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

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## SECTION A. General description of the project

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

**"Rehabilitation of the District Heating System of Zaporizhzhia City"**

PDD Version: 03

Dated: December 10, 2010

Sectoral scopes:

- 1. Energy industries (renewable / non-renewable sources).
- 2. Energy distribution.
- 3. Energy demand.

### A.2. Description of the project:

The project main goal is fuel consumption reduction, in particular reduction of natural gas (which is imported to Ukraine), as well as power consumption reduction by means of district heating system rehabilitation of Zaporizhzhia city, including boiler and distribution network equipment replacement and rehabilitation, construction of individual heat supply stations and installation of cogeneration plants and frequency regulators, etc. Such reduction of fuel consumption will result in reduction of greenhouse gas emissions ($CO_2$ and $N_2O$). The purpose of the project is sustainable development of the region through implementation of energy saving technologies.

Situation existing prior to the starting date of the project

Concern "Mis'ki teplovi merezhi" ("MTM") is one of the main enterprises of heat generation and transportation in Zaporizhzhia City. The enterprise sells heat energy in forms of heat and hot water to local consumers, namely households, municipal consumers and state-owned organizations. Heat supply market in the region is stable for years.

The common practice for the district heating enterprises in Ukraine including Concern "MTM" is to fulfils annual minimal repairing of the DH system to keep it working; mainly this turns out to repairing of network's parts and boilers that might cause accidents.

Baseline scenario

The Baseline scenario is continuation of the current situation, i.e. business-as-usual scenario with minimum reconstruction works. Since there is no local legislation regarding the time of energy equipment replacement and maximum lifetime permitted for such equipment, this scenario is in compliance with the valid mandatory laws and regulations. This Baseline scenario doesn't require the attraction of additional investments, and it represents the common practice in Ukraine – to continue operation of the equipment which was installed in $70^{th}$ and even earlier, if it meets the technical needs and if necessary (for boilers, etc.) passes the technical examination by the authorized body.

Project scenario

The project "Rehabilitation of the District Heating System of Zaporizhzhia City" was initiated in 2005 to rehabilitate Zaporizhzhia city district heating system, including boiler and distribution network equipment replacement and rehabilitation, upgrading of central heat supply station (CHSS) with the installation of a system of weather control, and installation of individual heat supply station (IHSS), cogeneration units and frequency regulators. Project includes 41 boiler-houses with 159 boilers (total connected load 1013.2 Gkal/hour) and 164 km of heat distributing networks, that are managed by Concern "Mis'ki teplovi merezhi".

The project employs the increase in fuel consumption efficiency to reduce greenhouse gas emissions relative to current practice. Such reduction of fuel consumption is based on increase of the boiler efficiencies, reduction of heat losses in networks and installation of cogeneration units.

The following activities will ensure fuel saving:

- Replacement of old boilers by the new highly efficient boilers;
- Installation of heat utilizers;
- Rehabilitation of Central heat supply stations (CHSS)
- Installation of Individual heat supply stations (IHSS)
- Rehabilitation of heat supply networks with using of the pre-insulated pipes;
- Installation of cogeneration units;
- Installation of frequency controllers at boiler-houses and CHSS;
- Switching of boiler-houses from natural gas to biofuel;
- Building of heat pump station at the central sewage treatment plant #1 for using the heat of sewage;
- Usage of the waste heat energy from the secondary energy sources (SES) of industrial enterprises.

Estimated project annual reductions of GHG emissions, in particular $CO_2$, are from 39.4 to 61.7 thousands tons per year in 2006-2007, from 85.5 thousands tons to 281 thousand tons in 2008-2012, comparing to business-as-usual or baseline scenario.

Implementation of the project will provide substantial economic, environmental and social benefits to Zaporizhzhia city. Social impact of the project is positive since after project implementation the heat supply service will be improved.
Environmental impact of the project is expected to be very positive as emission of the exhaust gases such as $CO_2$, $NO_x$, and CO will be reduced. Also due to better after-implementation service, some part of population will cease to use electric heaters thus reducing electricity consumption, which is related to power plants emissions of $CO_2$, $SO_x$, $NO_x$, CO and particulate matter.

Concern "Mis'ki teplovi merezhi" fulfils annual minimal repairing of the DH system to keep it working, mainly performs the repair of pipeline parts, which can lead to accidents. The more economically feasible and realistic scenario without the usage of JI mechanisms is the baseline scenario with a very low activity on the rehabilitation of heat supply system. Minimal annual repairing doesn't lead to decreasing of baseline emissions because of degradation of the whole system with efficiency droop at other objects, the overall actual emissions of the enterprise would stay at the approximately same level. This scenario is less environmentally favorable for the near future, since GHG emissions of the enterprise will continue to be kept at the same level or even higher, but economically such scenario is more attractive.

Estimated project risks are limited and minimized. Ukraine has claimed district heating and municipal energy sector as a priority of the national energy-saving progress.

**A.3. Project participants:**

| Party involved | Legal entity project participant (as applicable) | Please indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Ukraine (Host Party) | OJSC "Oblteplocomunenergo" | No |
| | | No |

- ***OJSC "Oblteplocomunenergo":*** organization acting as Project Applicant and Supplier of GHG emission reductions on behalf of participants of Agreement on the Joint Activity on joining of efforts for development of the project, concluded between OJSC "Oblteplocomunenergo" and Concern "Mis'ki teplovi merezhi". It represents the interests of participants of Agreement and is responsible for the organizational aspects of JI project.

Historical details:
The enterprise "Chernihivteplomerezha" was founded on the basis of Order No. 353 of the Minister of Municipal Housing of USSR and Decision No.#714 of the Executive committee of the City Council of Deputies from December 31st, 1968. It has started its work on January 1st, 1969. Since 1982 the enterprise became the regional production association "Chernihivteplomerezha". On the 27-th of August, 1985, the enterprise was re-named to the Oblast Production Association (OPA) «Chernihivteplocomunenergo». On 25.03.1992 the enterprise became State Municipal Enterprise (SME)"Oblteplocomunenergo".

In 1995 the privatization of enterprise objects was hold. On 31.07.95 the SME "Oblteplocomunenergo" was re-named to the Open Joint Stock Company "Oblteplocomunenergo"

Today the OJSC "Oblteplocomunenergo" is the powerful heat supply complex. It has 12 boiler-houses and 2 heat points, automobile division, repairing-mechanical division, pre-isolated pipes manufacture division, measuring devices repairing and testing division, metrological lab, etc. The heat energy is also produced by 107 rented boiler-houses. 18 operation divisions in the region belong to the enterprise. The enterprise supplies heat energy to over 270 thousand of consumers (population, housing and administrative buildings) in 22 settlements in Chernihiv Region. The heating installed load is nearly 288 Gcal/hour, hot water supply – nearly 92 Gcal/hour. The part of the housing (inhabited) heated area is about 81%, of legal persons – 19%.

- ***Concern "Mis'ki teplovi merezhi"*** - organization implementing the project. It operates equipment for the production and distribution of heat energy, and also provides services for heating and hot water supply. Since this organization is the payer for the required energy and raw materials (fuel, electricity, water, etc.), it is most interested in reducing the specific fuel consumption as a result of the project implementation.

Historical details:

The company was founded in August 2002 by decision of the 34 th session of the 23rd convocation of Zaporizhzhia city council from 11.10.2002 № 17 "On creation of utility heating networks" and is owned by the territorial community of Zaporizhzhia city.

Concern “Mis’ki teplovi merezhi” has combined the municipal heating utilities – city district heating networks, created from the joint stock companies.

At present the district heating system of Concern “Mis’ki teplovi merezhi” includes all territorial districts (Leninsky, Zhovtnevy, Ordzhonikidzevsky, Shevchenkivsky, Zavodsky, Komunarsky and Khorticky) of Zaporizhzhia city. Concern “MTM” is the main heat-supply enterprise in the city.

District heating of the city consumers is provided by 46 boiler-houses. The length of heat supply networks in the two-pipe measuring is 687.76 km.

Concern “Mis’ki teplovi merezhi” employs 2.5 thousand highly qualified specialists.

## A.4. Technical description of the project:

### A.4.1. Location of the project:

The Project is located in Zaporizhzhia City in the South-East part of Ukraine (**Fig.A.1**).


*Fig. A.1. Location of Zaporizhzhia city on the map of Ukraine*

#### A.4.1.1. Host Party(ies):

The project is located in Ukraine.
Ukraine is an Eastern European country that ratified the Kyoto Protocol to UN FCCC on February 4th, 2004, enters into the list of the countries of the Appendix 1 and is eligible for the Joint Implementation projects.

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

Zaporizhzhia region.

Zaporizhzhia region is situated in the South-East of Ukraine, occupies mainly the left bank of the Dnipro River basin downstream. At the north and north-west it borders with Dnipropetrovsk region, to the west - with Kherson region, to the east - with Donetsk region, at the south it is washed by the Sea of Azov. It stretches from north to south for 208 km and from west to east for 235 km.
The climate is Atlantic-continental with hot summers and little snow, mostly warm winter. The average July temperature is 22.8 ° C, January -4.9 ° C. The average number of sunny days is 225 in a year. Under the terms of moisture supply area of the city belongs to the arid zone. Average annual rainfall is 443 mm. In summer downpours often occur, strongly erode the soil surface.
Heating period is usually 174 days. The typical outdoor temperature of a heating season is $1.4^0$ C (by SNIP).

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

Zaporizhzhia city.
Zaporizhzhia city territory covers an area of 334 square km.
The population is 776.9 thousand people.

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

The City is divided into 7 administrative districts: Leninsky, Oktyabrsky, Ordzhonikidze, Shevchenko, Zavodskyi, Kommunarsky and Hortitsky. Concern “Mis’ki teplovi merezhi” is divided into 7 respective affiliates. The heating systems of the all territorial districts of Zaporizhzhia are involved into the project (Figure A.2).

Coordinates: 47.83°N, 35.17°E

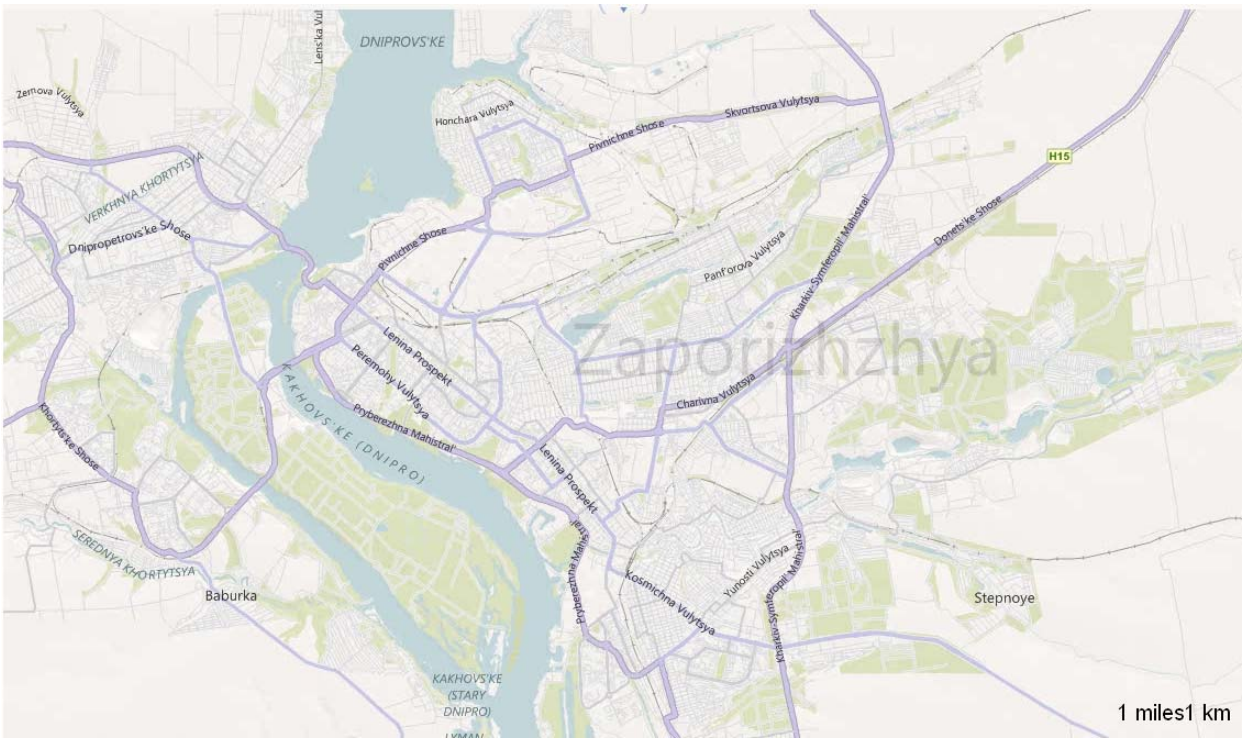


*Fig. A.2. The map of the Zaporizhzhia city where the JI Project will be implemented*

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

The main ,measures that will be used to improve the operation efficiency of the Concern "Mis'ki teplovi merezhi" are the following:

- Old operating boilers with low efficiency will be replaced by the new highly efficient KVGM[1], KSV[2],, KOLVI[3],, AOGV[4] boilers, that will result in efficiency increase from 65-85% up to 90-93%. Technical characteristic of new boilers scheduled to be installed are presented at the producer's websites that are listed in table below.

- Installation of surface condensation heat utilizers, including the ones developed by the Institute of Engineering Ecology, will allow to utilize the heat of the exhaust gases. Implementation of this technology will improve fuel consumption efficiency by 6-8%.

