and in the process of their analysis the interval estimations, which are based on the precision grade of registration devices are used. The literature review affirms that the defining of the errors of this or that measuring device of power losses accounting is usually used for the qualitative estimation of its acceptability. In the practical calculations, including the process of the NVTVE structure calculation, the results are provided as the determined indexes.

**B.1. Information about types of metering equipment:**

Information on the types of metering equipment used in the project monitoring, classes of accuracy and calibration procedures is given in Table 2.

*Table 2. Metering equipment involved in the project monitoring (background information)*

| Metering equipment | Type | Producer | Calibration frequency | Accuracy class |
|---|---|---|---|---|
| Electricity meter | TsE-6807B | "Energomira", Stavropol city | 16 years | 1 |
| Electricity meter | SOE-5020N | CJSC "ROSTOK COMPANY", Kyiv city | 16 years | 2 |
| Electricity meter | SOE-5028 | CJSC "ROSTOK COMPANY", Kyiv city | 16 years | 2 |
| Electricity meter | SO-EA05 | PO "Komunar", Kharkiv city | 16 years | 1 |

| | | | | |
|---|---|---|---|---|
| Electricity meter | SO-EA09 | PO "Komunar", Kharkiv city | 16 years | 1 |
| Electricity meter | NP-06 | "Telecommunication technologies", Ltd., Odesa city | 6 years | 2 |
| Electricity meter | NIK2102 | NIK-ELECTRONIKA Ltd., Kyiv city | 16 years | 2 |
| Electricity meter | SOI-446 | OJSC "LEMZ", Saint-Petersburg city | 8 years | 2,5 |
| Electricity meter | SO-U449M1 | OJSC "LEMZ", Saint-Petersburg city | 8 years | 2 |
| Electricity meter | SO-2 | SE Kharkiv plant of electrical equipment, Kharkiv city | 8 years | 2,5 |
| Electricity meter | SO-5 | SE Kharkiv plant of electrical equipment, Kharkiv city | 8 years | 2,5 |
| Electricity meter | 5SM4 | OJSC "LEMZ", Saint-Petersburg city | 8 years | 2 |
| Electricity meter | SO-197 | SE Kharkiv plant of electrical equipment, Kharkiv city | 8 years | 2 |
| Electricity meter | SO-193 | SE Kharkiv plant of electrical equipment, Kharkiv city | 8 years | 2 |
| Electricity meter | SO-5000 | CJSC "ROSTOK COMPANY", Kyiv city | 16 years | 2 |
| Electricity meter | SEA-101 | "SEA Electronics" Ltd., Kyiv city | 16 years | 2 |
| Electricity meter | Energiya-9 | "Telekart-prylad" Ltd., Odesa city | 16 years | 2 |
| Electricity meter | Mercury 201 | "NPK Inkoteks" Ltd., the Russian Federation | 6 years | 2 |
| Electricity meter | Cascade 1.15 | PA "Kyivprylad", Kyiv city | 16 years | 2 |
| Electricity meter | SOLO | OJSC "LEMZ", Saint-Petersburg city | 16 years | 2 |
| Electricity meter | SOEE-6705 | OJSC "LEMZ", Saint-Petersburg city | 8 years | 2 |
| Electricity meter | SA3U-I670M | OJSC "LEMZ", Saint-Petersburg city | 4 years | 2 |
| Electricity meter | TsE-6803V | "Energomira", Stavropol city | 16 years | 2 |
| Electricity meter | NP-03 | "ADD-Energiya" Ltd., Kyiv city | 6 years | 0.5 |

| | | | | |
|---|---|---|---|---|
| Electricity meter | ET | JC CJSC "ELVIN", Kyiv city | 6 years | 1 |
| Electricity meter | CR4U-I673 | OJSC "LEMZ", Saint-Petersburg city | 4 years | 2 |
| Electricity meter | TsE6811 | "Energomira", Stavropol city | 6 years | 1 |
| Electricity meter | SL 7000 | Plant of company Itron Franse, France | 6 years | 0.5 |
| Electricity meter | Alfa | "Elster Metronika" Ltd., the Russian Federation | 6 years | 0.5 |
| Electricity meter | ZMD | Plants of holding Landis+Gir Ltd, Switzerland | 6 years | 0.5 |
| Electricity meter | EMT | CJSC "ELGAMA-ELEKTRONIKA", Lithuania; | 6 years | 0,5 |
| Electricity meter | EMS | CJSC "ELGAMA-ELEKTRONIKA", Lithuania; | 6 years | 1 |
| Electricity meter | EMP | CJSC "ELGAMA-ELEKTRONIKA", Lithuania; | 6 years | 1 |
| Electricity meter | EPQS | CJSC "ELGAMA-ELEKTRONIKA", Lithuania; | 6 years | 0,5 |
| Electricity meter | LZQM | CJSC "ELGAMA-ELEKTRONIKA", Lithuania; | 6 years | 1 |
| Electricity meter | Mercury 230 | "NPK Inkoteks" Ltd., the Russian Federation | 6 years | 1 |
| Electricity meter | SA4E-5030 | CJSC "ROSTOK COMPANY", Kyiv city | 16 years | 1 |
| Electricity meter | ST-EA05 | PO "Komunar", Kharkiv city | 16 years | 1 |
| Electricity meter | ST-EA08 | PO "Komunar", Kharkiv city | 16 years | 1 |
| Electricity meter | NIK2301 | "NIK-ELEKTRONIKA" Ltd., Kyiv city | 16 years | 1 |
| Electricity meter | NIK2303 | "NIK-ELEKTRONIKA" Ltd., Kyiv city | 6 years | 1 |
| Electricity meter | SA4U-I678 | OJSC "LEMZ", Saint-Petersburg city | 4 years | 2 |
| Electricity meter | SA4U-I672M | OJSC "LEMZ", Saint-Petersburg city | 4 years | 2 |
| Electricity meter | SA4-195 | SE Kharkiv plant of electrical equipment, Kharkiv city | 4 years | 2 |

| | | | | |
|---|---|---|---|---|
| Electricity meter | SA4U-196 | SE Kharkiv plant of electrical equipment, Kharkiv city | 4 years | 2 |
| Electricity meter | SA4-198 | SE Kharkiv plant of electrical equipment, Kharkiv city | 4 years | 2 |
| Electricity meter | SA4-199 | SE Kharkiv plant of electrical equipment, Kharkiv city | 4 years | 2 |
| Electricity meter | Cascade 3.1 | PA "Kyivprylad", Kyiv city | 6 years | 2 |
| Electricity meter | F68700V | "Energomira", Stavropol city | 6 years | 1 |
| Voltmeter | E378 | PA "Krasnodar ZIP" | 4years | 2 |
| Ammeter | E378 | PA "Krasnodar ZIP" | 1year | 4 |
| Phasemeter | VAF-85 | "Electroizmeritel" | 1year | 4 |
| Ohmmeter | ESO-202/2 | Uman PA "Megometr" | 1year | 1,5 |
| Wattmeter | D 335 | PE "Zapadpribor" | 4 years | 1,5 |

*Fig. 1. Typical electricity meter*

*Fig. 2. Typical voltmeter*

*Fig. 3. Typical ammeter*

*Fig. 4. Typical phase meter*

*Fig. 5. Typical ohmmeter*

*Fig. 6. Typical wattmeter*

**B.2. Data collection (consolidated data for the whole monitoring period):**

**B.2.1. List of fixed parameters and constant values:**

Not applicable.

**B.2.2. List of parameters that are subject to periodic monitoring.**

*Table 3 Parameters that are controlled during the monitoring period and used to calculate emissions in the baseline scenario.*

| Parameter | Description | Source of data | Data unit | Recording frequency |
|---|---|---|---|---|
| $V_y$ | Total reduction of technical power losses in the power grid during the period y of the project scenario compared with the baseline scenario | Calculated used «The methodology of technical power losses amount determination, in 0.38-150 kV power grids power supply company for the indirect carbon dioxide emissions estimation» | *MWh* | Yearly |

| | | | | |
|---|---|---|---|---|
| $CEF_y$ | Carbon dioxide emission factor for projects of power loss reduction in power transport networks of Ukraine. This value objectively reflects specific carbon dioxide emissions due to power losses during transportation. Using such factors is a common practice when estimating JI projects. Only officially approved factors have been used for estimation | For 2008 - 1.082[1]<br>For 2009 - 1.096[2]<br>For 2010 - 1.093[3]<br>For 2011-2025 - 1.090[4] t | *$tCO_2e/MWh$ (kg $CO_2e/kWh$)* | Yearly |

Parameter values used for calculation of GHG emissions in the project scenario for each year are included in Excel file «VIN-1BTWE-2008-2011-31-01-2012-Km-ok-KP.xls».

**Since the baseline emissions are calculated based on difference between of power loss before and after the project implementation, consequently the project emission will equal zero.**

**B.2.3. Data related to leakage:**

The leakage of sulfur hexafluoride $SF_6$ (Electronegative gas) that is used as a heat rejection and insulating medium in sulfur hexafluoride circuit breakers and current transformers and indirect extraneous leakage of $CO_2$, $CH_4$, $N_2O$ from fuel extraction and transportation activities, are excluded according to the monitoring methodology provided in the determined PDD, version 3.0.

**B.2.4. Data relating to ecological and social impact:**

Project implementation doesn't cause adverse effects on the environment. Environmental effect will be caused only by dismantled equipment. It will further be used as secondary raw material.

Replacement of power grids, transformers, meters and other electrical equipment used to transport electricity takes place in the framework of the project. Equipment that is decommissioned as part of the project activity, is written off and dismantled. In such cases the Commission executes a "Certificate of fair wear and tear OZ-3" and prepares the conclusion of the impossibility of further use of this equipment. Equipment is described and placed in property of the warehouse (according to the decree of the CMU № 408 dated 16.03.1999 "On a system for collecting, sorting, transporting, processing and recycling of used packaging (packing) and municipal solid waste"[5]) with further sale to the companies involved in recycling scrap metal .