- Installation of wood-fired boiler "Kriger"[5] in boiler-house at Viyskbud str., 124b.

*Fig.A.3. Boiler "Kriger"KVM(a)-0,82*

- Rehabilitation of heat distribution networks will reduce heat losses due to replacement of the pipes of the main and distribution network with the pre-insulated pipes.

- Rehabilitation of central heat units (CHSS) with implementation of wheather control and reduction of electricity consumption due to implementation of frequency controlled drives for the power supply of circulation pumps.

- Replacing of the 4-pipe-lines by a 2-pipe ones with simultaneous installation of heat exchangers KIARM[6] (IHSS) near consumers.

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[1] www.uche.com.ua/boiler_equipm

2 www.tekom.com.ua/kotel/vk.html

[3] www.kolvi.com/index.php?option=com_content&task=blogcategory&id=11&Itemid=105

[4] www.majak.com.ua/products/majak12ks.html

[5] http://www.kriger.com.ua/ru/td/products/kriger/

[6] www.kiarm.ua

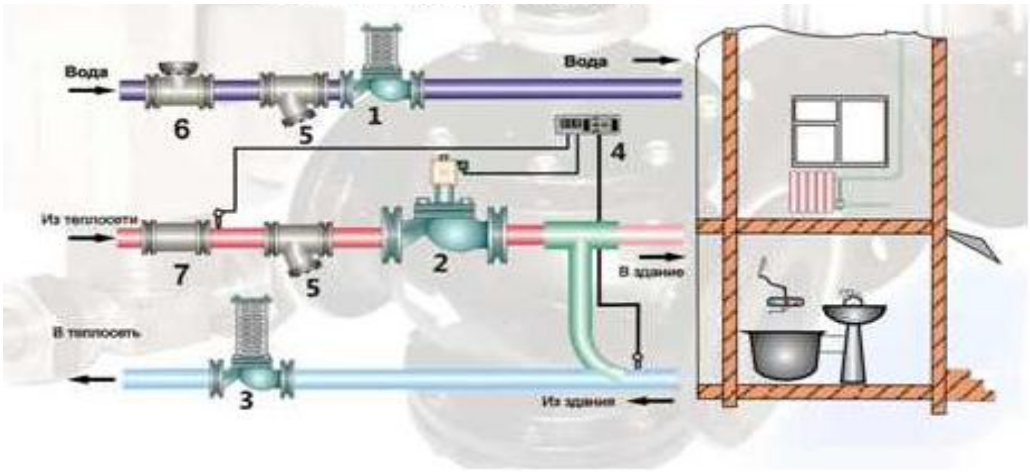


*Fig. A.4. Heat exchanger KIARM*

- Implementation of frequency controlled drives for hot water pumps will significantly reduce electricity consumption. Such controllers allow to change the power of electric motors in dependence on the connected load, as during the day, when water use is being changed, and during the year, when in summer the motors operate only for hot water supply. Specifications of frequency controllers "Hitachi"[7] and "Danfoss"[8] are shown at the manufacturer's site.


*Fig. A.5. Frequency controller "Hitachi"*

- Installation of cogeneration units enabling to replace the heat energy for hot water supply from the boiler-houses at the Tovariska str., 47, Adm. Ushakova str., 251, Citrusova str., 9 with the heat from the cogeneration units (electricity produced by cogeneration units will be consumed

[7] http://www.hitachi.com, www.danfoss.com

[88] www.danfoss.com/ukraine

by boiler-house's own needs and supplies to the electricity grid1) will result in increasing the fuel consumption efficiency, decreasing of dependence on the grid power supply, improvement of operational stability and reliability, decreasing of power consumption from power stations, decreasing of power transfer losses, and decreasing of environmental pollution.

- Usage of the heat energy of the secondary energy sources (SES) from OJSC "Zaporizhstal" for hot water supply in summer of consumers in Ordzhonikidze district (boiler-house at the Adm. Nakhimova str., 4), Leninsky district (boiler-house at Metalurhiv av., 32), Zhovtnevyy district (boiler-house at Artema str, 79A, boiler-house at Heroiv Stalingrada str., 2a), Zavodskyy district (boiler-house at Adm. Ushakova str, 251), Komunarskiy district (boiler-house at. Chubanova str., 3d).

- The project envisages building of the heat pump station with heat capacity of 15 Gcal/h at the central sewage treatment plant #1 with using heat from waste sewage to provide hot water supply to consumers of Komunarsky district of Zaporizhzhia.

The measures from this list will be implemented at boiler houses subject to rehabilitation.

The generalized schedule of their implementation will be the following:

| Project phase | Period |
|---|---|
| Boiler equipment rehabilitation, installation of heat utilizers | 01/2006-12/2012 |
| Rehabilitation of heat distribution networks | 01/2006-12/2012 |
| Rehabilitation of CHSS with implementation of the system of weather dependent control, implementation of IHSS | 01/2007 – 12/2012 |
| Implementation of frequency controllers | 01/2007 – 12/2012 |
| Implementation of CHP | 01/2007-12/2012 |
| Implementation of using of the waste heat energy of SES of industrial enterprises for hot water supply needs | 07/2005-10/2012 |
| Installation of the wood-fired boiler for hot water supply needs | 01/2009-12/2010 |
| Building of heat pump station at the central sewage treatment plant #1 for using the heat of waste sewage | 01/2010-12/2011 |

*Table A.1. Measures to be implemented at boiler houses subject to rehabilitation*

The results achieved after implementation of these technologies and measures are listed in **Appendix 1-2-8 (Boilers, Network, Total) and Appendix 3-7, v.2**.

These technologies have already been tested, but some of them are not widely used. For this reason there may be some obstacles that are typical for the implementation of new technologies and equipment.

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

The project activitiy. will increase energy efficiency of Zaporizhzhia City DH system, thus enabling it to produce the same amount of heat energy with less fuel consumption. Reduced fuel consumption will lead to reduction of $CO_2$ emissions.

In the absence of the proposed project, all equipment, including the old low efficient one but still workable for a long life period, will operate in as-usual mode, and any emission reductions will not occur.

Ukraine has claimed district heating and municipal energy sector as a priority of the national energy-saving progress. The law of Ukraine "On heat energy supply" (№ 2633-IV from 02.06.2005) regulates all relations at the heat supply market. It does not considerably change the previously existing practices at the market, but stimulates the more rigid energy saving and implementation of energy-efficient technologies. It states the high goals but does not have special program and is not provided with the necessary financing.

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

In course of project implementation, the following emission reductions will be achieved, at the stages of project implementation:

| | Years |
|---|---|
| Length of the crediting period | 25 |

Period before January 1, 2008:

| Year | Estimate of annual emission reductions in tonnes $CO_2$ equivalent |
|---|---|
| Length of the crediting period | **2** |
| 2006 | 39 456 |
| 2007 | 61 724 |
| **Total estimated emission reductions over the early crediting period (tonnes of $CO_2$ equivalent)** | **101 180** |
| **Annual average of estimated emission reductions over the early crediting period (tonnes $CO_2$ equivalent)** | **50 590** |

*Table A.2: Estimated emission reductions for period before January 1, 2008*

The First Kyoto Commitment period 2008 – 2012:

| Year | Estimate of annual emission reduction in tonnes $CO_2$ equivalent |
|---|---|
| Length of the crediting period | **5** |
| 2008 | 85 558 |
| 2009 | 103 180 |
| 2010 | 127 562 |
| 2011 | 189 315 |
| 2012 | 281 066 |
| **Total estimated emission reductions over the first commitment period (tonnes of $CO_2$ equivalent)** | **786 681** |
| **Annual average of estimated emission reductions over the first commitment period (tonnes $CO_2$ equivalent)** | **157 336** |

*Table A.3: Estimated emission reductions during the first commitment period*

The Post-first commitment period 2013 – 2030:

| Year | Estimate of annual emission reductions in tonnes $CO_2$ equivalent |
|---|---|
| Length of the crediting period | **18** |
| 2013 | 281 066 |
| 2014 | 281 066 |
| 2015 | 281 066 |
| 2016 | 281 066 |
| 2017 | 281 066 |
| 2018 | 281 066 |
| 2019 | 281 066 |
| 2020 | 281 066 |
| 2021 | 281 066 |
| 2022 | 281 066 |
| 2023 | 281 066 |
| 2024 | 281 066 |
| 2025 | 281 066 |
| 2026 | 281 066 |
| 2027 | 281 066 |
| 2028 | 281 066 |
| 2029 | 281 066 |
| 2030 | 281 066 |
| **Total estimated emission reduction over the post-first commitment period (tonnes of $CO_2$ equivalent)** | **5 059 188** |
| **Annual average of estimated emission reduction over the post- first commitment period (tonnes $CO_2$ equivalent)** | **281 066** |

*Table A.4: Estimated emission reductions after the first commitment period 2013-2030*

Total amount of Emission Reductions over the crediting period:

| | **Estimate of annual emission reductions in tonnes of $CO_2$ equivalent** |
|---|---|
| Length of the crediting period | **25** |
| **Total estimated emission reduction over the crediting period 2006 – 2030 (tonnes of $CO_2$ equivalent)** | **5 947 048** |
| **Annual average of estimated emission reductions over the crediting period (tonnes of $CO_2$ equivalent)** | **237 882** |

*Table A.5: Estimated total amount of Emission Reductions over the crediting period*

Thus the estimated amount of emission reductions over the first commitment period (2008-2012) is **786 681** tonnes of $CO_2e$, over the whole crediting period (2006 – 2030) - is **5 947 048** tonnes of $CO_2e$.

For more detailed information see **Appendix 1-2-8 (Total)**.
Description of formulae used to estimate emission reductions is represented in paragraph D.1.4.

## A.5. Project approval by the Parties involved:

The project is already supported by local authorities, namely the Executive Committee of the Zaporizhzhia City Council; therefore the organizational risks for the project are minimized.

The project was initiated in 2005.

April, 2005 - Agreement was signed between Concern "Mis'ki teplovi merezhi" and Institute of Engineering Ecology on implementation of the heat utilizers at the enterprise for reduction of the GHG emissions due to fuel saving as the first stage of the joint implementation project (#533 dated 04/11/2005).

October, 2010 - Agreement was signed between OJSC "Oblteplocomunenergo" and Concern "Mis'ki teplovi merezhi" on joining of efforts for development of the project and on the representation of interests of the Concern by OJSC "Oblteplocomunenergo" (#238 dated10/01/2010).

October, 2010 - Agreement was signed between OJSC "Oblteplocomunenergo" and Institute of Engineering Ecology on development of the Joint Implementation Project on Green House Gas Emission Reductions due to fuel saving through rehabilitation of the district heating system of Zaporizhzhia city (# 733/497 dated1 0/01/2010).

November, 2010 - Ukrainian DFP – the National Environmental Investment Agency of Ukraine has issued the Letter of Endorsement for this project (#1900/23/7 dated 11/16/2010).

According to the procedure, the LoAs by Parties involved will be issued after the project determination.

## SECTION B. Baseline

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

The main complication for implementation of the JI projects on district heating in Ukraine is the practical absence of monitoring devices for heat and heat-carrier expenditure in the municipal boiler-houses. Only the fuel consumption is registered on a regular basis. It makes practically impossible the application of AM0044 methodology which basic moment is monitoring of the value $EG_{PJ, i, y}$ (thermal energy output of project boiler i in year y) - page 9 of Methodology AM0044 (version 1)[2], which should be measured every month by flow-meters (the expenditure of heat-carrier) and thermal sensors (temperatures at the input and output of the boiler, etc.). This also concerns the definition of the average historical value of heat power generation per year $EG_{BL, his, i}$ (average historic thermal energy output from the baseline boiler "i").

Besides, in section "Scope of Application" it is mentioned, that the scope of application of the Methodology AM0044 is limited only to the increase of boilers' efficiency by means of their replacement or modernization, and it does not apply to the fuel type switch. At the same time our project includes also such kind of modernization as well as some others such as the replacement of burner equipment, installation of cogeneration units, etc.
The methodology developed by the Institute of Engineering Ecology, takes into account all activities included in the project.
The methodology is based on continuous monitoring of fuel consumption and consideration of various other factors, such as: the connection or disconnection of customers, the change in net calorific value of fuel, climate change, the ratio of the heat consumption for heating and hot water consumption for own needs, etc.
This methodology is given in Section D (monitoring plan). It is already approved by IAEs for JI project for Chernihiv region and similar JI projects for AR Crimea, Donetsk region and for cities Kharkiv, Rivne and Luhansk.

This Methodology has two important advantages in comparison with the methodology AM0044 (at least for Ukrainian conditions):

- It takes into account the quality of heat supply (heating and hot water supply). Almost annually for the various reasons (receiving of less amount and high price of the fuel, in particular natural gas which is nearly 95 % of fuel type used in Ukraine for the needs of the municipal heat supply), the consumers receive less than necessary amount of heat, in the result of which the temperature inside the buildings is much lower than normative one, and hot water supply is insufficient or absent. As the purpose of JI projects, including the current project, is the GHG ($CO_2$) emission reduction under the conditions of not worsening in any circumstances of the social conditions of population, the issue of approaching of the heat supply quality to the normative one is extremely important. Therefore, the amount of the fuel consumption for the after project implementation period is calculated for the conditions of providing the normative parameters of heat supply and at least partially of hot water supply, and in accordance with the monitoring plan, the implementation of continuous control (monitoring) of its quality (measurement of internal temperature in the specific buildings as well as registration of residents' complaints for the poor-quality heat supply) is foreseen. This increases the control for the qualitative heat supply for the consumers and excludes deliberate reduction of heat consumption, and, in such a way, of fuel consumption with the purpose of increasing of generation of GHG emissions reduction units (ERUs) at the project verification.
- Definition of the fuel consumption in base year (baseline) in view of the fact that in Ukraine at the majority of the municipal heat supply enterprises the natural gas is used as a fuel, which

consumption is measured constantly by the counters with the high measurement accuracy, seems to be more exact, than definition of the fuel consumption with use of heat power, boiler efficiency and heat value of the fuel. This especially concerns the efficiency, which changes greatly depending on load of boilers, which also changes essentially, and often not automatically but manually, in the heat supply systems within a day and within a year. Averaging of such values without having of the heat account system is fraught with serious discrepancies. Definition of the fuel consumption in the presence of counters requires only data collection and implementation of arithmetic actions.