Implementation of this project will allow for improvement of servicing the consumers of electricity services. Experienced staff of Vinnytsyaoblenergo PJSC and compliance with the regulations "On electric energy sector" 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.

[1] http://www.neia.gov.ua/nature/doccatalog/document?id=127171
[2] http://www.neia.gov.ua/nature/doccatalog/document?id=127172
[3] http://www.neia.gov.ua/nature/doccatalog/document?id=126006
[4] http://www.neia.gov.ua/nature/doccatalog/document?id=127498
[5] http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=408-99-%EF

**B.3. Emergency situations and procedures for detection and liquidation of malfunctions at EC Vinnytsyaoblenergo PJSC :**

Vinnytsyaoblenergo PJSC provides for the following procedures to identify and eliminate malfunctions according to the determined PDD. The operator informs the engineer of a transformer substation about emergency or malfunction. If the problem can not be eliminated right away, a commission of 6-7 people, consisting of representatives of the technical department, a chief engineer, a shift engineer and leading engineers. Depending on the type of failure deficiency or emergency certificate is executed. It is further transferred to the administration of Vinnytsyaoblenergo PJSC , after which repair of equipment takes place. All records on equipment failures and elimination of such failures are stored in the respective district units of Vinnytsyaoblenergo PJSC .

There were no emergency situations and considerable technological abnormalities that could affect the monitoring of the project figures at Vinnytsyaoblenergo PJSC in the monitoring period of January 1, 2008- December 31, 2011.

## SECTION C. Quality assurance and quality control measures

### C.1. Roles and responsibilities

Operational structure includes Vinnytsyaoblenergo PJSC operational departments and personnel for operation of the distribution electrical grids. Monitoring management structure of the project also includes specialists of Ltd «EES», the company – developer of the project.
Detailed operation management structure is provided in Figure 7.
Scheme of data collection using automated system of electricity consumption commercial accounting (ASECCA) in the perimeter of the energy supply company is provided in Figure 8.
Scheme of data collection prior to implementation of the automated system of electricity consumption commercial accounting (ASECCA) is shown in Figure 9.

Name of person(s)/entity(ies) establishing the monitoring plan:

**Vinnytsyaoblenergo PJSC (Project Paticipant)**
Hrushko Borys
Leading engineer, distribution network department
Phone/Fax: (0432) 52-50-12

**Ltd "Ekologichni Energetychni Systemy" (not Project Participant)**
Technical director
Prots Roman
tel: +(380) 24451601

All data that will be collected during the monitoring process must be kept on paper and electronic media in the archives of Vinnytsyaoblenergo PJSC for at least 2 years after the ending of period of transfer ERUs to the purchaser, and along with the issue of an appropriate order on the regional energy companies and mentioning the persons that will be responsible for storage.