Approved Consolidated Methodology ACM0009 "Consolidated baseline methodology for fuel switching from coal or petroleum fuel to natural gas" (version 03.2)[9] proposes the dependences for baseline and reporting year emissions quantity definition (see pages 4 and 5), that contain determination of Energy efficiency $\varepsilon_{project,i,y}$ and $\varepsilon_{baseline,i}$ for equipment. In the chapter "Baseline emissions" on the page 6 there is an explanation that: Efficiencies for the project activity ($\varepsilon_{project,i,y}$) should be measured monthly throughout the crediting period, and annual averages should be used for emission calculations. Efficiencies for the baseline scenario ($\varepsilon_{baseline,i}$) should be measured monthly during 6 months before project implementation, and the 6 months average should be used for emission calculations.

For this reason, the own project specific methodology was developed, that is based on the permanent measuring of the fuel consumption and amendments for possible parameters changes in baseline in comparison with reporting year. The variable parameters may be the changes in lower heating value of fuels, quality of heating service, weather changes, changes in customers' number, etc. Taking into account only equipment efficiency does not eliminate the possibilities of undersupply of heat to customers (deterioration of heat supply service), and possible weather warming in reported year, change in fuel quality, disconnection of some consumers, and other factors, and could lead to artificial overestimation of ERUs amount.

In additional, the proposition in ACM0009 to take (by conservatism principle) the baseline efficiency of equipment equal to 100 % is unacceptable in "District Heating" type projects, because not only fuel switch, but mainly namely increasing of equipment (boilers) efficiency are implemented in these projects. Accepting of such calculated baseline would lead to essential underestimation of results of implemented measures. And, anyway, as it was shown before, this would not solve the problem with impossibility of monthly measurements for getting energy efficiency $\varepsilon_{project,i,y.}$

Approved Methodology AM0048 "New cogeneration facilities supplying electricity and/or steam to multiple customers and displacing grid/off-grid steam and electricity generation with more carbon-intensive fuels" (version 03)[10] already in its title shows the scope of applicability, that is different from the scope of the "District Heating" projects. In our projects, the cogeneration facilities produce hot water and not steam. Beside this, in according to AM0048 (page 22) and its monitoring plan (pages 23-30), it is necessary to realize, among other measurements, monthly measurement of *SCPCSG,i,y* (Total steam self-generated by project customer 'i' during year 'y' of the crediting period, TJ), measured by the steam meter at the customer 'i' (page 25). Thus Methodology AM0048 couldn't be implemented in original. In principle, it could be modified for conditions of hot water production for heating and hot water supply systems, but this will require modification of monitoring plan with introduction of other parameters that it is necessary to measure and register. But it would be the another methodology, that would require to measure such parameters as heat output, or hot water output with its temperature (in analogy with requirements of Methodology AM0048 to measure steam output, its pressure and temperature.

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[9] http://cdm.unfccc.int/filestorage/K4P3YG4TNQ5ECFNA8MBK2QSMR6HTEM/Consolidated%20methodology%20for%20industrial%20fuel%20switching%20from%20coal%20or%20petroleum%20fuels%20to%20natural%20gas.pdf?t=emx8MTI5MjQ5MDE4NS4zMg==|afOcs9-plKnHl-kSQFRbdHZKAx0

[10] http://cdm.unfccc.int/filestorage/3IGLTAFC1VSY4HQUO8WZDN0657EMXJ/EB52_repan06_AM0048_ver03.pdf?t=eEt8MTI5MjQ5MDEzMS43MQ==|6_dBnGJ1BJlhw3xEzaRRF_mGL9I

As it was already mentioned before, the majority of the heat supply enterprises and heat customers in Ukraine are not equipped with heat meters or devices for heat-carrier output (hot water for heating and hot water service) determination. Just for this reason, the methodology was developed that is based on the permanent measuring of the fuel consumption and corrections for possible changes of parameters in reporting year comparing to the baseline. The changeable parameters may be the lower heating value of fuels, quality of heating service (providing of normative temperature value inside apartments), weather features, number of customers, etc. As it was mentioned before, this approach eliminates any possibility of reduction of fuel consumption and correspondingly GHG emission due to incomplete delivery of heat to consumers.

In view of the above mentioned, in contrast to the methodologies AM0044, ACM0009 and AM0048, our Methodology, developed for "District Heating" projects in Ukrainian conditions and used in JI Projects "Rehabilitation of the District Heating System in Donetsk Region", "Rehabilitation of the District Heating System of Chernihiv Region", "Rehabilitation of the District Heating System in Crimea", "Rehabilitation of the District Heating System in Kharkiv city", etc., is the most appropriate, precise, corresponding to the principle of conservatism, and the most closely reflects the aims, goals and spirit of Kyoto Protocol.

The baseline study will be fulfilled every year of the emission reduction purchasing, to correct adjustment factors which have an influence at the baseline. For more detailed information see **paragraph D.1.**

There were three different versions of Baseline scenario that were discussed before starting this project.

The first version of Baseline scenario was a business-as-usual scenario with minimum reconstruction works balanced by overall degradation of DH system. For this Baseline scenario there are no barriers (no investment barrier since this scenario doesn't require the attraction of additional investments, and no technological barrier since the equipment is operated by existing skilled personnel, and additional re-training is not required), and represent the common practice in Ukraine.

The second version of Baseline scenario was to make reconstruction works without JI mechanism. In this case there exist both investment barrier since this scenario requires the attraction of large additional investments, and due to very large payback time and high risks it is not attractive for investments, and as well the technological barrier since operation of the new modern equipment will require additional re-training of personnel. Rehabilitation of heat supply equipment in order to improve its efficiency is not a common practice in Ukraine.

The third version of Baseline scenario was the shortened project activity, without any of the non-key type of activity, for example elimination of frequency controllers installation, etc., from the project. This makes project economically less attractive, with the longer pay back period.

Thus, the first version was chosen for Baseline scenario.

**Status and adequacy of the current delivery system**

Current heat generation in Zaporizhzhia city DH system is based mainly on Ukrainian and Russian made boilers including:

PTVM-30; PTVM-50; AG-105; AOGV-100E; B-25/15-GM; DKVR-10/13; DKVR-4/13; KBNG–2,5; KV-0,3GN; KVG-4,65; KVG-5.2-115SN; KVG-7,56; KVG-4,65; KVGM-1,2; KVGM-2,9; KVGM-20; KVGM-30-150M; KVGM-35-150; KVGM-50; KVGM–100; KSV-2,0; KSVa-1,25Gn; TVG – 4r; TVG – 8; Minsk-1; MH-120; NIISTu-5; Nika-1,25; Universal-5; Universal,"Rondomat" Vitogas-100.

Detailed information is presented in **Appendix 1-2-8 (Boilers).** Current efficiencies of those boilers are in the range of 68-90 %.

The heat distribution networks are characterized by the typical heat losses from 10 to 35%. Detailed information is presented in **Appendix 1-2-8 (Network).**

**Identification of the Baseline Scenario**

Current operation of the Zaporizhzhia city district heating system results in continuous deterioration of the heat-generating and distribution equipment, followed by continuous slight efficiency droop. However, at the same time operative maintenance increases efficiency, which pretty much compensates deterioration, and makes annual total emissions level (the Baseline) about the same for years.

Project also provides electric power production on the new cogeneration units. This power will replace consumption from the national power grid, that's why we take into account the valid approved average value of Carbon Emission Factor (EF) for Baseline definition.

**Baseline Carbon Emission Factors**

Boilers of the Zaporizhzhia city district heating system use natural gas as a fuel.

For natural gas (NG) we used $CO_2$ emission factor from the data table, 1996 IPCC Guidelines for National Greenhouse Gas Inventories Vol.2 Energy [11]: We assume that Carbon emission factor for the natural gas will be the same at least for period 2005-2012.

For our calculations we assume also that the Net Calorific Value (NCV) of the natural gas doesn't change during that time. However, according to the Monitoring Plan, the actual NCV will be taken into account for the baseline correction for any reported year.

Ukraine has united state power grid, therefore the average value of Carbon Emission Factor is applied for electric power generation. Carbon Emission Factors for 2005 was taken from Table 2 « Baseline Carbon Emission Factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines, Version 2.3. ERUPT 4, Senter, The Netherlands, 2004[12]

Carbon Emission Factors for 2006-2012 was taken from from Table 8 "Emission Factors for the Ukrainian grid 2006-2012" of Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", verified by TUV SUD Industrie Service GmbH 17.08.2007.

In course of development of the Monitoring reports for this project, the valid values for corresponding period will be used.

**Activity Level**

Activity level is represented by annual fuel consumption. For calculation of Baseline emissions, the 2005 was taken as the Base year. This year is one of the typical years concerning the outside temperature in heating period, as well as concerning the conditions of production and consumption of the heat. The fuels and electricity consumption in base year is represented in Table B.1.

[11] http://www.ipcc-nggip.iges.or.jp/public/gl/invs5a.html

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

| Boiler-houses of concern "Mis'ki teplovi merezhi" | Baseline Consumption | NCV, GJ/ths. $m^3$ |
|---|---|---|
| Natural Gas, ths. $Nm^3$/year | 420 108.41 | 34.03 |
| Electricity, MWh | 80 513.2 | |

*Table B.1. Baseline fuel and electricity consumption*

Details are given in **Appendice 1 (Boilers) and Appendice 1-1 (NCV).**

**Calculation of Baseline Carbon Emissions**

There are 4 types of GHG emissions involved in the baseline scenario:

1) $CO_2$ emissions from boilers operated by concern "Mis'ki teplovi merezhi" to provide thermal energy for heating and hot water. Calculation of baseline was based on the assumption that the baseline emissions for each reported year remain the same as in the base year 2005.
2) $CO_2$ emissions from electricity consumption from the state grid by boiler houses and central Heating Points.
3) $CO_2$ emissions from electricity production to the state grid after the installation of cogeneration units.
4) $CO_2$ emissions from gas consumtion by boiler-house for hot water supply service, which will be replace after installation of CHP units for HPS.

Calculation of resulting annual Baseline Carbon Emissions, that would take place during typical heating season if Zaporizhzhia city heating system remains unchanged, is provided in **Appendix 1-2-8 (Total)**. They consist of an exact amount of total $CO_2$ emissions that took place during the base (2005) year and additional emissions, occurring due to electricity production to the state grid, which will be replaced after the installation of cogeneration units, and which are consumed by boiler-houses, at which frequency controllers will be installed.

Key information and data used to establish the baseline is provided in the tables below:

| Data / Parameter | $B_b$ |
|---|---|
| Data unit | ths. $m^3$ |
| Description | Natural gas consumption by boiler-houses, base year |
| Time of determination/monitoring | Once after the end of the base year |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | 420 108 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Measurements are taken by gas meters at each boiler-house |
| QA/QC procedures (to be) | Equipment is calibrated and inspected according to the quality |

| | |
|---|---|
| applied | management procedures "On metrology and metrological activity"[13] |
| Any comment | Fuel consumption by the boiler-houses is the basic data allowing calculation of GHG emissions in base year; information shall be archived in paper and electronic form. |

| | |
|---|---|
| Data / Parameter | **$NCV_b$** |
| Data unit | GJ/ths.$m^3$ |
| Description | Average annual Net Calorific Value of natural gas in the base year |
| Time of determination/monitoring | Once after the end of the base year |
| Source of data (to be) used | Fuel Supplier's Report |
| Value of data applied (for ex ante calculations/determinations) | 34.03 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | N/A |
| QA/QC procedures (to be) applied | Equipment is calibrated and inspected according to the quality management procedures "On metrology and metrological activity"[14] |
| Any comment | Data allowing calculation of GHG emissions in base year; information shall be archived in paper and electronic form. |

| | |
|---|---|
| Data / Parameter | **$P_b$** |
| Data unit | MWh |
| Description | Electric power consumption, base year |
| Time of determination/monitoring | Once after the end of the base year |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | 80 513.2 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Measurement by Electric power meters installed in boiler-houses |
| QA/QC procedures (to be) applied | Equipment is calibrated and inspected according to the quality management procedures "On metrology and metrological activity"[15] |
| Any comment | Auxiliary data allowing adjustment of baseline; information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | **$EF_{CO2,NG}$** |
| Data unit | t $CO_2$/GJ |
| Description | $CO_2$ emission factor for natural gas, base year |

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

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

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

| | |
|---|---|
| Time of determination/monitoring | Once after the end of the base year |
| Source of data (to be) used | Normative documents |
| Value of data applied (for ex ante calculations/determinations) | 0.0561 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Intergovernmental Panel on Climate Change, IPCC, 1996 Volume 2[16] |
| QA/QC procedures (to be) applied | IPCC is reliable source of the information |
| Any comment | Auxiliary data allowing adjustment of baseline |

| | |
|---|---|
| Data / Parameter | **$EF_{CO2,ELEC,y}$** |
| Data unit | t $CO_2$/MWh |
| Description | Carbon emission factor for Ukrainian electrical grid for JI projects reducing electricity consumption, the base year |
| Time of determination/monitoring | Once, at the beginning of the project |
| Source of data (to be) used | Normative documents |
| Value of data applied (for ex ante calculations/determinations) | 0.896 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines, Version 2.3. (ERUPT 4, Netherlands), 2004[17] |
| QA/QC procedures (to be) applied | ERUPT 4 is reliable source of the information |
| Any comment | Researches don't take into consideration production of energy by nuclear power plants |

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

[16] http://www.ipcc-nggip.iges.or.jp/public/gl/invs5a.html

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

The anthropogenic emissions of GHG in the project scenario will be reduced due to complex modernization of heat generating and distributing equipment with application of the technologies proposed in the project activities and described above.