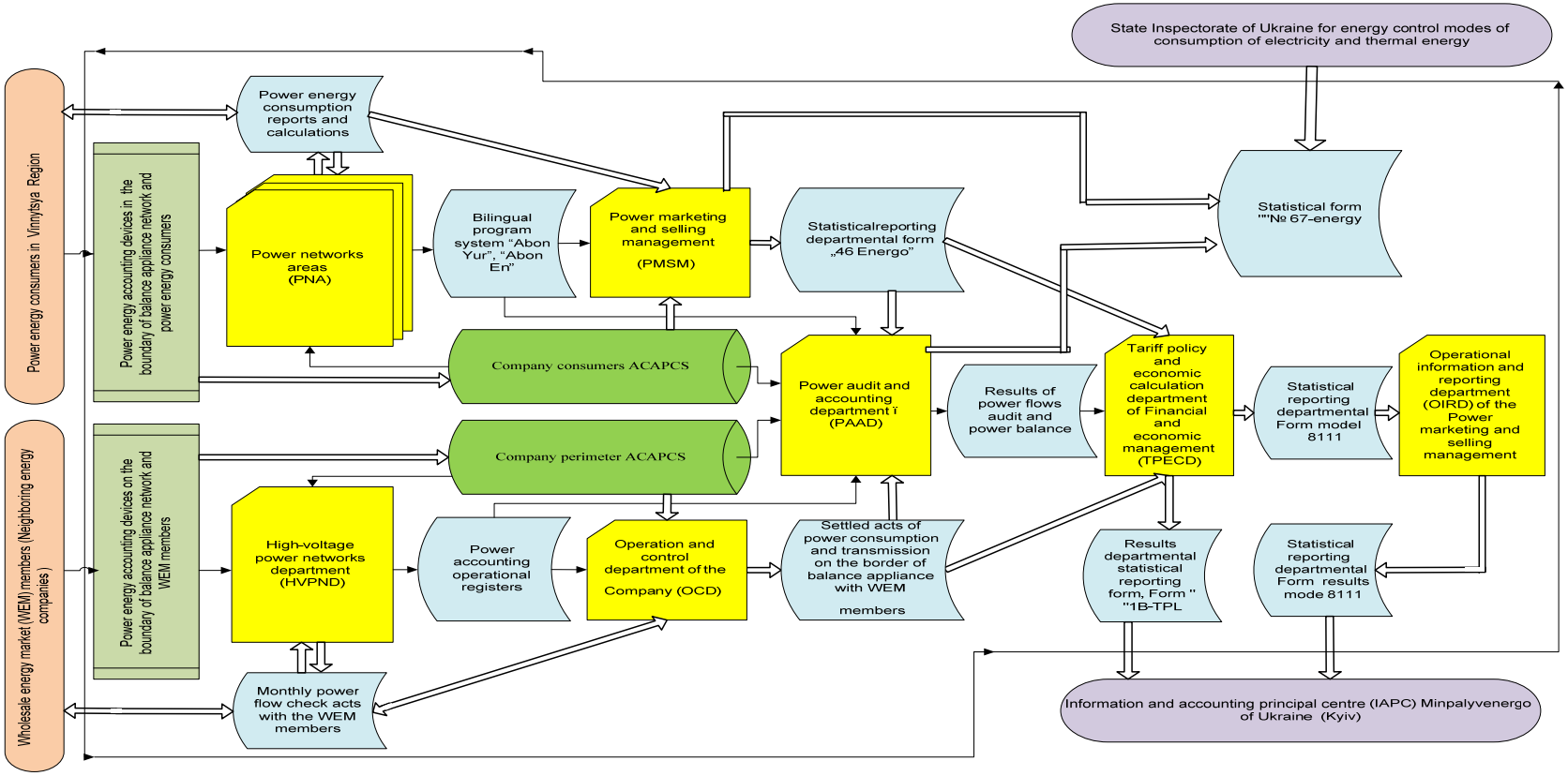



*Figure 7. Scheme of operational structure of project management*

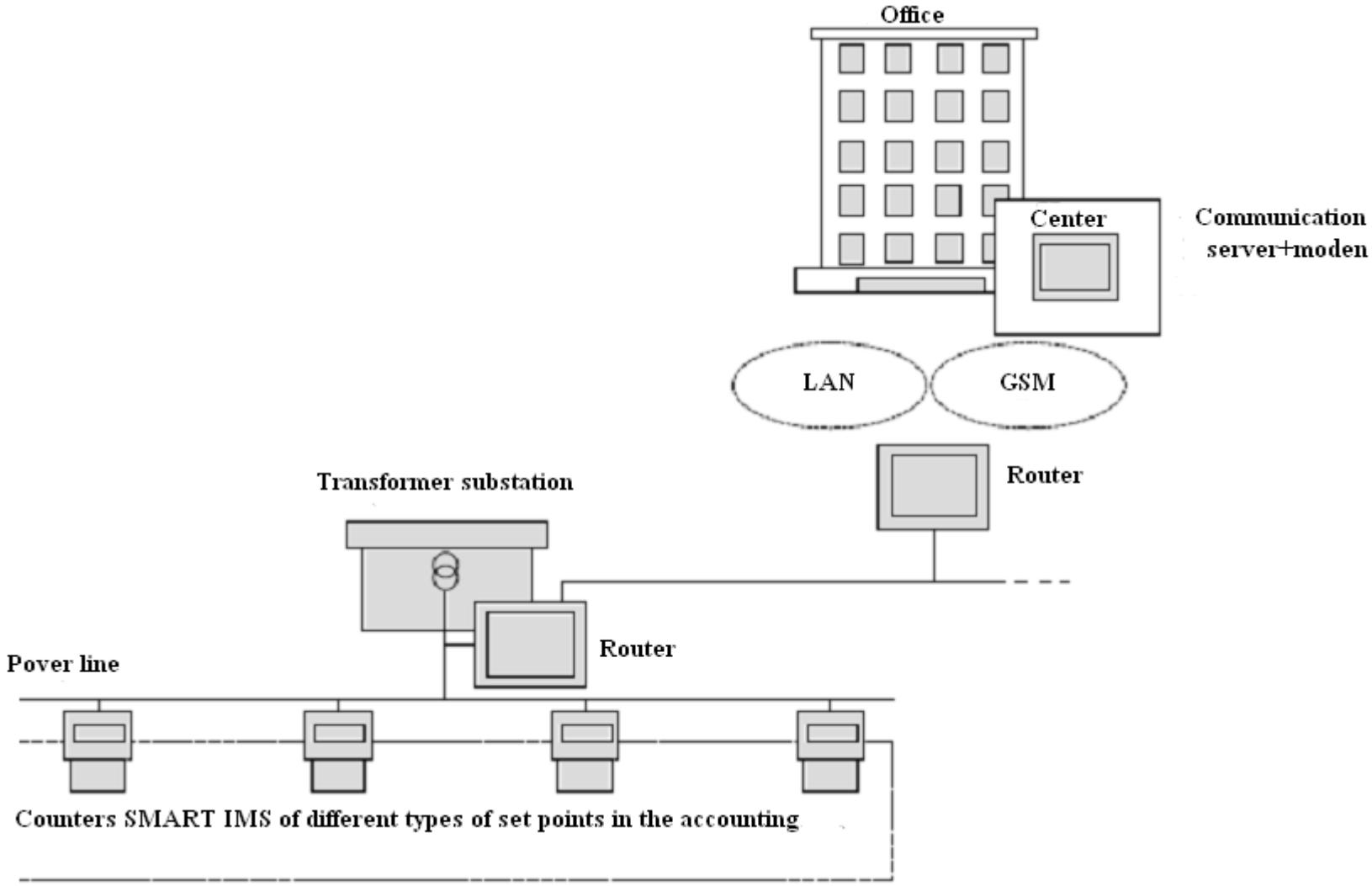
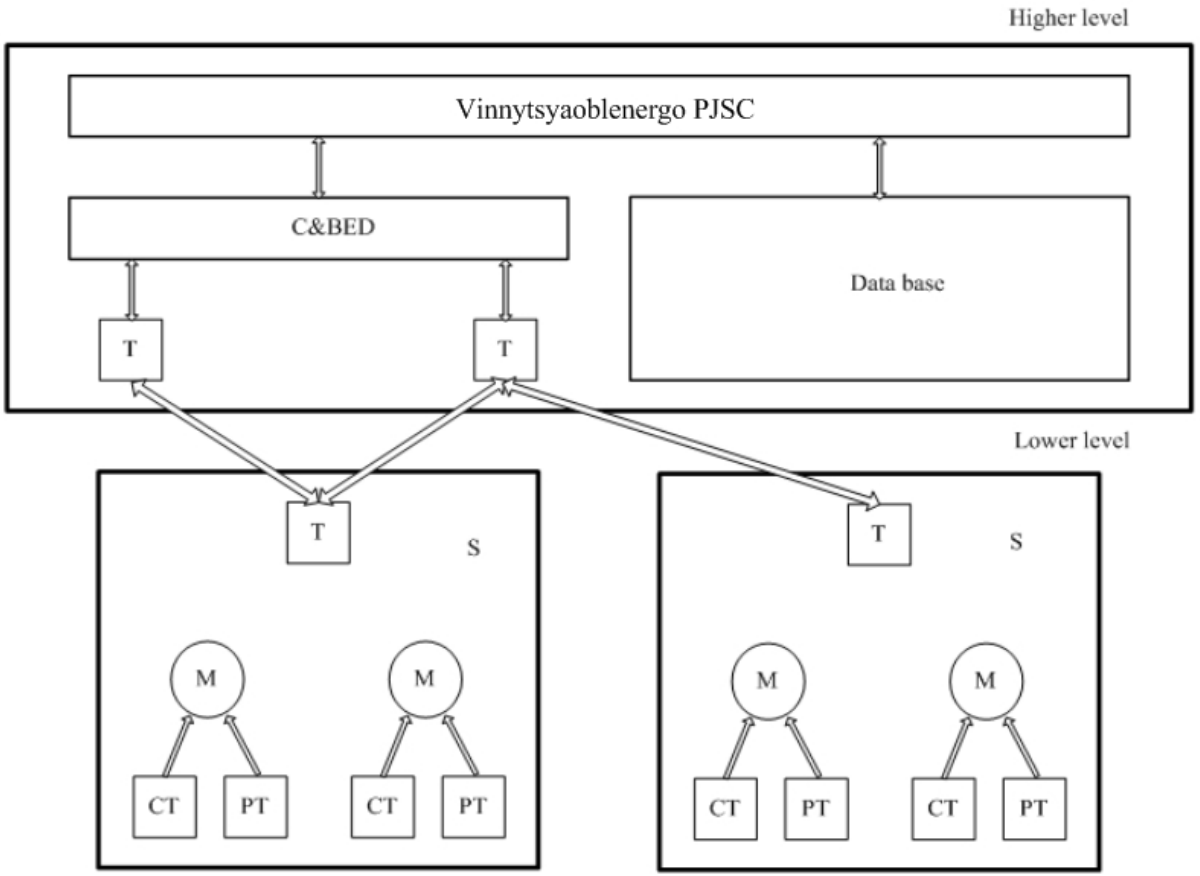



*Figure 8. Scheme of data collection using automated system of electricity consumption commercial accounting (ASECCA) in the perimeter of the energy supply company*

Legend




T - telephone;
CT - current transformer;
PT – power transformer;
S - Substation;
M - meter;
C&BED – Calculations and the balance of electricity department

Data of electricity meters at the substation are taken by on-duty personnel.

*Figure 9. Scheme of data collection with the help of operative informational complex (OIC)*

**C.2. Trainings:**

Since the principal activities of Vinnytsyaoblenergo PJSC didn't change when implementing the Joint Implementation (JI) project and the project monitoring is carried out as a part of practice established at the company, special technical trainings for personnel are not necessary. Technical personnel of the enterprise possesses necessary knowledge and experience for execution of the project implementation and monitoring.

In case of new equipment implementation (the equipment which has not been used by this enterprise before), the company-manufacturer of this equipment shall conduct trainings for the personnel. During the monitoring period the equipment which would require special training for the personnel was not installed.

Vinnytsyaoblenergo PJSC retrains the personnel according to the requirements of Norms of labour protection. The enterprise has the Labour Protection Department responsible for professional development and trainings of the personnel.

**C.3. Involvement of third parties:**

JSC "LvivORGRES"was involved in the verification of the monitoring plan and the correctness of calculations.Verification of measurement and calculation means was conducted by the State Enterprise "Vinnytsyastandartmetrologia".

**C.4. Internal audits and control methods:**

Means of metering equipment used for monitoring of the project activity are subject to periodic state verification. Personnel of Vinnytsyaoblenergo PJSC is liable to periodic examination of their knowledge of requirements to:
- collecting data according to the monitoring plan (the collection of data under the monitoring coincides with the usual practice of data collection at the company);
- labour protection;

Each quarter, representatives of «EES» Ltd, developers of the project, conduct internal audits of the project monitoring system at Vinnytsyaoblenergo PJSC . Internal audit includes measures on verification of monitoring parameters accounting and record keeping, timely calibration of metering equipment, cross-check of data of the automated system of electricity consumption commercial accounting (ASECCA) and departmental reporting forms 1B-TVE DAEK «Structure of balance of electricity and process losses of electricity for transmission via electrical grids".

## SECTION D. Calculation of GHG emission reductions

This section contains formulae used for calculation of , baselie emissions and GHG emission reductions.

### D.1. Description of formulas used for project emissions calculations

The mission reduction will be achieved by reducing power losses in the company's power grids which in its turn will be achieved as a result of the project implementation.

Since the baseline emissions are calculated based on difference between of power loss before and after the project implementation, consequently the project emission will equal zero.

$$PE_y = 0$$

### D.2. Description of formulas used for baseline emissions calculations

Therefore, the baseline emissions are:

$$BE_y = V_y \cdot CEF_y, \quad (1)$$

where
$BE_y$ = baseline emissions (tCO2e);
$V_y$ = total technical loss reduction in the power distribution system during the period *y* of the project scenario compared with the baseline, MWh;
$CEF_y$ = carbon dioxide emission factor for projects of power loss reduction in power transport networks of Ukraine in the year y, $tCO_2e/MWh$;
*y* = the year for which estimates are made.

### D.2. Description of formulas used for emission reductions calculations

Emissions reductions are defined by the following equation:

$$ER_y = BE_y - (PE_y + LE_y), \quad (2)$$

Where:
$ER_y$ = emission reduction during the year y, t CO2e;
$BE_y$ = baseline emission of the greenhouse gases in the year y, t CO2e;
$PE_y$ = greenhouse gases emission caused by the project activity in the year y, t CO2e;
$LE_y$ = escape emission in the year y , t CO2e;
*y* = the year for which estimates are made.

## SECTION E. Results of the GHG emission reductions monitoring

### E.1. GHG emissions in the project scenario

**Since the baseline emissions are calculated based on difference between of power loss before and after the project implementation, consequently the project emission will equal zero.**

*Table 4. Project emissions for the period of January 1, 2008 – December 31, 2011*

| Years | Project emissions, ($tCO_2e$) |
|---|---|
| 2008 | 0 |
| 2009 | 0 |
| 2010 | 0 |
| 2011 | 0 |
| Total project emissions in the crediting period of 2008-2011 (tonnes of $CO_{2e}$ equivalent) | 0 |

### E.2. Leakages

According to the Methodology provided in the determined PDD, version 3.0, there are no leakages related to this project.

### E.3. GHG emissions in the baseline scenario

Calculation of baseline emissions are made in Excel file «VIN-1BTWE-2008-2011-31-01-2012-Km-ok-KP.xls» according to the formulae given in section D.1. of the Monitoring report.

For ease of calculation of emission reductions in the Excel file «VIN-1BTWE-2008-2011-31-01-2012-Km-ok-KP», all the values with the quotient of one hundred are rounded to integers. Therefore, when summing the values of ERUs, which are listed in Tables № № 5,6 there may be minor differences.

The results of calculation of GHG emissions in the baseline scenario during the reporting period are shown in table 5:

*Table 5. Emissions in the baseline scenario for the period of January 1, 2008 – December 31, 2011*

| Years | Baseline emissions, ($tCO_2e$) |
|---|---|
| 2008 | 267313 |
| 2009 | 269346 |
| 2010 | 201561 |
| 2011 | 183953 |
| Total baseline emissions in the crediting period of 2008-2011 (tonnes of $CO_{2e}$ equivalent) | 922174 |

### E.4. Emissions reduction due to the project implementation in the monitoring period:

Calculation of emission reductions are made in Excel file «VIN-1BTWE-2008-2011-31-01-2012-Km-ok-KP.xls» according to the formulae given in section D.1. of the Monitoring report. As a result of activities implemented under the project during the reporting period the following emission reductions were achieved:

*Table 6. Results of emission reductions calculation for the period of January 1, 2008 – December 31, 2011*

| Year | Project emissions (t $CO_2e$) | Leakages (t $CO_2e$) | Baseline emisssions (t $CO_2e$) | Emission reductions (t $CO_2e$) |
|---|---|---|---|---|
| 2008 | 0 | 0 | 267313 | 267313 |
| 2009 | 0 | 0 | 269346 | 269346 |
| 2010 | 0 | 0 | 201561 | 201561 |
| 2011 | 0 | 0 | 183953 | 183953 |
| Total emissions (t $CO_2e$) | 0 | 0 | 922174 | 922174 |

Since the determined PDD version 3.0 contains miscalculated ERUs for the period of 2008 – 2010 years, and the monitoring was conducted at the beginning of 2012, then according to Ltd «EES» there had been conducted calculations of ERUs for the year 2011 inclusive. Therefore, the value of the ERUs for

reductions for the year and an average value of the ERUs from 2012 to 2025rr, in the determined PDD version 3.0 and in the the Report of monitoring somewhat differ.

# ANNEX 1

**Ltd " EKOLOGICHNI ENERGETYCHNI SYSTEMY "**

# THE METHODOLOGY

# OF TECHNICAL POWER LOSSES AMOUNT DETERMINATION, IN 0.38-150 kV POWER GRIDS POWER SUPPLY COMPANY FOR THE INDIRECT CARBON DIOXIDE EMISSION ESTIMATION

**Lviv**
**2011**

PREFACE

| | | |
|---|---|---|
| 1 | ORDERED | Ltd “ Ekologichni Energetychni Systemy ” |
| 2 | DEVELOPED | OJSC “ LvivORGRES” |
| 3 | EXECUTOR | Y.Koval |
| 4 | COORDINATED | Energy conservation and management institution<br>National technical university of Ukraine “KPI”, A.Prakhovnyk |

Chief executive officer

OJSC “LvivORGRES” I.Kavych

Chief operative officer

OJSC “ LvivORGRES ” V.Kondratenko

Quality manager

OJSC “ LvivORGRES ” V.Kaminskyi

Electrical department manager

OJSC “ LvivORGRES ” I.Lutsyk

Electrical department sector supervisor

OJSC “ LvivORGRES ”,

Responsible executor Y.Koval

APPROVED
Ltd “ Ekologichni Energetychni Systemy ” director

_____ Y.Schpak
“_____”_____2011

APPROVED

Energy conservation and management institution
National technical university of Ukraine “KPI”

_____ A.Prakhovnyk
“_____”_____2011

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## CONTENTS

# THE METHODOLOGY

# OF TECHNICAL POWER LOSSES AMOUNT DETERMINATION, IN 0.38-150 kV POWER GRIDS POWER SUPPLY COMPANY FOR THE INDIRECT CARBON DIOXIDE EMISSIONS ESTIMATION

## 1 APPLICATION

The methodology of technical power losses amount determination, in 0.38-150 kV power grids power supply company for the indirect carbon dioxide emissions estimation (hereafter – Methodology) is used for the determination of technical power losses amount in 150-0.38 kV power grids power supply company for the indirect carbon dioxide emissions estimation during the transportation and supply of power.

## 2 NORMATIVE REFERENCES

Law of Ukraine «On electric power engineering» as of October, 16 1997, № 575/97-VR with subsequent amendments.

NST 6570-96 Electric counters of active and reactive power, motor meter. General technical conditions.

ISO 14064-1:2006 Greenhouse gases - Part 1: Specification with guidance at the organizational level for quantification and reporting of greenhouse gas emissions and removals.

Electrical equipment arrangement regulations. Chapter 1.5 Electric power calculation.

Regulations of electric power usage, are sanctioned by Electric power engineering regulation national committee decree as of 31.07.96 №28 (with supplements and changes as of 17.10.2005 № 910)

The methodology of carbon dioxide specific emissions, during power production and its consumption, estimation is sanctioned by the National agency of ecological investments decree of March, 21 2011 № 39

GND 34.09.104-2003 Power balance structure in the 0,38-150 kV power grids, arrangement methodology, balance components analyses and technological power losses normalization.

Alteration № 1 to GND 34.09.104-2003 Power balance structure in the 0,38-150 kW power grids, arrangement methodology, balance components analyses and technological power losses normalization.

GND 34.09.203-2004 Power losses for 35-750 kW substations personal needs normalization and 6-10 kW distributive points.

Instructions to the power accounting procedure (Appendix 10 to the Contract between Wholesale Power Market members) approved by the Annual assembly on 21.02.2003 and by NCER Decree dated 30.05.2003 with subsequent amendments.

Instruction on compilation, reporting, and analyses of departmental 1B-TVE reporting form data "Power balance structure and technological power losses for the transition on power grids ", sanctioned by the Ministry of electrification and power engineering of Ukraine, on September, 09 1997.

Form № 67 – "Report on consumers electric power accounting system organization as of 01.01.20__ and about establishment in the consumers power grids and power transition organizations of automated power accounting systems and local data collecting and processing equipment (LDCPE)", sanctioned by the Ministry of fuels and energy of Ukraine decree of July, 01 2008 № 352 in the concordance with Ukrainian State Committee on Statistics.

## 3 TERMS AND NOTIONS

The following are terms used in this method and definition of concepts designated by them:

**3.1 power return**

The electric energy amount, that is returned by the licensee transferor and consumer and also lost for the economic needs

**3.2 power issue (consolidated income) into the grid**

The electric energy amount, which consists of the values sum of power for consumers return, for economic needs and reporting value of technical power losses, according to GND 34.09.104-2003

**3.3 power losses for economic needs of local grids**

Power consumption under the average purchase price for the ensuring of licensed activity on the transmitting and supply of power (power supply under the regulated tariff according agreement, concluded between the supplier and consumer (legal entity) respectively with the requirements of "Rules of power usage ", is not realized) , according to the GND 34.09.104-2003

**3.4 power transmitting organization (licensee-transferor)**

Economic entity, that received the NERC license for the right to go into business of power transmitting by the transnational power grids or by local grids, as well as power suppliers under the regulated tariff, that carry out their activity on the settled territory, according to GND 34.09.104-2003

3.5 **power characteristics**

The aggregate data reflecting the power balance structure of a power supply company in the reported year.

3.6 **power supply company**

A power transporting company transporting power by local power grids and supplying it at regulated tariff in a fixed area.

**3.7 reported relative technological power losses in power grids**

Quotient determined in the percent from the division of reporting value of technological power consumption and issue value of power into the grid, according to GND 34.09.104-2003

**3.8 reported value of technological power losses in power grids**

Power amount, that is determined by the difference between the sum of income value and sum of power return value, that are determined under the indices of calculated power account means, according to GND 34.09.104-2003

**3.9 reported value of technological power consumption for substation and distributive points own needs**

Constituent part of reporting value of technological power consumption that is equal to the power amount, lost for the substation and distributive points personal needs, that is determined under the indices of calculated power account means, according to GND 34.09.104-2003

**3.10 Value of nontechnical power losses in the power grids**

Constituent part of reporting value of technological power consumption (for the – conditionally reporting value of technological power consumption ), that is equal to the difference between reporting value of technological power consumption and normative value of technological power consumption according GND 34.09.104-2003

**3.11 reduction factor (scaling)**

The quotient of the division of a power sale total for the reported year by that of the previous or following year.

**3.12 conservative approach**

The approach when selecting the TVE component calculation option used for CO2 emission reduction estimation only those options are taken into account aimed at reducing the resulting amounts of TVE components.

**3.13 main power grid**

Power grid, used for power transmitting from the producer to the linking points of local grids, according to the Law of Ukraine «On electric power engineering»

**3.14 power grid**

Collection of electrical equipment for power transference and distribution, according the Law of Ukraine «On electric power engineering»

**3.15 metrological power losses**

Constituent of the nontechnical power losses, stipulated by the power income and return measuring errors, according GND 34.09.104-2003

**3.16 local power grid**

Joined power grid, aimed at power transfer from the transnational power grid to the consumer, according the Law of Ukraine «About electric power engineering»

**3.17 power receipt**

Power amount, received by the licensee-transmitter under the balance belonging from the neighboring licensee-transmitters, generating sources and power consumers substations, according to GND 34.09.104-2003

**3.18 GHG indirect emissions (energetic mediated GHG emissions)**

GHG emissions during power production, that is used by the economic entity or physical entity from the power grid, according to ISO 14064-1:2006

**3.19 Non-technical power losses in the power grids**

Part of the reporting technological power consumption, that arises during the power supply and is stipulated by the errors of income and power return measurement by the accounting devices,

as well as power return understatement for the consumers at the actual payment with the use of retail prices for the electricity, errors during the determination of power consumption amount for the calculated month at the weighted values of power consumption by the consumers without power accounting devices indices taking down, in this calculated period, nonsimultaneous power accounting devices taking down, seasonal component presence and accounting devices with the estimation errors work, that excel their standard values, according to GND 34.09.104-2003

**3.20 normative value of technological power consumption in the power grids**

Reporting value of technological power consumption constituent, that is equal to the sum of technical calculated values in the power grids elements and normative power losses for the substations and distributive points personal needs, according to GND 34.09.104-2003

**3.21 relative normative technological power consumption in the power grids**

Quotient determined in the percent from the division of normative value of technological power consumption and issue value of power into the grid, according to GND 34.09.104-2003;

**3.22 power transfer**

Power transmitting with the help of grids under the agreement, according the Law of Ukraine «About electric power engineering»;

**3.23 power supply**

Consumer providing with the power with the help of technical means of power transportation and distribution under the agreement, according the Law of Ukraine «About electric power engineering»;

**3.24 reference year**

The year for which the components of the reported power balance structure are defined in accordance with the norms and used to reduce the power balance structure of the previous or following years to the same power characteristics

**3.24 calculated period**

Calendar section of time (month, quarter, year), predictable or reporting, for which the calculations of normative technological power consumption values, are carried out, according to GND 34.09.104-2003;

**3.25 power accounting devices**

Power accounting means, that are used for commercial calculations, according the Regulations of power usage;

**3.26 power consumer**

Economic entities and legal entities, that use power for their personal needs, under the agreement on its sell and purchase, according the Law of Ukraine «About electric power engineering»;

**3.28 power balance structure**

Licensee-transmitter indices system for the calculate period, that is composed on the ground of accounting devices indexes, and characterizes total power income, return, and transformation values with the spaces on every level and reporting value of technological power consumption structure, according to GND 34.09.104-2003;

**3.29 neighboring power transmitting organization (neighboring licensee-transmitter)**

Power transmitting company, that is the subject number two, on the balance belonging scale, between power transmitting organizations, according to GND 34.09.104-2003;

**3.30 technical calculated power losses in the elements of power grids**

Power amount, that is lost for the physical processes of grids elements current supply parts heating, during current running through them, magnetic wires heating and electric equipment elements constructions separate parts, and electricity line crown discharge, that is determined by calculation, taking into account definite conditions and assumptions, that are established by this normative document, according to GND 34.09.104-2003;

**3.31 technological power consumption in the power grids**

Power amount, that is equal to the sum of power losses in the power grids elements, that arise in them while power transfer, power losses for the substations and distributive points personal needs, and power losses for the glazed frost melting, accordint to GND 34.09.104-2003;

**3.32 power transformation**

Power amount that is transferred through the transformers from one level to the other in the scale of licensee-transferor grids, according to GND 34.09.104-2003.