The more obvious description of how the anthropogenic emissions of GHG are reduced below those that would have occurred in the absence of the JI project, may be represented by dynamic baseline, which is the function of the stage of project implementation (see **Fig. B.1**).

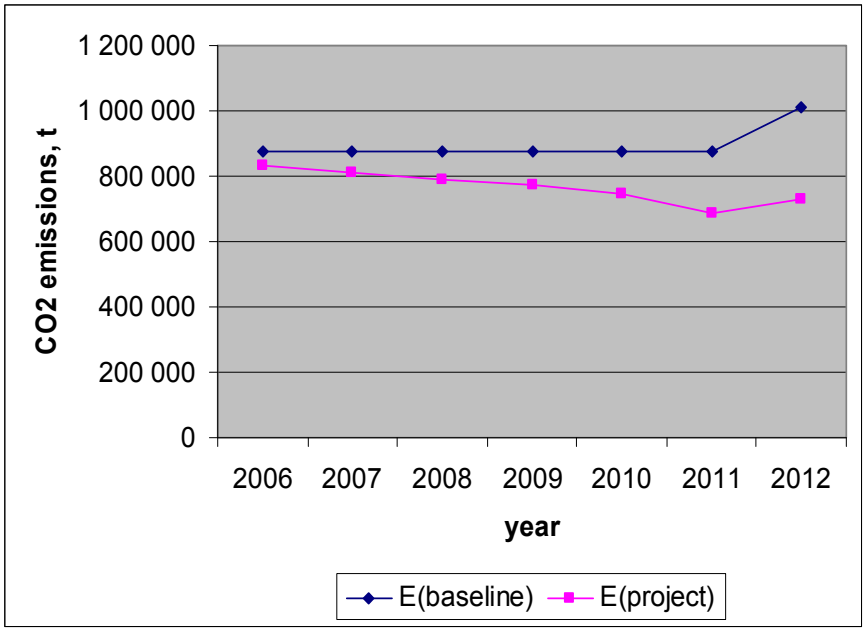



*Fig B.1. Dynamic baseline and project emissions of GHG*

**Additionality of the project**

The additionality of the project activity is demonstrated and assessed below with using the "Tool for the demonstration and assessment of additionality" (Version 5.2) (see **Fig. B.2**). This tool was originally developed for CDM projects but may be applied to JI projects as well.

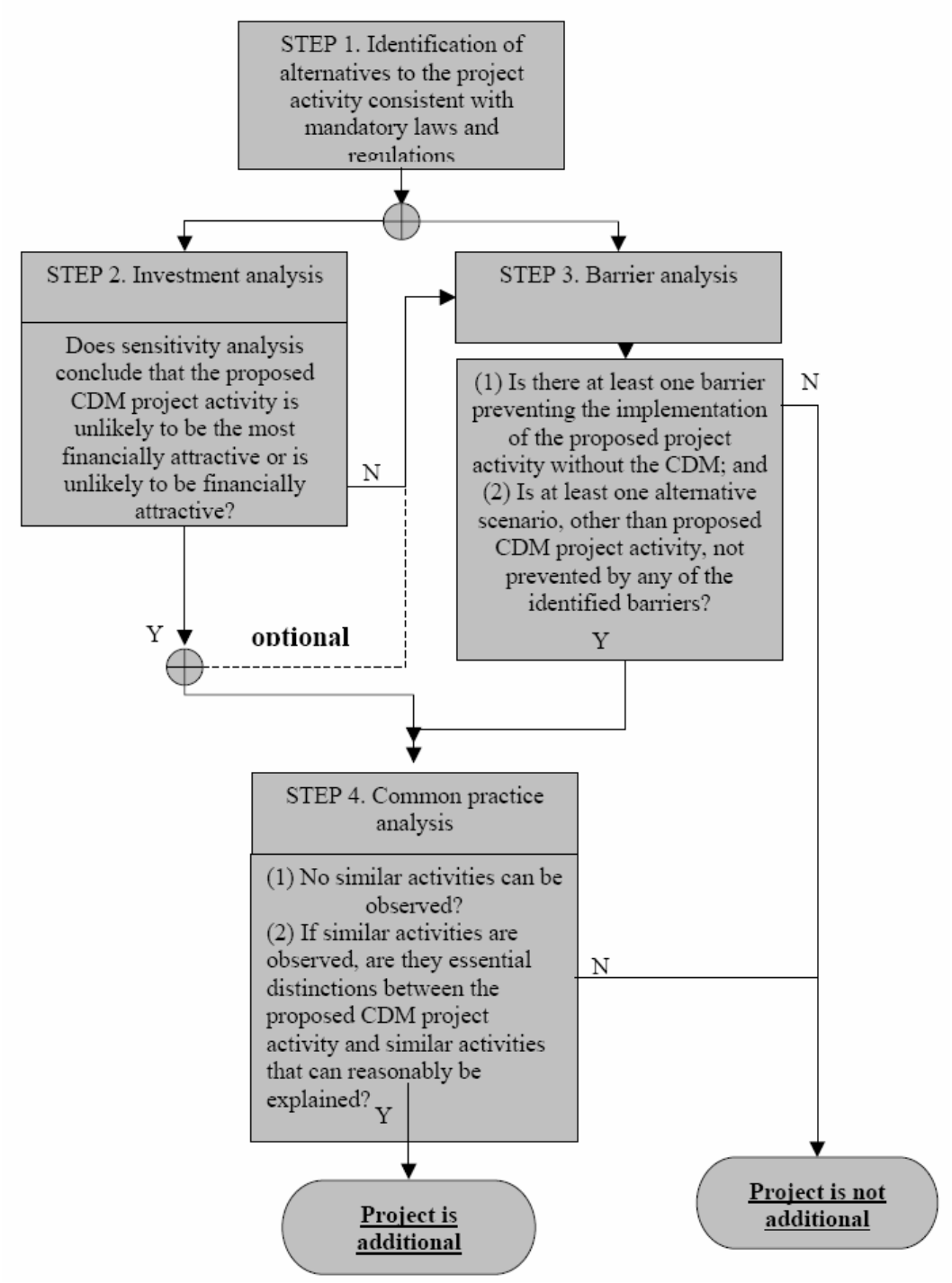



*Fig. B.2. Steps for demonstration of additionality*

**Step 1. Identification of alternatives to the project activity consistent with current laws and regulations**

**Sub-step 1a. Define alternatives to the project activity:**

There are three alternatives to this project (as was already discussed in section B1).
1. The first alternative is continuation of the current situation (no project activity or other alternatives undertaken), i.e. business-as-usual scenario with minimum reconstruction works, approximately balanced by overall degradation of the DH system.
It should be noted that there is no local legislation regarding the time of boilers replacement and maximum lifetime permitted for boilers. It is common practice to exploit boilers which was installed in 1970$^{th}$ and even earlier in Ukraine, if they pass the technical examination pass by the authorized body ("Derzhnagliadohoronpratsi").

2. The second alternative is to make reconstruction works (the proposed project activity) without JI mechanism.

3. The third alternative is the shortened project activity, without any of the non-key type of activity, for example elimination of frequency controllers installation, etc., from the project.

**Outcome of Sub-step 1a:** Three realistic and credible alternative scenarios to the project activity are identified.

**Sub-step 1b. Consistency with mandatory laws and regulations:**

According to The Laws of Ukraine "On licensing of the separate types of activity" (№ 1775-III, from June 01, 2000) and "On heat energy supply" (№ 2633-IV from 02.06.2005); Ukrainian Government Regulation "On introduction of changes to the Government Regulations №1698 from 14.11.2000 and №756 from 04.07.2001" №549 from 19.04.2006 and "On approval of the list of licensing bodies" №1698 from 14.11.2000, execution of economic activity in fields of heat energy production, distribution and supply require a license that is issued by Ministry of Housing and Municipal Economy of Ukraine.

Concern "Mis'ki teplovi merezhi" has such licenses.

The Project "District Heating System Rehabilitation of Zaporizhzhia City" has been prepared according to The Law of Ukraine from 01.07.1994 №74/94-VR "On energy saving" and The Law of Ukraine from 22.12.2005 №3260-IV "On changes in The Law of Ukraine "On energy saving".

However, alternative scenarios, namely: the scenario of "business as usual", for rehabilitation without the use of JI mechanisms and exclusion from the project any non-core activities - in line with mandatory laws and regulations.

**Outcome of Sub-step 1b:** The alternatives, which are: to continue business-as-usual scenario, to make reconstruction works without JI mechanism and to implement shortened project activity, without any of the non-key type of project activity, are in compliance with the mandatory laws and regulations.

Hence, the Step 1 is satisfied.

According to the "Tool for the demonstration and assessment of additionality" (Version 5.2), for further additionality analysis it is possible to follow the Step 2 or Step 3 (or both).

**Step 2. Investment analysis**

The purpose of the investment analysis in the context of additionality is to determine whether the proposed project activity is not:
a) The most economically or financially attractive; or
b) Economically or financially feasible, without the revenue from emission reductions sale.

**Sub-step 2a: Determine appropriate analysis method**

The appropriate analysis method is to be chosen in dependence of generating of financial or economic benefits by the project. If project activity generates no financial or economic benefits other than JI related income, then the simple cost analysis (Option I) may be applied, otherwise the investment comparison analysis (Option II) or the benchmark analysis (Option III) should be used.
The main sourse of income of the district heating enterprises in Ukraine are payments from customers according to the tariffs, that are regulated by the "Procedure of setting tariffs for production, transportation and supply of heat energy and for centralized heating and hot water supply services"[18].

According to this Procedure, tariffs are to be set on the base of the scheduled prime cost, and doesn't allow to obtain benefit from reduction of fuel, power, raw materials, etc. consumption. Any reduction of expenses for these raw inputs should result in decrease of tariffs for the end consumers and corresponding decrease of an enterprise's revenue, thereby the enterprise doesn't obtain additional revenue.

**Outcome of Sub-step 2a:** Te simple cost analysis (Option I) may be applied,

**Sub-step 2b: Option I. Apply simple cost analysis**

Implementation of the project activity will require substantial additional investments – about 105.2 million EUR only for the main equipment installation / rehabilitation. The prices for the new equipment, that is planned to be installed in the project, are represented on the sheets "Parameters" in the **Appendices 1-2-8** in Excel format, based on the averaged prices of the manufacturers. These prices are used for calculations of investment costs, and should be corrected in future according to actual manufacturer's prices (changed due to inflation, etc.).

The required investments for implementation of the project "Rehabilitation of the District Heating System of Zaporizhzhia City" include the costs of the main equipment installation / rehabilitation listed in the Table B.2 below, as well as the auxiliary costs such as personnel training, maintenance control, systematic data collection and archiving, etc.

| | |
|---|---|
| Energy efficiency improvement | The costs. ths. EUR |

[18] http://www.kmu.gov.ua/kmu/control/uk/cardnpd

| | |
|---|---|
| Rehabilitation of boiler houses including replacement / rehabilitation of boilers and burners, installation of heat utilizers, etc. | 13 658.5 |
| Rehabilitation of heat distriburion network | 10 888.3 |
| Rehabilitation of CHSS, installation of IHSS | 1 290.2 |
| Frequency controllers implementation | 644.9 |
| Installation of CHP units | 19 060.9 |
| Implementation of using of the waste heat energy from the secondary energy sources (SES) of industrial enterprises | 42 571.1 |
| Switching of boiler-house from natural gas to biofuel with installation of biofuel boilers | 231.6 |
| Building of heat pump station at the central sewage treatment plant #1 for using the heat of sewage | 14 677.5 |
| **Total** | **105 235.0** |

*Table B.2. The costs of the main equipment installation / rehabilitation*

Estimated costs for implementation of the defined above alternatives to the project activity:

1. For the first alternative (continuation of the current situation, business-as-usual scenario) no additional investments are required.

2. For the second alternative (the proposed project activity without JI mechanism) the requred additional investments are the same as for the project activity.

3. For the third alternative (shortened project activity) the requred additional investments are less then the ones requred for the project activity.

**Outcome of Sub-step 2b:** There is at least one alternative which is less costly than the project activity.

Hence, the Step 2 is satisfied.

**Step 3: Barrier analysis**

**Sub-step 3a: Identification of barriers that would prevent the implementation of the proposed project activity**

**Investment barriers**

The general situation in District Heating sector in Ukraine may be characterized as quite insufficient, and is analyzed and described in several available reviews and reports. Some citations, especially describing technical and financial situation, are given below.

“The existing district heating systems suffer from the same, well-known problems as those in other Central and European Countries. Old-fashioned Russian technology, oversized equipment, neglected maintenance and repairs, have resulted in increasing inefficiency. Typically, the overall efficiency of the

DH systems (from fuel consumption in boilers to heat supplied to the building entrance) is about 50%. Including the losses within the buildings, it is estimated that only one third of the energy of the fuel is useful heat for the final consumers.

The bad technical state of the DH systems has its counterpart in the bad financial state. Non cost-covering tariffs can not meet the revenue requirements and subsidy payments are too small to cover all costs and are often delayed. In addition, collection rates are going in line with increasing tariffs" [Report: Market Potential for District Heating Projects in the Ukraine and their Modernization with Austrian Technology, Vienna, 2004, p.3[19].

"The current regulatory framework and tariff policy makes it difficult to attract private investors to district heating. Yet the main stakeholders, *e.g.* municipalities and residents, in most cases lack the necessary financing capacity. (P. 324).

District heating in Ukraine suffers from inefficiency and urgently needs investment in refurbishment and modernisation. … Yet, the current policy framework does not make district heating attractive for investment, which undermines its sustainability. Barriers to investment and efficiency improvements include (but are not limited to): the current pricing policy; lack of metering; the focus on heat production, not consumption; unclear ownership and management of buildings; and difficult access to financing for interested parties. It is vital to create adequate policy and regulatory conditions for attracting private investments in the sector. (P. 328). [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006[20].

"District heating suffers from inefficiency and low level of investment. The major impediments for investment include the unclear pricing policy, unregulated management and ownership conditions, the accumulated debt of heat producers" [Overview of Heating Sector in Ukraine, CASE, 2007[21].

The energy efficiency projects in the district heating sector in Ukraine could not be implemented at the expense of tariffs for heat energy, since the innovative constituent in tariffs is usually absent, and even "In some regions of Ukraine heat tariffs are below the cost coverage level, which results in debt accumulation of heat producers to the creditors (fuel supply companies, staff etc.)" [Overview of Heating Sector in Ukraine, CASE, 2007[22].

Moreover, no bank gives credits without the proper guarantees. Concern "Mis'ki teplovi merezhi" is a communal ownership enterprise, and all its main funds belong to territorial population. For this reason the property of enterprise can not be a credit mortgage. Thus, the DH system rehabilitation without additional external investments (grants, subsidy, subvention, etc.) practically isn't possible, and in current situation practically only municipal or state financing might be used for this purposes. But Ukrainian government does not have enough funds for this, and insufficiency and delay of the budget financing of activity in this sector is the main its problem.

Moreover, the real budget financing is usually significantly lower than scheduled (see diagram below, [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006].

---

[19] http://www.energyagency.at/(publ)/themen/elektrizitaet_index.htm

[20] http://www.iea.org/Textbase/ publications/free_new_Desc.asp?PUBS_ID=1819

[21] www.case-ukraine.com.ua

[22] www.case-ukraine.com.ua

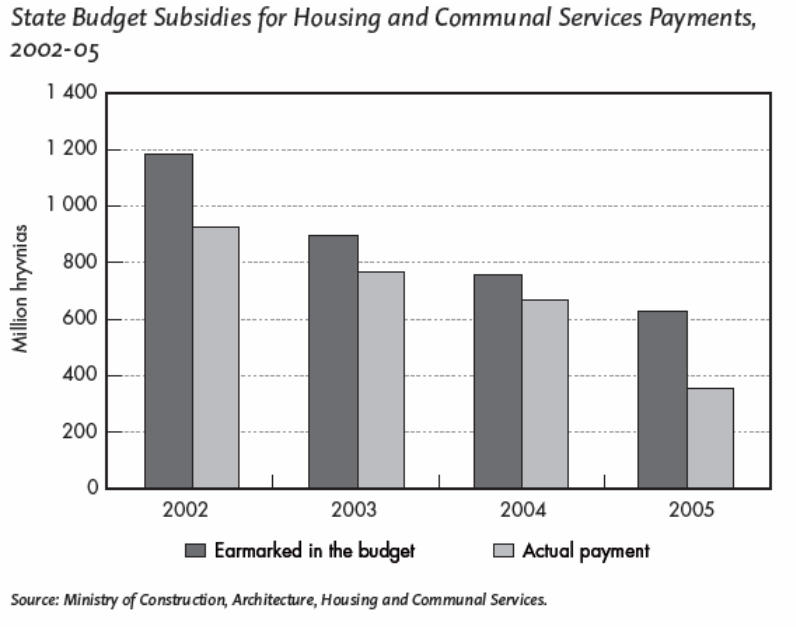



*Fig.B.3. Diagram of the real State budget subsidies for Housing and communal services payments*

Also, as discussed earlier, "district heating tariffs do not cover costs and the difference must be covered by direct subsidies to heat providers, which come from local or state budgets". But even these payments are often delayed or even not paid: "Budget payments, however, are often delayed, which results in significant accumulated debt to district heating companies" [UKRAINE ENERGY POLICY REVIEW 2006, OECD/IEA, 2006].

From the other side, the additional financing of the project activity from JI mechanism is not only important for project financing, but the fact of signing of the external economic contract between Supplier and Purchaser itself is a very positive factor that even can enable to shift the priorities of budget financing in favor of the project, thus decreasing the investment barrier.

**Technological barriers**

1. Not all proposed technologies are widely approved already. Qualification of operational personal for implementation of the new technologies may be not sufficient to provide proper activity implementation in time.

2. Efficiency of installed equipment could be lower than was claimed by producers or equipment may have substantial defects.

3. Available amount of natural gas. Last years Ukraine faced with incomplete delivery of natural gas from Russian Federation.

**Organizational barriers**

The management experience in implementation of JI projects is absent, including international collaboration, determination, verification, registration, monitoring of similar projects and so on.

**Outcome of Sub-step 3a:** Identified barriers would prevent the implementation of the proposed project activity as well as of the other alternatives - to make reconstruction works without JI mechanism and to shortened project activity, without any of the non-key type of project activity.

**Sub-step 3b: Explanation that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)**

One of the alternatives is to continue business-as-usual scenario. Therefore, as the barriers mentioned above are directly related to investing into upgrading of the Zaporizhzhia city district heating system, there is no impediment for concern "Mis'ki teplovi merezhi" to maintain the district heating system at its present level.

**Outcome of Sub-step 3b:** The identified barriers would not prevent the implementation of at least one of the alternatives – the business-as-usual scenario.

Hence, the Step 3 is satisfied.

**Step 4: Common practice analysis**

**Sub-step 4a. Analysis of other activities similar to the proposed project activity**

The district heating system of Concern "Mis'ki teplovi merezhi" covers all territorial districts (Leninsky, Zhovtnevy, Ordzhonikidzevsky, Shevchenkivsky, Zavodsky, Komunarsky and Khorticky) of Zaporizhzhia city. Concern "MTM" is the main heat-supply enterprise in this quite large city.
At present there are at least 6 District Heating Rehabilitation Projects in Ukraine beside this project, and all of them are stimulated with the JI mechanism: for DH systems in Chernihiv region, Donetsk region, AR Crimea, Kharkiv, Luhansk and Rivne cities. However the other JI project activities are not to be included in Common practice analysis. The common practice for district heating enterprises in Ukraine without JI is only a necessary repair of the old equipment, mainly in emergency cases, and not the renewal. Thus the proposed project activity does not reflect a widely observed and commonly carried out activity.

**Outcome of Sub-step 4a:** Thus the proposed project activity is not a common practice, the similar activities are not observed in the host countryu.

**Sub-step 4b. Discuss any similar Options that are occurring**
All District Heating Rehabilitation Projects in Ukraine are being implemented only within the framework of the Kyoto Protocol JI mechanism. In the absence of additional financiong (such as grtants, other non-commercial finance terms, carbon credits, etc/) implementation of these projects would be impossible. Application of the JI mechanism is the only incentive to implement such projects.

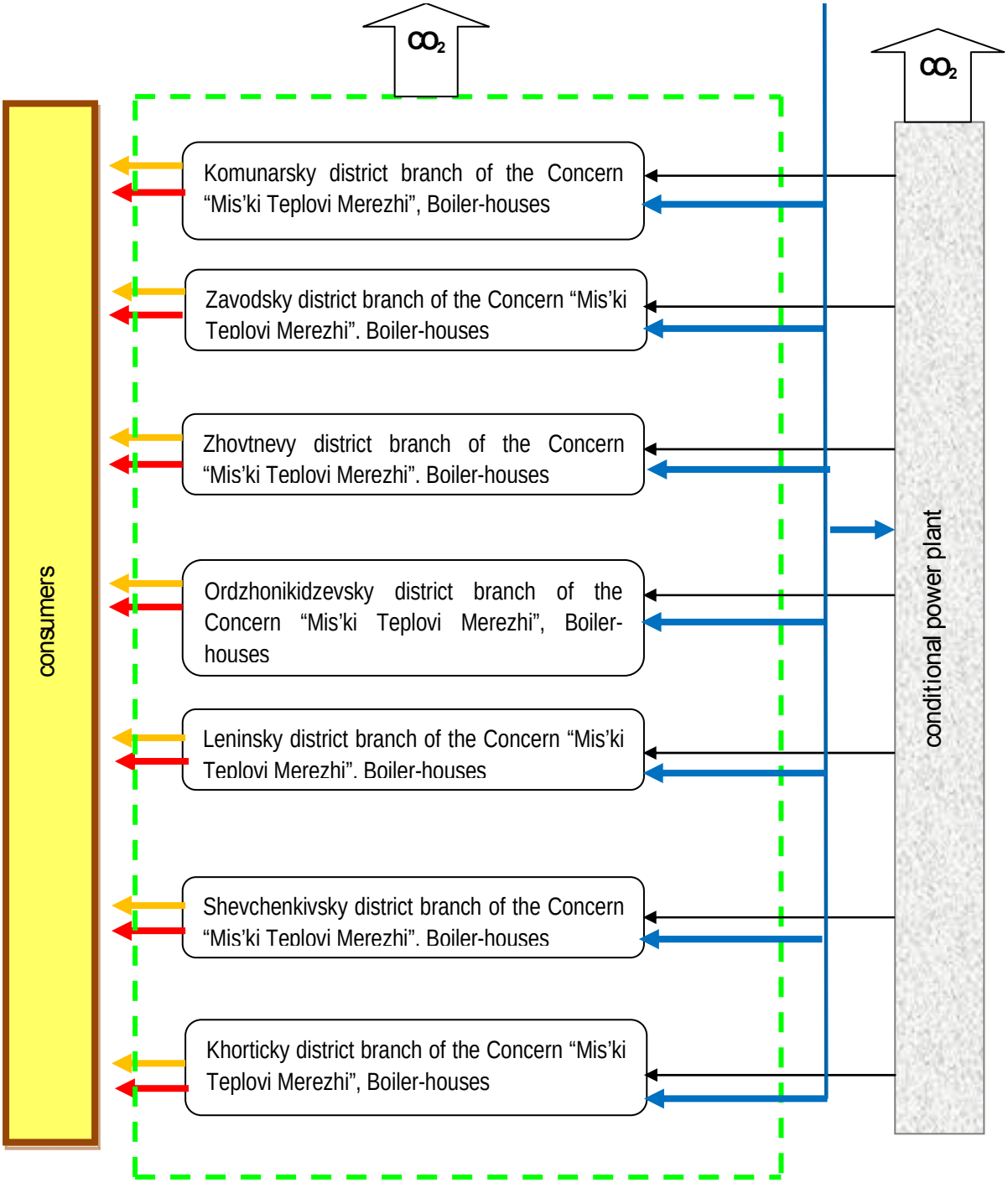
**Outcome of Sub-step 4b:** Based on the available facts, the following conclusions may be made:
- Activities similar to this Project are not widespread in the housing and utilities sector ofUkraine.
- These activities are not a result of national policy being pursued in respect to promoting the utilization of gas as a fuel in municipal heat supply systems.

Thus, the Project activities do not fall under the category of *common practice.*
Hence, the Step 4 is satisfied.

The results of the above discussed analysis lead to the conclusion that the proposed project activity is additional.

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

Project boundaries for Baseline scenario are represented on the graphical picture on the **Fig. B.4.**




| | |
|---|---|
| | Heating |
| | Hot water supply (HWS) |
| | electricity |
| | Fuel production and transportation |

*Fig.B.4. Flowchart of Project boundaries for Baseline scenario*

As can be seen with the existing heating system heat consumers get heat and hot water boilers from the city of Zaporizhzhia. Boiler-houses are provided with electricity from the State electricity grid (conditional power plant).
Emissions associated with electricity production on conditional power, not included in the project boundary. Emissions associated with production and transportation of fuel, are also not included in the project boundary.

Project boundaries for Project scenario are represented on the graphical picture on the **Fig. B.5** by green dotted line.
The project boundaries include the use of secondary heat resources from OJSC "Zaporizhstal" for hot water supply in summer period in Ordzhonikidze district (boiler-house at the Adm. Nakhimov street, 4), Leninsky district (boiler-house at Metalurhiv av.,32), Zhovtnevy district (boiler-house at Artema, 79A, boiler-house at the Heroiv Stalingrada street, 2a), Zavodsky district (boiler-house at the Adm.Ushakov street, 251), Komunarsky district (boiler-house at the Chubanova street, 3e), as well as replacement of heat energy for hot water supply from the boiler-house at the Tovariska, 47, Adm. Ushakov, 251, Citrusova, 9 by the heat from cogeneration units. Electricity produced by cogeneration units, will be consumed by boiler-house's needs. Emissions associated with electricity production at conditional power plant, are not included in the project boundary, and emissions associated with production and transportation of fuel, are not included in the project boundary.