## 4 ABBREVIATIONS

The following abbreviations were used in this methodology:

| | | |
|---|---|---|
| RVTVE | − | reporting value of technological power consumption in the power grids; |
| NPL | − | nontechnical power losses value in the power grids; |
| EM | − | electricity meter |
| LEP | − | transmission line; |
| NVTVE | − | normative value of technological power consumption in the power grids; |
| NERC | − | National Electricity Regulation Commission of Ukraine;; |
| NCTVE | − | normative characteristic of technological power consumption in the power grids; |
| PUE | − | Rules for electrical installation |
| TVE | − | technological power consumption in the power grids; |
| CT | − | current transformer; |
| VT | − | voltage transformer; |

### 5 MAIN PRINCIPLES

5.1 Methodology of the specific emissions of carbon dioxide in the process of the power production by the thermal electric power stations and its consumption (hereinafter – DAEI methodology) determines the procedure and is used for carbon dioxide in the process of the power production by the thermal electric power station and its consumption by the final consumer specific emissions estimation, is lost while transmitting and supplying during GHG emission reduction estimation in the course of JI projects realization according the article 6 of the Kyoto protocol to UN framework convention on climate changes and other projects, directed on the GHG emissions reduction.

DAEI methodology contains directions as to the indicated indices values calculation arrangement and output data sources that are used in these calculations. Calculation of the indicated indices is carried out according thermal power stations activity actual results, transnational power grids operator, and power supply companies. Carbon dioxide emissions in the process of power

consumption calculation or while its transfer and supply is based on the data concerning technological power consumption in the power grids.

According to DAEI methodology the data concerning technological power consumption in the power grids are accepted on the bases of annual report according the form 1B- TVE "Power balance structure and technological power consumption for the power transfer through the grids " (1B-TVE form).

Specific indirect carbon dioxide emissions for the electric power unit calculation that is used by the consumer and is lost for its transfer and supply should be carried out separately.

Specific indirect carbon dioxide for the electric power unit, that are lost for the its transfer and supply by the power supply company, are determined according the formula (6) of DAEI Methodology, in which the data as to the TVE in the 800-220 kV transnational grids are used, in the percent to the issue (consolidated income) of power into the network and data concerning TVE in the 150-0.38 kV power grids of power supply companies in the percent to the issue (consolidated income) of power into the grid according the form data 1-B TVE form for the respective year. So the use of the data of line 19 is expected “RVTVE percent from the power issue into the grid” form 1-B TVE.

5.2 GHG emission reduction estimation in the course of JI projects realization for the current calculated period (year) according to DAEI methodology is made through the means of difference calculation between the basic emissions (for the basic year) and project emissions (for the current calculated year).

The peculiarity of the process of transmission and distribution is that the balance of power structure indicators (income and output power (total value and significance of voltage levels), transformation of energy between degrees of , RVTVE (total value and significance of voltage levels), NVTVE (total value and significance levels of voltage), calculated on the bypass power LEP and transformers for voltage levels and releasing (saldovane revenues) in the electricity network in different accounting periods (baseline and current) differ significantly among themselves, because changing the supply of electricity to consumers and the mutual flow of electricity between neighboring distribution companies. During the insignificant changes of technical characteristics of grids in the calculated periods, the scopes of transfer and power supply structure can change essentially, that is energetic characteristics of the object, concerning which the estimation of GHG emissions reduction in the course of JI projects realization should be made. Such estimation may be done correctly only under condition of object energetic characteristics providing, for the calculated periods to equal conditions. Object energetic characteristic, that is to be provided is the power balance structure according the form 1-B TVE “Power balance structure and TVE for the power transfer through the grids” for the respective year.

That important to note that chapter 8 data “Technical calculated power losses”, chapter 9 “Normative power losses for substations personal needs”, and chapter 10 “Normative TVE value” of forms 1-B TVE in different calculating periods were figured out according to requirements, that were in effect on that time, normative documents and should be adjusted to the normative base that is on effect nowadays.

Chapter 8 data “Technical calculated power losses” to March, 31 2004 were calculated according the requirements GKD 34.09.104-96 “TVE normalization for transference through 154-0.38 kV power grids. Methodical directions”. In the period since April, 1 2004 till March, 31 2009 – according the requirements GND 34.09.104-2003, since April, 1 2009 and till present day - according the requirements GND 34.09.104-2003 with the consideration Change № 1 to GND 34.09.104-2003.

Chapter 9 data “Normative power losses for substations personal needs” to March, 31 2004, calculated according the requirements RD 34.09.208-81 «Instruction on the power consumption for 35-500 kV substations personal needs normalization», since April, 1 2004 and till present day - according the requirements GND 34.09.203-2004.

So, power balance structure on the form 1-B TVE for the respective years should be made according the data of form 1-B TVE 2010.

Power balance structure bringing to equal conditions on the form 1-B TVE should be made with the use of scoping coefficient, that is equal to 1 for the year 2010, being the reference year.

5.3 Applying the conservative approach, while it is evident, that grids technical characteristics in 2010, from the TVE point of view are more perfect, than in any previous calculated year, and to proceed from the fact that to calculate indices of chapters 8 and 9 of 1-B TVE forms for the previous calculated years with the use of data provided in chapters 1,2 and 3 and provided normative TVE (NCTVE) characteristics that is practically impossible because of necessity to develop for each previous year NCTVE according to normative bases that is in effect at present day, data providing in chapters 8 and 9 should be made in the following way:

5.3.1. Variable technical calculated power losses in LEP (line 8.1) are equal to the value for 2010 on the respective power level multiplied by the calculated overplus transfused square through LEP for the respective previous year on the respective voltage level and divided by the square of calculated overplus transfused through LEP for 2010 on the respective voltage level;

5.3.2. Variable technical calculated power losses in transformers (line 8.3.1) are equal to the value for 2010 on the respective voltage level multiplied on the calculated overplus transfused square on transformers for the respective previous year on the respective level and divided on the square of calculated overplus transfused on transformers for 2010 on the respective voltage levels;

5.3.3. Conditionally-stable technical calculated power losses in transformers (line 8.3.2) for the respective previous year is considered equal to the value of 2010 on the respective voltage level; (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

5.3.4. Other conditionally-stable technical calculated power losses in other elements (line 8.4.3) for the respective previous year is considered equal to the value of 2010 on the respective voltage level; (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

5.3.5. Normative power losses for substations personal needs (chapter 9) for the respective previous year is considered equal to the value of 2010 on the respective voltage level (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

5.4. Reduction to equal conditions of the data in chapters 1, 2, 3 of the balance structure shall be made by using the reduction factor equal to 1 for 2010 and for other years the quotient from the division of the power sale in 2010 by the sale in the respective year. Such reduction, made by dividing the values in Chapters 1, 2, 3 for each year by the reduction factor, will be correct only if the following two conditions are simultaneously satisfied:

- relative values of power sale structure on voltage levels, calculated by Chapter 3 data as percentage of the power sale in 2010 and each other year are similar and do not have significant differences;

- reduction factor trend in 2010 and the previous years is stable, without sharp fluctuations and tends to decrease starting with 2010;

The decision to reduce the data in Chapters 1, 2, 3 of power balance structure to equal conditions is taken when the above conditions are satisfied. If not, only the data in Chapters 8 and 9

of 1-B TVE shall be reduced.

If the decision is made to reduce the data in Chapters 1, 2, 3 of the power structure balance to equal conditions the data are divided by the reduction factor. All other data of 1-B TVE form, besides those of Chapters 8 and 9 are calculated by the formulae given in the Instructions to reporting and analysis of the 1-B TVE form data.

The criteria of the 1-B TVE form data providing correction verification are as follows:

- equality of power sale into the grid values (chapter 18) for 2010 and respective previous years;

- equality of reporting TVE percentage from the power issue into the grid (line 19) in forms 1-B TVE for the respective year before and after 1-B TVE form data providing.

5.5. In case of a change the territory of the energy supply company licensed to supply electricity at regulated tariffs, which took place as a result of its division and the formation of her new utility company in accordance with NERC's decisions and changes as a result, the structure of the balance of power in form 1B-TVE for the year in which was a division, and subsequent years after separation, may be required during the calculation of indirect carbon dioxide emissions, accounting reporting forms 1B-TVE utility company for part of the settlement period (the year in which the division took place, and prior to the year in which the division occurred).

5.6. For the years after 2010 the reduction of the data in Chapters 1,2,3 of 1-B TVE form to equal conditions is made using the reduction factor if such reduction was made for the years prior to 2010.

If the data in Chapters 1,2,3 of 1-B TVE form are reduced to equal conditions after 2010. the data in Chapters 8 and 9 are reduced as follows:

5.6.1. Variable technical calculated power losses in LEP (line 8.1) are equal to the value for the subsequent period on the respective power level multiplied by the calculated overplus transfused square through LEP for the respective previous year on the respective voltage level and divided by the square of calculated overplus transfused through LEP for the subsequent period on the respective voltage level;

5.6.2. Variable technical calculated power losses in transformers (line 8.3.1) are equal to the value for the subsequent period on the respective voltage level multiplied on the calculated overplus transfused square on transformers for the respective previous year on the respective level and divided on the square of calculated overplus transfused on transformers for the subsequent period on the respective voltage levels;

5.6.3. Conditionally-stable technical calculated power losses in transformers (line 8.3.2). other conditionally-stable power losses in other elements (line 8.4.3) and normative losses for substation own usage (Chapter 9) are taken as equal to reported values.

5.7. If the data in Chapters 1, 2, 3 of 1-B TVE form for the years after 2010 are equal to reported values than the data in Chapters 8 and 9 are also equal to reported values.

5.8 Total value in section 8, "Technical estimated energy losses" for all billing periods should be multiplied by coefficient of deterioration in electrical indexes over time, the value of which according to statements presented in [1], and Recommendations Appendix A [1] is taken no more than 1,15.

5.9. Structure of RVTVE in the main power grids 800-220 kV, relative value of which is used in the interest of power transmission to the grid (consolidated income) according to the formula (6) “Methodology of the specific emissions of carbon dioxide in the process of the power production by the thermal electric power stations and its consumption” to calculate specific indirect emissions of carbon dioxide for the power unit, contains the technical calculated power losses in the grids,

power consumption by the substations as well as the untechnical losses. Untechnical power losses in the main grids are conditioned by the metrological losses, which under the quantitative estimation of the structure of the untechnical losses are to be calculated on the basis of the actual metrological characteristics of the accounting devices. Thus RVTVE in the main power grids are such that are calculated by the power registration system with the actual metrological error and are considered as the indirect emissions of carbon dioxide.

The structure of the RVTVE in the local power grid 150-0.38 kV of the power supply company contains the technical calculation power losses in the grids, power consumption by the substations as well as the untechnical losses. Nontechnical losses in the local power grid of the power supply company are conditioned by the metrological losses as well as by others factors conditioned by the understatement (overstatement) of the power transmission to the consumers.

Metrological power losses in the process of the quantitative estimation of the structure of the untechnical losses are to be calculated on the basis of the actual metrological characteristics of the accounting devices. Peculiar feature of the system of power registration in the local grid 150-0.38 kV of the power supply company is the existence of hundreds of thousands of the accounting devices, actual metrological characteristics of which are unknown. That is why in the process of the quantitative estimation of the metrological losses only fixed metrological characteristics of the accounting devices must be used. The calculated metrological losses should be corrected taking into consideration actual metrological characteristics of the accounting devices of the same type, which are defined with the certain assumptions. As the result we obtain the component of the fixed metrological power losses.

The components of the untechnical losses, conditioned by the understatement (overstatement) of the power transmission to the consumers, arise:

- due to the power theft and to the errors in the process of calculation of the amount of the supplied power and compiling pay-lists;

- due to the technological reasons, connected with the procedure of the estimation of the amount of power supplied to the consumers, i.e. due to the calculation of the amount of power supplied to the consumers at the actual payment using the power retail prices without the pay-lists; usage of the average amounts while compiling the pay-lists; unsumuultaneous taking of indexes from the accounting devices as well as the existence of the seasonal component;

- due to the technical reasons, i.e: due to the errors of the accounting devices, which exceed their fixed indexes.

The first two components of the non-technical losses are conditioned by the power theft and by the drawbacks in the organization of the control over the power consumption and the payment. These losses form the part of RVTVE, conditioned by the faults of power supply organization. They are very difficult to formalize as this component of the nontechnical power losses is predetermined by the social and organizational factors.

The component of the nontechnical power losses, conditioned by the faults of power supply organization cannot be considered as the indirect carbon dioxide emissions, because it is of untechnical nature.

The third component of the nontechnical power losses, connected with the work of the accounting devices with the measuring errors that exceed their fixed indexes, are to be estimated separately, according to the actual metrological characteristics of the accounting devices of the

same type, which are defined with the certain assumptions.

Thus, RVTVE in the local power grid of the power supply company (data of the line 19 "The percentage of reporting TVE (RVTVE) from the power supply to the grid" form 1-B TVE) in the process of calculation should be transferred to the indirect carbon dioxide emissions taking into consideration the fixed metrological power losses and the component of the nontechnical power losses, conditioned by the faults of power supply organization.

5.10 According to the above mentioned the scheme of the putting of the power balance structure of the form 1B-TVE for the accounting periods to the equal condition and the scheme of RVTVE correction in the local power grid 150-0.38 kV of the power supply company to ensure the possibility of usage of the provided corrected RVTVE for the transmission of them to the indirect losses of carbon dioxide are to be worked out.

5.11 In the process of the development of the RVTVE correcting scheme the fact that **NPL** cannot be measured should be taken into consideration. They may be only calculated but with some error. The error depends not only of the power supply and transmission measurement errors in the process of RVTVE calculation, of the component of the nontechnical power losses, conditioned by the faults of power supply organization, etc, but also of the NVTVE calculation errors, and of the technical calculation power losses in the grids. The technical calculation power losses in the grids as well as the losses, conditioned by the measurement errors are the components of the power balance, and in the process of their analysis the interval estimations, which are based on the precision grade of registration devices are used. The literature review affirms that the defining of the errors of this or that measuring device of power losses accounting is usually used for the qualitative estimation of its acceptability. In the practical calculations, including the process of the NVTVE structure calculation, the results are provided as the determined indexes.

## 6 REDUCTION OF POWER BALANCE STRUCTURE DURING THE ESTIMATED PERIODS TO EQUAL CONDITIONS, AND RVTVE ADJUSTMENT IN THE 0.38-150 kV POWER GRID OF POWER SUPPLY COMPANY

### 6.1 Structure and principal power balance equations

6.1.1 According to the principles of GND 34.09.104-2003 the power balance structure is the system of the indexes of the power transmission organization (licensed-transmitter) within the calendar (computation) period, compiled according to the indexes of the accounting devices and characterizes the amounts of delivery, transmission and transformation of power and RVTVE structure.

6.1.2 RVTVE $\Delta A_{AL}$ is equal to the difference between the sum of the power delivery and the sum of power transmission to the licensed-transmitters (neighboring structural units), consumers as well as to the power for the proper needs, measured by the power accounting devices:

$$\Delta A_{AL} = A_D - A_{\text{T}}^{\text{Neig}} - A_{\text{T}}^{C}, \quad (1)$$

where $\Delta A_D$ - Amount of power delivered to the grid;

$A_T^{Neig}$ - Amount of power transmitted to the neighboring licensed-transmitters;

$A_T^C$ - Amount of power transmitted to the consumers and power used for the proper needs.

6.1.3 Delivery (consolidated delivery) of power to the grid $A_{DG}$ is the amount of power transmitted to the consumers, used for the proper needs and for RVTVE

$$A_{DG} = A_T^C + \Delta A_{AL} \quad (2)$$

6.1.4 Reported relative technological power losses in the grids $\Delta A_{AL}^*$ are calculated in the interest as the quotient from the division of RVTVE and the amount of power delivery to the network:

$$\Delta A_{AL}^* = (\Delta A_{AL} | A_{DG}) \times 100\% \quad (3)$$

6.1.5 Untechnical power losses $\Delta A_{UT}$ is equal to the difference between RVTVE and NVTVE:

$$\Delta A_{UT} = \Delta A_{AL} - \Delta A_{NATPL} = \Delta A_M + \Delta A_K , \quad (4)$$

and consists of:

- amount of metrological power losses $\Delta A_M$ , calculated by the formula

$$\Delta A_M = \pm UB_D \cdot A_{DG} , \quad (5)$$

where $UB_D$ - assumptive power unbalance in the grid;

- amount of the nontechnical power losses $\Delta A_K$ , produced in the process of power transmission and is equal to the difference between the amount of nontechnical power losses and the amount of metrological power losses:

$$\Delta A_K = \Delta A_{UT} - \Delta A_M . \quad (6)$$

6.2 **Power supply company official statistical reporting list containing input data for the RVTVE correction**

6.2.1 According to the principles of DAEI Methodology the calculation of indexes is carried according to the actual results of activity of the thermal electric power stations, of the main power grids operator as well as of the power supply companies. That is why in the process of calculation

of RVTVE amount in the power grids of the company, that are transferred to the indirect carbon dioxide emissions only the data of the official statistical report should be used.

6.2.2 Reduction to equal conditions of the power structure balance is carried out using the data of the official statistical report of the power supply company according to:

- report form 1-B TVE "Structure of the power balance and the technological power losses in the process of its transmission in the power grids " within the year, which is compiled according to the Regulations of compiling and provision of reports and analysis of the data of the report form 1B-TVE;

- form No 67 – energo "Report of the organization of the active power registration system of the consumers as of 01.01.20__ and of the installation of the systems of the automatized power registration and the local devices of the data collection and processing in the consumers' power grids and in the power transmission companies" within the year.

6.2.3 In case of absence of the data of the official statistical report of the year the usage of the estimated amounts, calculated by the substantiated assumptions is admissible.

6.2.4 Annual report data from the power supply company of the quantity of domestic power consumers.

**6.3 Input data for the RVTVE correction**

6.3.1 From the report form 1-B TVE "Structure of the power balance and the technological power losses in the process of its transmission in the power grids" data is used according to:

- power delivery to the grid, MW·h;
- power transmission to the consumers, MW·h;
- power transmission to the neighboring licenced-transmitters, MW·h;
- amount of RVTVE in the grid, MW·h;
- amount of NVTVE in the grid, MW·h;
- amount of NPL in the grid, MW·h;
- delivery (consolidated delivery) of power to the grid, MW·h;
- relative amount of RVTVE in the grid before delivery (consolidated delivery) of power to the grid, %.