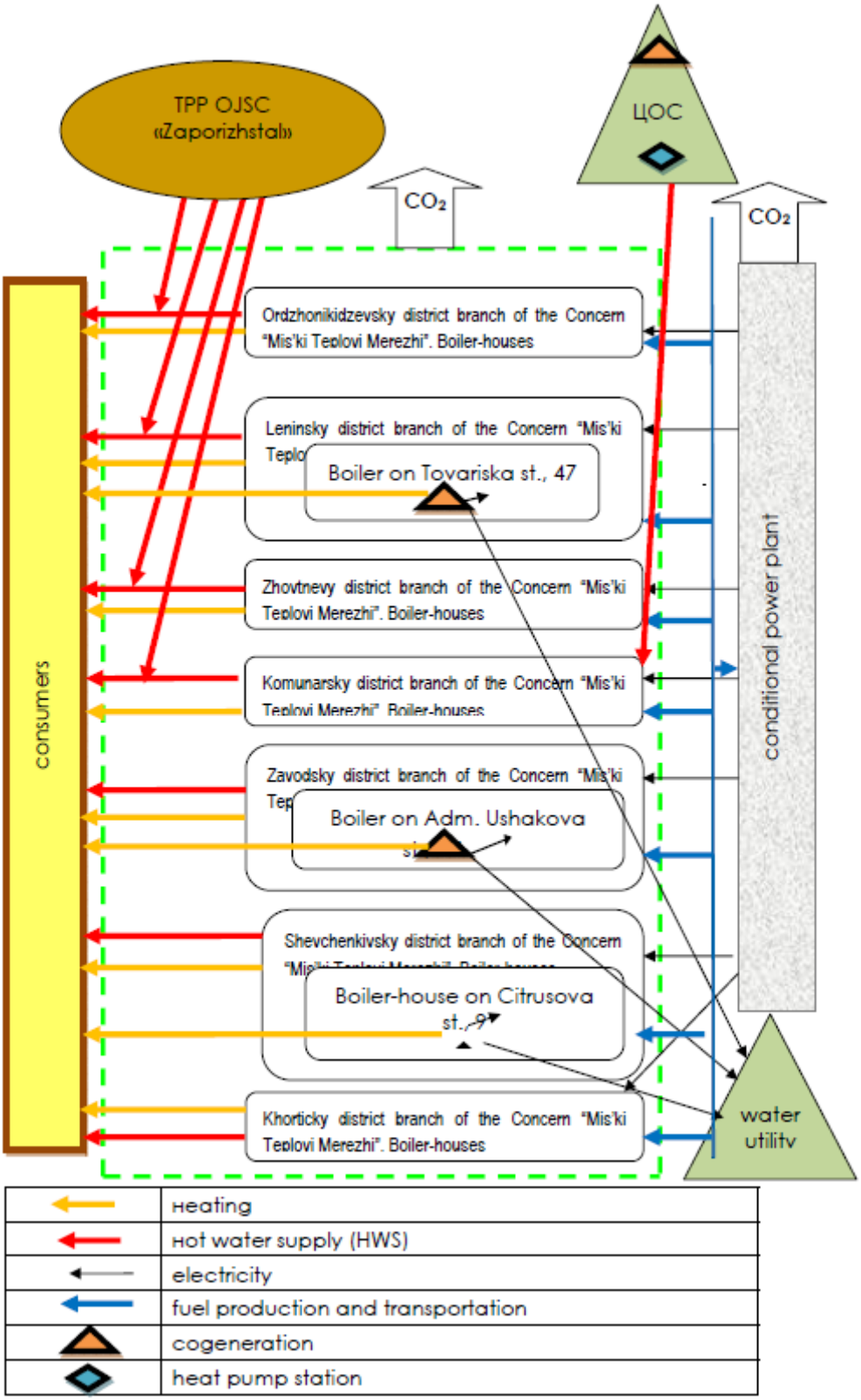



*Fig.B.5. Flowchart of the Project boundaries for Project scenario*

**Direct and Indirect Emissions**

| On-site emissions | | | |
|---|---|---|---|
| Current situation | Project | Direct or indirect | Include or exclude |
| $CO_2$ emissions from fuel combustion in boilers | Reduced $CO_2$ emissions from fuel combustion in boilers due to increased efficiency and fuel saving. Additional $CO_2$ emissions at the boiler houses where the new CHP units will be installed due to additional fuel consumption by CHP | Direct | Include |
| $NO_x$ and CO emission from combustion in existing boilers/ burners | Reduced $NO_x$ and CO emissions from fuel combustion after boiler / burners' replacement | Direct | Exclude. $NO_x$ and CO are not GHGs. |
| $CO_2$ emissions from fuel combustion in boilers at the boiler houses due to the too large heat losses in the networks | Reduced $CO_2$ emissions from boiler houses due to decreasing of heat losses in the network pipes, due to replacement pipes with the pre-insulated ones, reconstruction of HDS, and reduction of networks' length | Direct | Include |
| Off-site emissions | | | |
| Current situation | Project | Direct or indirect | Include or exclude |
| $CO_2$ emissions from power plant(s) due to electricity production to the grid, that is consumed by boiler houses and CHSS, where frequency controllers will be installed. | Reduced $CO_2$ emissions from power plant(s) | Direct | Include |
| $CO_2$ emissions from power plant(s) due to power consumption used for heating by Zaporizhzhia city customers. It takes place due to inefficiencies of heat supply service quality for many consumers in the current situation. Exploitation of power heaters is quite typical and widespread. | Reduced $CO_2$ emissions from power plant(s) due to reduction of power consumption for heating by Zaporizhzhia city customers. This will take place after project implementation when heat supply service will become more efficient. Exploitation of electric heaters will be decreased substantially. | Direct | Exclude, not under control of project developer |

| | | | |
|---|---|---|---|
| $CO_2$ emissions from fuel extraction and transportation. | Reduced $CO_2$ emissions from fuel extraction and transportation due to fuel saving. | Indirect | Exclude, not under control of project developer |

*Table B.3. Project boundaries and sources of emissions*

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

Date of baseline setting: 10/09/2005

The baseline is determined by the Institute of Engineering Ecology (IEE), project developer, Concern "Mis'ki teplovi merezhi", organization that implements the project, and OJSC "Oblteplocomunenergo", project participant- supplier.

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## SECTION C. Duration of the project / crediting period

### C.1. Starting date of the project:

The starting date of the project is: 04/11/2005

### C.2. Expected operational lifetime of the project:

The minimal nominal lifetime of the new boilers is 20 years. The real average lifetime of the new network equipment is estimated to be up to 30 – 40 years. Thus the expected operational lifetime of the project may be about 30 years. According to conservatism principle, for further calculations we assume operational lifetime, and also the corresponding crediting period - 25 years/300 month (2006-2030).

### C.3. Length of the crediting period:

Earning of the ERUs corresponds to the first commitment period of 5 years/60 months (January, 1, 2008 – December, 31, 2012).

The starting date of the crediting period is set to the date where the first emission reductions are expected to be generated from the project, that is January, 2006. The end of the crediting period is the end of the lifetime of the main equipment that is minimal December 31, 2030. Thus the length of the crediting period is 25 years/300 month.

If the post-first commitment period under the Kyoto Protocol will be applicable, the crediting period may be expanded up to the end of the expected operational lifetime of the project (25 years /300 month, 2006-2030).

## SECTION D. Monitoring plan

### D.1. Description of monitoring plan chosen:

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

**Indicator of project performance**

The most objective and cumulative factor that will give a clear picture of whether emission reductions really took place – is *fuel saving*. It can be identified as a difference between baseline fuel consumption and fuel consumption after project implementation. If boilers consume fuel at the projected level, than all other relevant indicators such as efficiencies of new boilers and burners, specific gas consumption of CHP units, as well as heat losses in pre-insulated pipes are adequate.

**Verification of project performance indicators**

Concern "Mis'ki teplovi merezhi" collects data on fuel purchasing for heating in form of fuel bills. Information on saved fuel will be attached to verification reports on a yearly basis (before April 1st for all years of project implementation) with all relevant documentation and historical information on fuel purchasing transactions made by Supplier.

## Verification of Emission Reduction Units and Baseline Scenario

The monitoring methodology developed for "District Heating" projects in Ukrainian conditions consists in the following:

For any project year, the baseline scenario may be different due to the influence of external factors such as weather conditions, possible changes of the lower heating value of fuel(s), number of customers, heating area, etc. The Baseline and the amount of ERUs for each project year should be corrected with taking into account these and some other factors.

The following methodology is proposed to be used.

Amount of the Emission Reduction Units (ERUs), t $CO_2e$:

$$ERUs = \sum[E_i^b - E_i^r] \quad (1)$$

The sum is taken over all boiler-houses (i) which are included into the project.

$E_i^b = E_{1i}^b + E_{gen\ i} + E_{cons\ i}^b$ (2)

$E_i^r = E_{1i}^r + E_{cons\ i}^r$ (3)

where

$E_{1i}^b$ and $E_{1i}^r$ – $CO_2$ emissions due to fuel consumption for heating and hot water supply service for an i boiler-houses and CHSS and fuel consumption by boiler-house for hot water supply service, which will be replace after installation of CHP and HPS+CHP in the base year (amount of consumption from heating network, and which will be replaced in the project year) and produced by object, included in the project in the reported year, respectively, t $CO_2$;
$E_{gen\ i}$ – $CO_2$ emissions due to electricity production to the grid after installation of CHP units, t $CO_2$;
$E_{cons\ i}^b$ and $E_{cons\ i}^r$ – $CO_2$ emissions due to electric power consumption from grid (i) by the boiler-house in the base year and in the reported year, respectively, t $CO_2$.

[i] index – boiler-house;
[b] index – relates to base year;
[r] index – relates to reporting year.

For each boiler-house:

$E_1^b = NCV_b * EF_{CO2,NG,b} * B_b$ (4)

$E_1^r = NCV_r * EF_{CO2,NG,r} * B_r$ (5)

$E_{gen}^b = W_b * EF_{CO2,ELEC,g}$ (6)

$E_{cons}^b = P_b * EF_{CO2,ELEC,c}$ (7)

$E_{cons}^r = P_r * EF_{CO2,ELEC,c}$ (8)

where

NCV –net calorific value, GJ/ths.$m^3$;
$EF_{CO2,NG}$ – carbon emission factor, t $CO_2$/GJ;
B – amount of fuel consumed by a boiler-house, ths $m^3$;
$W_b$ – scheduled electric power production by the new CHP units at a boiler-house, MWh;
$W_r$ – electric power production by the installed new CHP units, MWh;
$EF_{CO2,ELEC,g}$ – Carbon Emission factor for electricity generation in Ukraine, t$CO_2$/MWh;

$P_b$ – electric power consumption by a boiler-house where energy saving measures are scheduled to be implemented, MWh;
$P_r$ – electric power consumption by a boiler-house with energy saving measures implemented, MWh;
$EF_{CO2,ELEC,c}$ – Carbon Emission factors for reducing electricity consumption in Ukraine, $tCO_2/MWh$;
[b] index – relates to base year;
[r] index – relates to reporting year.

According to the Dynamic Baseline assumption, the efficient value of $E_1^b$ may be defined as follows:

$$E_{1i}^b = E_{hi}^b,+ E_{wi}^b; \quad (9)$$

where the first term describes emissions from fuel consumption for heating, and the second one – from fuel consumption for hot water supply.

If there was hot water supply in base year (regardless of service duration, $(1-a_b) \neq 0$), the following formula for $E_{1,b}$ shall be applied:

$$E_1^b = NCV_b * EF_{CO2,NG,b} *[B_b*a*K_1*K_h + B_b*(1-a)*K_1*K_w] \quad (10)$$

$$E_{1i}^r = NCV_r * EF_{CO2,NG,r} * B_r \quad (11)$$

where
NCV – Net Calorific Value, GJ/ths.$m^3$;
$EF_{CO2,NG}$ – carbon emission factor, t $CO_2$/GJ;
B – amount of fuel consumed by a boiler-house, ths $m^3$ or tons per year;
$K_1$, $K_h$, $K_w$ – adjustment factors;
a – portion of fuel (heat), consumed for heating purposes;
(1-a) – portion of fuel (heat), consumed for hot water supply services;

$$a_b = L_{h,b}*g*N_{h,b} / L_{h,b}*g*N_{h,b}+L_{w,b}*N_{w,b} \quad (12)$$

$$a_r = L_{h,r}*g*N_{h,r} / L_{h,r}*g*N_{h,r}+L_{w,r}*N_{w,r} \quad (13)$$

where
$L_h$, $L_w$ – maximum connected load for providing heating and hot water, MW;
g - conversion factor for average heating load during the heating period (shall be determined for each boiler-house on historical basis (usually 0.4-0.8)
N, $N_w$ - duration of heating period and hot water supply period per annum, hour;

[h] index – heating;
[w] index – hot water supply.

**Adjustment factors:**

1. $K_1$ (Factor of the net calorific value change):

$$K_1=NCV_b / NCV_r \quad (14)$$

2. Adjusting factor for heating shall be applied for development of Dynamic Baseline, taking into account all external factors, such as weather conditions, Heating area , etc.

Quantity of fuel consumed for heating is proportional to required heat for heating period, $Q_h$:

$$B_h = B*a = Q_h / NCV*\eta_h \quad (15)$$

where
$\eta$ - total effectiveness of boiler-house.

According to the assumptions as to Dynamic baseline required heat in base year for correct comparison shall be reduced to actual conditions (external conditions of the project) of reporting year:

$$Q_{h, b, r} = Q_{h,b}*K_h = Q_{h, r} \quad (16)$$

where
$Q_{h, b, r}$ – necessary heat for Dynamic baseline; it is conceded to be equal to $Q_r$ – necessary heat for reporting year;
$Q_{h, b}$ – necessary heat for base year;
$K_h$ – average adjusting factor for heating.

Average adjusting factor may be determined on the basis of such equality:

$$K_h = Q_{h, r} / Q_{h\,b.} \quad (17)$$

Required heat for buildings' heating within the year, according to the "Norms and instructions of fuel and heat energy losses rate setting for heating of dwelling and civil buildings, as well as social needs in Ukraine. KTM 204 Ukraine 244-94"[23]:

$$Q_h = F_h * k_h * (T_{in} - T_{out}) * N_h, \quad (18)$$

where
$Q_h$ – required heatof heat for heating, kW*hour;
$F_h$ – Heating area of premises, $m^2$;
$k_h$ – average heat transfer factor of the buildings, $kW/m^2*K$;
$T_{in}$ – average temperature inside the premises during heating period, K (or °C);
$T_{out}$ – average external temperature during heating period, K (or °C);
$N_h$ – duration of heating period per annum, hour.

Therefore:

$$K_h = (F_{h,r} * k_{h\,r}) * (T_{in,r} - T_{out,r}) * N_{h,r} / F_{h,b} * k_{h,b} * (T_{in,b} - T_{out,b}) * N_{h,b} \quad (19)$$

2.1. $K_2$ (temperature change factor):

$$K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b}) \quad (20)$$

2.2. $K_3$ (Heating area and thermal insulation change factor):

$$K_3 = (F_{h\,r} * k_{h\,r}) / F_{h\,b} * k_{h\,b} = [(F_{h\,r} - F_{h\,t\,r} - F_{h\,n\,r}) * k_{h\,b} + (F_{h\,n\,r} + F_{h\,t\,r}) * k_{h\,n}] / F_{h\,b} * k_{h\,b}, \quad (21)$$

where
$F_{h\,b}$ - Heated floor area in the base year

[23] *Norms and instructions of rate setting for fuel and heat energy discharge for heating of dwelling and civil buildings, as well as social needs in Ukraine. KTM 204 Ukraine 244-94. Kyiv, 2001, 376 p.*

$F_{h\,r}$ – heated floor area in the reported year
$F_{h\,n\,r}$ - heated area of new homes connected to the heating system (assuming with new (improved insulation) in reported year, $m^2$
$F_{h\,t\,r}$ - heated area of buildings (existing in the base year) in the reported year with improved thermal insulation
$k_{h\,b}$ – average heat transfer coefficient of buildings in the base year, $kW/m^2*K$
$k_{h\,r}$ – average heat transfer coefficient of buildings in the reported year, $kW/m^2*K$
$k_{h\,n}$ – heat transfer coefficient of heated buildings with new thermal insulation (new or old house with new insulation), $kW/m^2*K$

2.4. $K_4$ (Factor of heating period duration change):

$$K_4 = N_{h\,r} / N_{h\,b} \quad (22)$$

where
$N_{h\,b}$ – duration of the heating period in the base year, hour;
$N_{h\,r}$ – duration of the heating period in the reported year, hour

Thus,

$$K_h = K_2 * K_3 * K_4 \quad (23)$$

3. Adjusting factor for hot water supply shall be used for development of Dynamic Baseline taking into account all external factors, such as weather conditions, quantity of consumers, etc.
Quantity of fuel consumed for hot water supply is proportional to required heat for the period of such service rendering, $Q_w$:

$$B_w = B*(1-a) = Q_w / NCV*\eta_w, \quad (24)$$

where
$\eta_w$ - general efficiency of the hot water supply system.

According to the assumptions as to Dynamic baseline required heat of heat in base year for hot water supply (for correct comparison) shall be reduced to actual conditions (external conditions of the project) of reporting year:

$$Q_{w\,b,\,r} = Q_{w,\,b} * K_w = Q_{w,\,r} \quad (25)$$

where:
$Q_{w, b, r}$ – heat necessary for hot water supply as to Dynamic baseline; it is conceded to be equal to $Q_{w\,r}$ – heat necessary for hot water supply in reporting year;
$Q_{w, b}$ – heat necessary for hot water supply in base year,
$K_w$ – average adjusting factor for hot water supply;

Average adjusting factor may be determined on the basis of such equality:

$$K_w = Q_{w, r} / Q_{w, b.} \quad (26)$$

Component $K_w$ may be determined by the correlation of heat consumed for hot water supply in basic and reporting years:

$$Q_w = n_w * v_w * N_w, \quad (27)$$

where:
$Q_w$ – heat necessary for hot water supply, kW*hour;
$n_w$ – average quantity of consumers, personal accounts;
$v_w$ – standard specific discharge of hot water for personal account (in heat units, kW*hour/hour);
$N_w$ – duration of service rendering per annum, hour.

Thus:

$$K_w = n_{w, r} * v_{w, r} * N_{w, r} / n_{w, b} * v_{w, b} * N_{w, b} \quad (28)$$

3.1. $K_5$ (Factor of change of consumers' quantity):

$$K_5 = n_{w, r} / n_{w, b} \quad (29)$$

where
$n_r$ – number of consumers in the base year;
$n_b$ – number of consumers in the reported year

3.2. $K_6$ (Factor of change of standard specific discharge of hot water for personal account):

$K_5 = n_{w,r} / n_{w,b}$ (30)

where:
$v_{w\,r}$ – consumption of hot water for the personal account in the base year, hour;
$v_{w\,b}$ – consumption of hot water for the personal account in the reported year, hour.

At present such standard specific discharge of hot water is effective, which was proposed in the KTM 204 Ukraine 244-94 in 1993. There is no information about the changes, so $K_6 = 1$, and is not subject to special monitoring.

3.3. $K_7$ (Factor of change of the duration of hot water supply period):

$K_7 = N_{w,r} / N_{w,b}$ (31)

where
$N_{w\,b}$ – duration of hot water service in the base year, hour;
$N_{w\,r}$ – duration of hot water service in the project year, hour

Thus,

$K_w = K_5 * K_6 * K_7$ (32)

If expected monitored data for the boiler-house in any project year are unavailable:

- for statistic data unavailable the default values from IPCC reports will be taken;
- for non-statistic data unavailable, the calculations for this boiler-house in this year will not be made, in according to principle of conservatism the estimated emission reductions for this boiler-house in this year will be assumed equal to 0.

Data to be checked in section D.1 for monitoring in order to estimate GHG emission reductions for baseline and project scenarios.

The following tables contain the data, which will be collected for monitoring of project emission reductions and such data will be archived.

| Data / Parameter | **$B_r$** |
|---|---|
| Data unit | ths. $m^3$ |
| Description | Natural gas consumption by boiler-houses, project year |
| Time of determination/monitoring | Daily |
| Source of data (to be) used | Each boiler-house |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Measurements are taken by gas meters at each boiler-house |
| QA/QC procedures (to be) applied | Equipment is calibrated and inspected according to the quality management procedures "On metrology and metrological activity"[24] |
| Any comment | Information shall be archived in paper and electronic form |

| Data / Parameter | **$NCV_r$** |
|---|---|
| Data unit | GJ/ths.$nm^3$ |
| Description | Net Calorific Value |
| Time of determination/monitoring | Monthly |
| Source of data (to be) used | Fuel Supplier's Report |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | N/A |
| QA/QC procedures (to be) applied | Equipment is calibrated and inspected according to the quality management procedures "On metrology and metrological activity"[25] |
| Any comment | Information shall be archived in paper and electronic form |

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

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

| Data / Parameter | $T_{out\ r}$ |
|---|---|
| Data unit | °C |
| Description | Daily external temperature during heating season, project year |
| Time of determination/monitoring | Once per reporting period. |
| Source of data (to be) used | Meteorological Centre sends the Report every decade or month for every day of heating season. Reports are filed in special journals |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Average value |
| QA/QC procedures (to be) applied | Average outside temperature during the heating season shall be registered every day and calculated by concern "Mis'ki teplovi merezhi" from the daily outside temperature values taken by dispatcher of the enterprise from Zaporizhzhia Meteorological Centre from 10 to 11 a.m. every day of heating season. |
| Any comment | Information shall be archived in paper and electronic form |

| Data / Parameter | $T_{in\ r}$ |
|---|---|
| Data unit | °C |
| Description | Average internal temperature during heating season, project year |
| Time of determination/monitoring | Once per heating season. |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Average internal temperature is calculated on the basis of repaid sums caused by insufficient heating (if the standard level is not achieved) |
| QA/QC procedures (to be) applied | According to "Rules of rendering of heat and hot water supply service to population" № 1497 from 30.12.1997, the enterprises must make the return payments to population for delivery less than necessary amount of heat. The normative inside temperature should be not lower than 18 °C.<br>Amount of the return payment is:<br>– 5% from normative payment for every degree from 18 to 12 °C;<br>– 10% from normative payment for every degree from 12 to 5 °C;<br>– when inside temperature is lower than 5 °C the payment is to be returned completely.<br><br>Therefore the inside temperature will be calculated by formulae:<br><br>If R = 0 (according to conservatism principle for the baseline assume R < 0.05):<br>$T_{inr}$ = 18 °C.<br><br>If 0.05 < R ≤ 0.3 NP:<br>$T_{inr}$ = 18 – (R/5) [°C]<br><br>If 0.3 NP < R < NP: |

| | |
|---|---|
| | $\mathbf{T_{inr}}$ = 12 – [(R – 0.3 NP)/10] [$^{o}$C]<br>where:<br>R - % of return payment from NP;<br>NP – amount of normative payment.<br><br>Thus if the inside temperature will be 18 $^{o}$C or higher we will accept it as 18 $^{o}$C according to conservatism principle, if it will be lower than 18 $^{o}$C it will be calculated from return payments by the methodology presented above. |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{n_{w\,r}}$ |
| Data unit | thous. persons |
| Description | Quantity of consumers for hot water supply service for every boiler houses, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Statistics of concern "Mis'ki teplovi merezhi" |
| QA/QC procedures (to be) applied | Confirmed by agreements with consumers, organizations and legal entities are concludes directly with concern "Mis'ki teplovi merezhi". They are updated once per year. |
| Any comment | The information is collected in special electronic journals "Registration of income from population" (for inhabitants). For organizations and legal entities such information is taken from contracts concluded with them |

| | |
|---|---|
| Data / Parameter | $\mathbf{F_{h\,r}}$ |
| Data unit | $m^2$ |
| Description | Heating area for every boiler houses, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The revise is made in case of new contracts with Customers or in case of contracts break. The data is taken for January, 01 for every year. |
| QA/QC procedures (to be) applied | The information is collected at the sale departments of concern "Mis'ki teplovi merezhi"by the certificates of owners in accordance with technical passport of building.<br>Total area with balconies and stairs and Heating area are displayed in the special journal |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{k_{h\,r}}$ |

| | |
|---|---|
| Data unit | $W/m^2*K$ |
| Description | Average heat-transfer factor of the buildings, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | 0.63 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Heat transfer factor is recorded ones per year at recording of connection or disconnection of any heating area to boiler-houses included in project. |
| QA/QC procedures (to be) applied | For calculation of Heat transfer factor of buildings for every boiler-house, the method of Weighted average value was used, that depends on heating area of existing buildings and heating area of the new buildings. Values of the heat transfer factor for existing buildings were taken from SNiP 2-3-79 (1998) - not higher than 0.63. Values of the heat transfer factor of new buildings were taken according to State Buildings Norms (B.2.6-31:2006) - not higher than 0.36. |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{F_{h,t,r}}$ |
| Data unit | $m^2$ |
| Description | Heating area of buildings (existed in base year) with improved heat insulation, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | N/A |
| QA/QC procedures (to be) applied | The information is collected at the sale departments of concern "Mis'ki teplovi merezhi"by the certificates of owners in accordance with technical passport of building.<br>Total area with balconies and stairs and Heating area are displayed in the special journal |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{k_{h\ n}}$ |
| Data unit | $W/m^2*K$ |
| Description | Average heat-transfer factor of the buildings with the new thermal insulation, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | State Building Standards (B.2.6-31:2006) |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and | For calculation of Heat transfer factor of buildings for every boiler-house, the method of Weighted average value was used |

| | |
|---|---|
| procedures (to be) applied | |
| QA/QC procedures (to be) applied | Heat transfer factor is recorded ones per year at recording of connection or disconnection of any heating area to boiler-houses included in project. |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{F_{h,n,r}}$ |
| Data unit | $m^2$ |
| Description | Heating area of new buildings connected to the heat supply system (it is conceded that such buildings have new improved heat insulation), project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | N/A |
| QA/QC procedures (to be) applied | The information is collected at the sale departments of concern "Mis'ki teplovi merezhi"by the certificates of owners in accordance with technical passport of building.<br>Total area with balconies and stairs and Heating area are displayed in the special journal |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{N_{h,r}}$ |
| Data unit | hour |
| Description | Duration of heating period, base year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | The duration of the Heating period is accepted in accordance with item 7.9.4 of "Rules of technical exploitation of heating equipment and networks. 2007". Beginning and ending of the heating period are determined in every town separately. The heating period begins if the average daily outside temperature is 8 $^oC$ or lower during 3 days, and finishes if average daily outside temperature is 8 $^oC$ or higher during 3 days. According to SNiP 2.01.01-84 (Climatology in heating engineering) the duration of heating period for project development is to be taken as 174 days. |
| QA/QC procedures (to be) applied | - |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{L_{h,r}}$ |
| Data unit | Gcal/h |
| Description | Maximal connected load for heating period, project year |
| Time of | Once per year |