6.3.2 From the form No 67 – energo "Report of the organization of the active power registration system of the consumers as of 01.01.20__ and of the installation of the systems of the automatized power registration and the local devices of the data collection and processing in the consumers' power grids and in the power transmission companies" the data of the amount of meters installed for the domestic users is used:

- single-phase induction meters of the appropriate accuracy class;
- three-phase induction meters of the appropriate accuracy class;
- single-phase electronic meters of the appropriate accuracy class;
- three-phase electronic meters of the appropriate accuracy class.
- data of the total amount of all the types of meters with the overdue term of the state control.

**6.4 Reduction to equal conditions of power balance structure during the estimated periods in 1B-TVE form, for the periods prior to 2010**

6.4.1 The reduction factor is calculated which is equal to one in 2010, for others previous computation years it is equal to the quotient of the division of the delivery (consolidated delivery) of power to the grid in 2010 (chapter 18 total) and the delivery (consolidated delivery) of power to the grid for the previous computation year (chapter 18 total).

6.4.2. The relative values of the power sale structure on voltage levels, calculated by Chapter 3 data as percentage of power sale of the respective year, are calculated for 2010 and each computation period.

6.4.3. Based on the analysis of the data calculated under 6.4.1 and 6.4.2 if the conditions of 5.4 are satisfied, the decision is taken on the reduction to equal conditions of the data from Chapters 1,2,3 of the power structure balance.

6.4.4. If the reduction to equal conditions of data in Chapters 1,2,3 and chapters 8 and 9 is to be made, then:

6.4.4.1 Amount of power delivery to the grid for the previous computation year in the chapter 1 (lines 1.1 – 1.12 in columns 10-15) is divided by the reduction factor.

6.4.4.2 Amount of the power transformation for the corresponding previous computation year in chapter 2 (lines 2.7 – 2.12 in columns 10-14) is divided by the reduction factor.

6.4.4.3 Amount of the effective power transmission for the corresponding previous computation year in chapter 3 (lines 3.1.1 – 3.1.10 and 3.2.1 – 3.1.11 in columns 10-16) is divided by the reduction factor.

6.4.4.4 Variable technical power computation losses in LEP (line 8.1 in columns 10-15 ) for the corresponding previous computation year are equal to the amount in 2010 (line 8.1 in columns 10-15) with the corresponding voltage degree multiplied by the square of the computation transference in LEP for the corresponding previous year (chapter 12 in columns 10-15) with the corresponding voltage degree divided by the square of the computation transference in LEP in 2010 with the corresponding voltage degree (chapter 12 in columns 10-15);

6.4.4.5 Variable technical power computation losses in the transformers (line 8.3.1 in columns 10-14 ) for the corresponding previous computation year are equal to the amount in 2010 (chapter 8.3.1 in columns 10-14) with the corresponding voltage degree multiplied by the square of the computation transference in the transformers for the corresponding previous year (chapter 13 in columns 10-14) with the corresponding voltage degree divided by the square of the computation transference in the transformers in 2010 with the corresponding voltage degree (chapter 13 in columns 10-14);

6.4.4.6 Conditionally-constant technical computation power losses in the transformers (line 8.3.2 in columns 10-14) for the corresponding previous computation year with the corresponding voltage degree are equal to the amount in 2010 (line 8.3.2 in columns 10-14) with the corresponding voltage degree; (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

6.4.4.7 Other conditionally-constant power losses in others units (line 8.4.3 in columns 10-15) for the corresponding previous computation year with the corresponding voltage degree are equal to the amount in 2010 (line 8.4.3 in columns 10-15) with the corresponding voltage degree;

(for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

6.4.4.8 Normative power losses for the proper needs of the substations (chapter 9 in columns 10-14) for the corresponding previous computation year with the corresponding voltage degree are equal to the amount in 2010 (chapter 9 in columns 10-14) with the corresponding voltage degree (for a leap year the Conditionally-stable technical calculated power losses in transformers shall be multiplied by 8784 hours and divided by 8760 hours).

6.4.4.9 The amount of power delivery (consolidated delivery) to the grid is verified (chapter 18) for the corresponding previous computation year, which should be equal to the amount of power delivery (consolidated delivery) to the grid (chapter 18) in 2010. If this condition is not fulfilled the error should be found.

6.4.4.10 The equality of the report TVE percentage of the power delivery to the grid is verified (line 19) in the forms 1-B TVE for the corresponding previous year before the reduction and after the reduction.

6.4.5. If only the data of Chapters 8 and 9 are to be reduced to equal conditions the calculation is done according to 6.4.4.4-6.4.4.8/

6.4.6 Technical calculated energy losses (line 8 in column total) is multiplied by a coefficient of deterioration in electrical indexes over time.

6.4.7 Data of the implemented forms 1-B TVE for the prior to 2010 calculation periods is used for the calculations in 6.6.

**6.5. Reduction to equal conditions of power balance structure during the estimated periods in 1B-TVE form, for the periods following 2010**

6.5.1. If the reduction to equal conditions is performed for the data from Chapters 1,2,3 of 1-B TVE form of the previous to 2010 periods, so for the subsequent periods the reduction factor is calculated equal to the quotient of the power sale in 2010 (Chapter 18 total) divided by power sale (Chapter 18 total) in the subsequent period.

6.5.2. The data in Chapters 1.2.3 and Chapters 8 and 9 are reduced to equal conditions as follows:

6.5.2.1. Amount of power delivery to the grid for the subsequent computation year in the chapter 1 (lines 1.1 – 1.12 in columns 10-15) is divided by the reduction factor.

6.5.2.2. Amount of the power transformation for the corresponding subsequent computation year in chapter 2 (lines 2.7 – 2.12 in columns 10-14) is divided by the reduction factor.

6.5.2.3. Amount of the effective power transmission for the corresponding previous computation year in chapter 3 (lines 3.1.1 – 3.1.10 and 3.2.1 – 3.1.11 in columns 10-16) is divided by the reduction factor.

6.5.2.4. Variable technical power computation losses in LEP (line 8.1 in columns 10-15 ) for the corresponding subsequent computation year are equal to the amount in 2010 (line 8.1 in

columns 10-15) with the corresponding voltage degree multiplied by the square of the computation transference in LEP for the corresponding previous year (chapter 12 in columns 10-15) with the corresponding voltage degree divided by the square of the computation transference in LEP in 2010 with the corresponding voltage degree (chapter 12 in columns 10-15);

6.5.2.5. Variable technical power computation losses in the transformers (line 8.3.1 in columns 10-14 ) for the corresponding subsequent computation year are equal to the amount in 2010 (chapter 8.3.1 in columns 10-14) with the corresponding voltage degree multiplied by the square of the computation transference in the transformers for the corresponding previous year (chapter 13 in columns 10-14) with the corresponding voltage degree divided by the square of the computation transference in the transformers in 2010 with the corresponding voltage degree (chapter 13 in columns 10-14);

6.5.2.6. Conditionally-constant technical computation power losses in the transformers (line 8.3.2 in columns 10-14), other conditionally-constant power losses in others units (line 8.4.3 in columns 10-15) and normative power losses for the proper needs of the substations (chapter 9 in columns 10-14) are taken as equal to the reported values.

6.5.2.7. The amount of power delivery (consolidated delivery) to the grid is verified (chapter 18 total) for the corresponding subsequent computation year, which should be equal to the amount of power delivery (consolidated delivery) to the grid (chapter 18 total) in 2010. If this condition is not fulfilled the error should be found in the reduction of receipts, transformation and effective power transmission in 6.5.2.1-6.5.2.3.

6.5.2.8. The equality of the report TVE percentage of the power delivery to the grid is verified (line 19) in the forms 1-B TVE for the corresponding subsequent year before the reduction and after the reduction.

6.5.3. If the data in Chapters 1, 2, 3 of 1-B TVE form for the years after 2010 are equal to reported values. i.e. reduction using the reduction factor is not applied than the data in Chapters 8 and 9 are also equal to reported values.

6.4.6 Technical calculated energy losses (line 8 in column total) is multiplied by a coefficient of deterioration in electrical indexes over time.

6.5.5. The reduced data in 1-B TVE form for the subsequent to 2010 periods are used for calculation according to 6.6.

**6.6 RVTVE correction procedure**

***6.6.1 Calculation of the admissible normative unbalance of power in the grid***

6.6.1.1 The amount of the admissible non-balance of power in the grid $UB_D$ is calculated according to the annex E GND 34.09.104-2003 using the formula:

$$UB_D = \pm\sqrt{\sum_{i=1}^{N_н} \delta_{нi}^2 d_{нi}^2 + \sum_{j=1}^{N_в} \delta_{вi}^2 d_{вi}^2}\ , \qquad (7)$$

where $\delta_{нi}^2$ ( $\delta_{вi}^2$ ) - Correspondingly total relative error of the first (j) measuring complex which consists of the measuring current and transformers

and a meter, which measures power delivery (transmission);

$d^2_{ні}$ ($d^2_{ві}$) - Amount of power, delivered (transmitted) through the first (j) measuring complex;

$N_{ні}$ - Amount of measuring complexes, used to measure the amount of power delivered;

$N_{ві}$ - Amount of measuring complexes, used to measure the amount of power transmitted.

While calculating the amount of power unbalance the calculation scheme provided in "Directions of the commercial power registration scheme" should be used.

6.6.1.2 The total relative error of the first (j) measuring complex is calculated using the formula:

$$\delta_i = \sqrt{\delta^2_{CTi} + \delta^2_{TTi} + \delta^2_{met}}, \quad (8)$$

where $\delta_{CTi}$ - Relative error for the measuring current transformers of the first (j) measuring complex, which corresponds to the appropriate precision class, %;

$\delta_{TTi}$ - Relative error for the measuring current transformers of the first (j) measuring complex, which corresponds to the appropriate precision class, %;

$\delta_{met}$ - Relative error for the meter of the first (j) measuring complex, which corresponds to the appropriate precision class, %;

6.6.1.3 Portion of power delivered (transmitted) through the first (j) measuring complex on every current degree is calculated according to the data of the report form 1-B TVE of the power delivery and transmission to the neighboring licensed-transmitters and to the consumers with the with the corresponding degree.

6.6.1.4 Normative precision classes of the measuring complexes which are used for the registration of the power delivery and transmission to the neighboring licensed-transmitters and consumers while calculating the amount of the admissible normative unbalance are used according to the requirements of " Directions of the commercial power registration scheme" and chapter 1.5 PUE and are provided in the table 1.

Table1 - Set precision classes of the measuring complexes

| ID number | Index | Name of equipment | Precision class, % |
|---|---|---|---|
| 1 | Set precision classes of the measuring complexes, used to register power delivery (all the degrees) | CT | 0,5 |
| | | TT | 0,5 |
| | | Meter | 0,5 |
| 2 | Set precision classes of the measuring complexes, used to register power transmission to the neighboring licensed-transmitters (all the degrees) | CT | 0,5 |
| | | TT | 0,5 |
| | | Meter | 0,5 |
| 3 | Set precision classes of the measuring complexes, used to register power transmission to the consumers with the degree 110 (150) kV | CT | 0,5 |
| | | TT | 0,5 |
| | | Meter | 0,5 |
| 4 | Set precision classes of the measuring complexes used to | CT | 0,5 |

| | | | |
|---|---|---|---|
| | register power transmission to the consumers with the degree 35 kV | TT | 0,5 |
| | | Meter | 1,0 |
| 5 | Set precision classes of the measuring complexes, used to register power transmission to the consumers with the degree 10(6) kV | CT | 0,5 |
| | | TT | 0,5 |
| | | Meter | 2,0 |
| 6 | Set precision class of the meters, used to register power transmission to the consumers with the degree 0,38 kV | Meter | 2,0 |

6.6.1.5 The amount of the admissible normative power unbalance in the grid $UB_{Dnorm}$ is calculated using the formula (7) under the condition that the metrological characteristics of the measuring complexes correspond to those provided in the table 1.

***6.6.2 Calculation of the power non-technical losses component, conditioned by the existence of groups of the accounting devices of the same type, actual metrological characteristics of which differ from the normative ones***

6.6.2.1 According to the data, provided in [2,3], the verification of the induction meters has shown that they have a low metrological reliability and exceed the bounds of the precision classes even during the interverification period.

Interverification period for the single-phase induction meters is 8 years, for the three-phase meters - 4 years.

6.6.2.2 Presuming that the average term of meters after the last repair is about 4 and 2 years, the average systematized error trend according to chapter [2,3] is about 0,2 relative units per year for both types of meters. Thus, the systematized error $\Delta_{met}$ for the induction meters of the corresponding type and precision class is calculated by the formula:

$\Delta_{met} = -0,2 T_{ver} K_{met}$, where (9)

$T_{ver}$ - Meter service term after the last verification, years;

$K_{met}$ - Meter precision class.

6.6.2.3 Systematized error for the electronic (statistic) meters $\Delta_{met} = 0$.

6.6.2.4 Using the conservative approach, the misregistration of power transmission is calculated only for the domestic consumers. Misregistration of power transmission for legal entities (industrial and non-industrial consumers) is equal to zero.

6.6.2.5 Misregistration of power transmission to the domestic consumers on one induction meter of the corresponding precision class, $A_i^{misregistr\ ation}$ per year is equal:

$A_i^{misregistr\ ation} = (\Delta_{met} / 100) A_{aver}$, where (10)

$A_{aver}$ - Average annual power transmission to one domestic consumer.

6.6.2.6 Misregistration of power transmission to the domestic consumers, conditioned by the existence of accounting devices of the same type, the actual metrological characteristics of which differ from the fixed is equal to:

$$A_{misregistr\ ation} = \sum_{i=1}^{N_H} A_i^{misregistr\ ation} N_i \text{ , where} \qquad (11)$$

$N_i$ - Amount of induction meters of the corresponding type and precision class.

***6.6.3 Calculation of the power non-technical losses component, conditioned by the existence of the sensitivity threshold in the inductive meters***

6.6.3.1 Using the conservative approach, power misregistration is conditioned by the existence of the sensitivity threshold in the inductive meters, it is calculated only for the domestic consumers, where the most widespread meters of the precision class 2,5 are installed. According to the expert appraisal, it is presumed that the nominal current for 90% of the total number of such meters is 5A, and for the rest 10% - 10A. Misregistration of power transmission for the domestic consumers, equipped by the induction meters of precision 2,0 and 1,0, as well as for the legal entities (industrial and non-industrial consumers) is equal to zero.

6.6.3.2 Misregistration of power is conditioned by the existence of the sensitivity threshold in the inductive meters that is the minimal amount of current when the meter disc turns round constantly. Sensitivity threshold at State standard 6570 for the most widespread single-phase inductive meters of the precision class 2,5 is 0,85%. Total capacity of the devices of the domestic consumer (radiotelephones, radio and television equipment, etc, which are in the waiting mode) do not surpass the sensitivity threshold. The time, during which only the equipment which consume less than the sensitivity threshold is connected to the grid is more than 12 hours per day (night hours and the period when people are not at home during the working day). It is 4380 hours per year.

According to such assumptions, the misregistration of power for one single-phase meter of precision class 2,5 per year will be[3]:

$$\Delta A_{misregistr\ ation\ 2.5} = -(U_{nom} I_{nom} T_t (0{,}85 / 100) \text{ , where} \qquad (12)$$

$U_{nom}$ - Nominal current of the meter, 220 W;

$I_{nom}$ - Nominal current of the meter, A;

$T_t$ - Time, during which only the equipment which consume less than the sensitivity threshold is connected to the grid.

6.6.3.3 Misregistration of power transmission to the domestic consumers, equipped by the induction meters of the corresponding type , $A_{misregistr\ ation\ 2.5\,sum}$ per year will be:

$\Delta A_{misregistr\ ation\ 2.5\,sum} = \Delta A_{misregistr\ ation\ 2.5} N_{met\ 2.5}$ , where (13)

$N_{met\,2.5}$ - Amount of single-phase inductive meters of precision class 2,5, for which the assumptions provided in chapter 6.4.3.1.are used.

If the data on 2.5 accuracy induction meters with nominal current 5A and 10A are missing, it shall be assumed that the amount of 5A meters is 90% while 10A meters are 10%.

***6.6.4 Calculation of RVTVE amounts and untechnical losses***

6.6.4.1 RVTVE amount $\Delta A_{ALamount}$ , is calculated having reduced it by the absolute amounts of the misregistrations of power transmission to the consumers, conditioned by the existence of accounting devices of the same type, the actual metrological characteristics of which differ from the fixed and by the existence of the sensitivity threshold in the inductive meters:

$$\Delta A_{ALamount} = \Delta A_{AL} - \Delta A_{misregistr\ ation} - \Delta A_{misregistr\ ation\ 2.5} \cdot \quad (14)$$

6.6.4.2 The amount of the relative RVTVE $\Delta A^*_{ALamount}$ is calculated using formula:

$$\Delta A^*_{ALamount} = (\Delta A_{ALamount} / A_{DG}) \cdot 100\% \cdot \quad (15)$$

6.6.4.3 The amount of the relative NPL, is equal to the difference between the **relative** amounts of RVTVE and NVTVE:

$$\Delta A^*_{UTamount} = \Delta A^*_{ALamount} - \Delta A^*_{NATPL} \quad (16)$$

***6.6.5 Calculation of the power untechnical losses component, conditioned by the faults in the power transmission organization***

6.6.5.1 The relative amount of power untechnical losses component $\Delta A^*_{AUPLorg}$ , conditioned by the faults in the power transmission organization, is calculated as the difference between the amount of the report relative TPL and the top bound of the admissible unbalance:

$$\Delta A^*_{AUPLorg} = \Delta A^*_{UTamount} - UB_{Dnorm} \cdot \quad (17)$$

6.6.5.2 If the relative amount of the power untechnical losses component, conditioned by the faults in the power transmission organization $\Delta A^*_{AUPLorg}$ , is more than zero, the amount of the of the power untechnical losses component, conditioned by the faults in the power transmission organization, MW·h. Is equal:

$$\Delta A_{AUPLorg} = A_{DG} (\Delta A^*_{AUPLorg} / 100) \quad (18)$$

6.6.5.3 If the relative amount of the power untechnical losses component, conditioned by the faults in the power transmission organization $\Delta A^{*}_{AUPLorg}$ , is less or equals to zero, the amount of the of the power untechnical losses component, conditioned by the faults in the power transmission organization, MW·h. Should be equal to zero:

$$\Delta A_{AUOPLorg} = 0 \qquad (19)$$

### *6.6.6 Calculation of RVTVE* for its transition to the indirect carbon dioxide emissions

RVTVE for its transition to the indirect carbon dioxide emissions, which is corrected according to the amount of the nontechnical power losses, conditioned by the faults in the power transmission organization; is equal to the difference between the amounts of RVTVE, calculated by the formula (14) and the amount of the nontechnical power losses component, conditioned by the faults in the power transmission organization, calculate using the formula (18) or (19):

$$\Delta A^{emissions}_{ALamount} = \Delta A_{ALamount} - \Delta A_{AUPLorg} \qquad (20)$$

## 7. MONITORING OF TVE AMOUNT CALCULATION RESULTS IN 0.38-150 KV POWER GRID IN ORDER TO ESTIMATE INDIRECT CO2 EMISSIONS

The monitoring of TVE amount in 0.38-150 kV power grids of a power supply company used for estimation of indirect CO2 emissions for respective periods is performed by checking:

- compliance of the official statistic reports of the power supply company in 1-B TVE form, form No. 67 as well as annual report of the company for the respective year with the data used for calculation;
- compliance of the TVE amount calculation procedure to that of the given methodology.

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