| | |
|---|---|
| determination/monitoring | |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Maximum connected load to the boiler-house, that is required for heating, is calculated by Concern «Mis'ki teplovi merezhi» for every heating season. It is calculated according to heat demand at outside temperature -22 $^{o}$C. |
| QA/QC procedures (to be) applied | - |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{L_{w,r}}$ |
| Data unit | Gcal/h |
| Description | Maximal connected load for hot water supply, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Report produced by Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Hot water supply service is realized by hot water delivery schedule for every boiler-house.<br>Hot water supply service is foreseen. There is a plan of disconnection of load for Hot water supply service for maintenance and preventive measures for every boiler-house. |
| QA/QC procedures (to be) applied | - |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{v_{w,r}}$ |
| Data unit | kWh/h |
| Description | Standard specific discharge of hot water at personal account, project year |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | N/A |
| QA/QC procedures (to be) applied | At present the standard specific discharge of hot water is valid in Ukraine that was established by the "KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it. |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | $\mathbf{P_r}$ |
| Data unit | MWh |
| Description | Electric power consumption, project year |
| Time of | Once per year |

| | |
|---|---|
| determination/monitoring | |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Measurement by Electric power meters installed in boiler-houses |
| QA/QC procedures (to be) applied | Equipment is calibrated and inspected according to the quality management procedures "On metrology and metrological activity"[26] |
| Any comment | Information shall be archived in paper and electronic form |

| | |
|---|---|
| Data / Parameter | **g** |
| Data unit | % |
| Description | Recalculating factor for determination of the average load during heating period |
| Time of determination/monitoring | Once per year |
| Source of data (to be) used | Concern "MTM" |
| Value of data applied (for ex ante calculations/determinations) | N/A |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Recalculating factor for average load during heating period is determined for each boiler-house on historical base, usually it is in the range (0,4 – 0,8) |
| QA/QC procedures (to be) applied | $g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$<br>where:<br>g – recalculating factor for average load during heating period;<br>$F_h$ – heating area of buildings, $m^2$;<br>$k_h$ – average heat transfer factor of heated buildings,$(W/m^2*K)$;<br>$T_{in}$ – average inside temperature for the heating period, K ;<br>$T_{out\ av}$ – average outside temperature for the heating period, K (or $^0C$);<br>$T_{out\ min}$ – minimal outside temperature for the heating period, K (or $^0C$). |
| Any comment | |

| | |
|---|---|
| Data / Parameter | **$EF_{CO2, NG}$** |
| Data unit | t $CO_2$/GJ |
| Description | $CO_2$ emission factor for natural gas, project year |
| Time of determination/monitoring | Once after the end of the project year |
| Source of data (to be) used | Normative documents |
| Value of data applied (for ex ante calculations/determinations) | 0.0561 |
| Justification of the choice of data or description of measurement methods and | IPCC 1996 Guidelines for National Greenhouse Gas Inventories Vol.2[27] |

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

| | |
|---|---|
| procedures (to be) applied | |
| QA/QC procedures (to be) applied | IPCC is reliable source of the information |
| Any comment | Auxiliary data allowing adjustment of baseline |

| | |
|---|---|
| Data / Parameter | $EF_{CO2,ELEC,c}$ |
| Data unit | t $CO_2$/MWh |
| Description | Carbon emission factor for Ukrainian electrical grid for JI projects reducing electricity consumption, project year |
| Time of determination/monitoring | Once, at the beginning of the project |
| Source of data (to be) used | Normative documents |
| Value of data applied (for ex ante calculations/determinations) | 0.896 |
| Justification of the choice of data or description of measurement methods and procedures (to be) applied | Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", verified by TUV SUD Industrie Service GmbH 17.08.2007[28] |
| QA/QC procedures (to be) applied | is reliable source of the information |
| Any comment | Researches don't take into consideration production of energy by nuclear power plants |

| | |
|---|---|
| Data / Parameter | $EF_{CO2,ELEC,g}$ |
| Data unit | t $CO_2$/MWh |
| Description | Carbon emission factor for Ukrainian electrical grid for JI projects reducing electricity consumption, project year |
| Time of determination/monitoring | Once, at the beginning of the project |
| Source of data (to be) used | Normative documents |
| Value of data applied (for ex ante calculations/determinations) | 0.807 |
| Justification of the choice of data or description of measurement methods and | Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", verified by TUV SUD Industrie Service GmbH 17.08.2007[29] |

[27] http://www.ipcc-nggip.iges.or.jp/public/gl/invs5a.html

[28] *Guidance "Standardized emission factors for Ukrainian electrical grid" (version 5, February 02 2007), executed by Global Carbon B.V "*

| | |
|---|---|
| procedures (to be) applied | |
| QA/QC procedures (to be) applied | Guidance "Standardized emission factors for Ukrainian electrical grid" is reliable source of the information |
| Any comment | Researches don't take into consideration production of energy by nuclear power plants |

[29] *Guidance "Standardized emission factors for Ukrainian electrical grid" (version 5, February 02 2007), executed by Global Carbon B.V "*

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

Project emissions consist of two types of GHG emissions:

1. $CO_2$e emissions from boilers due to gas consumtion with saving due to boiler houses rehabilitation, CHSS, IHSS installation and due to gas consumption by boiler-house for hot water supply service, which will be replace after installation of CHP and HPS+CHP.
2. $CO_2$ emissions from electricity consumption from the grid by the boilers and central Heating Points after installation of frequency converters.

$$E_r = \sum (B_{r(i)} * NCV_{r(i)} * EF_{CO2,NG}) + P_r * EF_{CO2,ELEC,c}, \quad (33)$$

where:

$E_r$ –project emissions in every reported year, t $CO_2$
$B_{r(i)}$ – fuel consumption in the project scenario, ths. $m^3$
$NCV_{r(i)}$ – Net Calorific Value of every type of fuel, GJ/ths. $m^3$
$EF_{CO2,NG}$ – carbon emission factor for every type of fuel, $tCO_2/GJ$
$P_r$ – project electric power consumption by boiler-houses and CHSS, on which frequency controllers will be installed, MWh
$EF_{CO2,ELEC,c}$ – Coefficient of carbon emissions by reducing electricity consumption, $tCO_2/MWh$

The sum is taken over all boiler
[$_r$] index – related to the reporting year

**D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of $CO_2$ equivalent):**

$$E_b = \sum (B_{b(i)} * NCV_{b(i)} * EF_{CO2,NG,b}) + W_b * EF_{CO2,ELEC,g} + P_b * EF_{CO2,ELEC,c}, \quad (34)$$

where:

$E_b$ – baseline emissions, t $CO_2$
$B_{b(i)}$ – fuel consumption in the baseline project scenario, ths. $m^3$
$NCV_{b(i)}$ – Net Calorific Value of every type of fuel, GJ/ths. $m^3$
$EF_{CO2,NG,b}$ – carbon emission factor for every type of fuel, $tCO_2/GJ$
$W_b$ – planned electricity production on all new installed cogeneration units, MWh
$EF_{CO2,ELEC,g}$ – carbon emission factor for electricity production, $tCO_2/MWh$
$P_B$ – baseline electric power consumption by boiler-houses and CHSS, on which frequency controllers will be installed, MWh
$EF_{CO2,ELEC,c}$ – - Coefficient of carbon emissions by reducing electricity consumption, $tCO_2/MWh$

The sum is taken over all boiler
Baseline and the amount of emissions for all years of the project may be adjusted, if taken into account the correction coefficients from section **B.1.**
Description of the formula, which allows to adjust the baseline emissions is in section **D.1.1.**

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

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

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

There are no data to be collected in order to monitor emission reductions from the project, because emission reductions will be calculated by means of formulae presented in paragraph **D.1.2.2.**

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

The total emission reduction in the project:

$$\mathbf{ERU = E_b - E_r.} \qquad (35)$$

where:
ERU – emission reduction units, $tCO_2$
$E_r$ –project emissions in every reported year, $tCO_2$
$E_b$ –baseline emissions, $tCO_2$

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

No leakage is expected. Dynamic baseline (based on collected monitoring data) will exclude all possible leakages.

| D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ID number *(Please use numbers to ease cross-referencing to D.2.)* | Data variable | Source of data | Data unit | Measured (m), calculated (c), estimated (e) | Recording frequency | Proportion of data to be monitored | How will the data be archived? (electronic/ paper) | Comment |
| | | | | | | | | |
| | | | | | | | | |

Any occasional leakage emissions (for example, caused by pipes' leakages, etc.) should be eliminated as soon as possible.

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

No leakages are expected

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

GHG emission reductions from the project are estimated by means of the following formulae:

$$\mathbf{ERU = E_b - E_r.} \quad (36)$$

where:
ERU – emission reduction units, $tCO_2$
$E_r$ –project emissions in every reported year, $tCO_2$
$E_b$ –baseline emissions, $tCO_2$

**Baseline emissions**
Baseline emissions consist of three types of GHG emissions:

3. $CO_2e$ emissions from boilers operated by Concern "Mis'ki teplovi merezhi".
4. $CO_2$ emissions from electricity consumption from the grid by the boilers and central Heating Points after installation of frequency converters.
5. $CO_2$ emissions from electricity production to the grid after installation of CHP units.

$$E_b = E1_b + E2_b + E3_b \quad (37)$$

where:
$E1_b$ – emissions from boilers operated by the Concern «Mis'ki teplovi merezhi», t $CO_2$;
$E2_b$ – emissions from electricity consumption from the grid by the boilers and central Heating Points after installation of frequency converters., t $CO_2$;
$E3_b$ – emissions from electricity production to the grid after installation of CHP units, t $CO_2$.

1) Emissions from heat generating sources operated by the Concern «Mis'ki teplovi merezhi»:

$$E1_b = \sum (B_{b(i)} * NCV_{b(i)} * EF_{CO2,NG,i}), \quad (38)$$

where:
$B_{b(i)}$ – fuel consumption in the baseline scenario, ths. $m^3$;
$NCV_{b(i)}$ – Net Calorific Value, GJ/ths. $m^3$ ;
$EF_{CO2,NG,i}$ – Carbon Emission Factors, t $CO_2$/GJ.

For more detailed information see **Appendix 1-2-8 (Boilers) and Appendix 3-7, v.2 (CHP, HPS+CHP).**

Heat, that will be produced from new cogeneration units, which willinstalled by Concern «Mis'ki teplovi merezhi».

2) $CO_2$ emissions from electricity consumption from the grid by the boilers and central Heating Points after installation of frequency converters, t $CO_2$

$$E2= P_b * EF_{CO2,ELEC,g}, \quad (39)$$

where:
$P_b$ – annual power consumption from the grid by the boilers and central Heating Points after installation of frequency converters, MWh;
$EF_{CO2,ELEC,g}$ – Carbon Emission factor for reducing electricity generation, $tCO_2$/MWh.

For more detailed information see **Appendix 3-7, v.2 (Frequency controllers).**

3) $CO_2$ emissions from electricity production to the grid after installation of CHP units.

$$E2= P_b * EF_{CO2,ELEC,c}, \quad (40)$$

where:
$P_b$ – annual power consumption from the grid by the boilers and central Heating Points after installation of frequency converters, MWh;
$EF_{CO2,ELEC,c}$ – Carbon Emission factor for electricity consumption, $tCO_2$/MWh..

For more detailed information see **Appendix 3-7, v.2 (CHP).**

**Project emissions**

Emissions in the project scenario from the boiler is the sum of the valid amount of fuel used in any financial year (from 2008), multiplied by the appropriate conversion factors. Valid - means taken away from fuel economy, which is due to improved efficiency of heating systems:

$$E_r = \sum ([B_{r(i)} - V_{(i)}] * NCV_{r(i)} * EF_{CO2,NG,i}), \quad (41)$$

Where:

$E_r$ – project emissions in every reported year,t $CO_2$

$B_{r(i)}$ – fuel consumption in project scenario, ths. $m^3$;

$V_{(i)}$ – fuel savings due to reconstruction of heating systems, ths.$m^3$;

$NCV_{r(i)}$ – Net Calorific Value, GJ/ths.$m^3$ ;

$EF_{CO2,NG,i}$ – $CO_2$ emission factor for every fuel type, t $CO_2$/GJ.

$$B_{r(i)} = [B_{b(i)} * NCV_{b(i)} * (\text{boiler efficiency in baseline year})_i] / [NCV_{r(i)} * (\text{boiler efficiency in project year})_i], \quad (42)$$

$$V_{(i)} = B_{b(i)} - B_{b(i)} * (100-L_b)/(100-L_r), \quad (43)$$

Where:

$B_{b(i)}$ – fuel consumption in baseline scenario, ths. $m^3$;

$L_b$ – heat losses in heating systems in the baseline scenario, %;

$L_r$ – heat losses in heating systems in the project scenario, %.

For more detailed information see **Appendice 1-2-8 (Boilers, Network, Total) and Appendixes 3-7, v.2 (CHP, CHP+HPS)**.

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

According to the common Ukrainian practice for such type projects, the environmental impact of the project will be estimated by fuel consumption and combustion.

- Law of Ukraine # 1264-XII "On environmental protection" from 25.06.1991;
- Law of Ukraine # 2707-XII "On atmospheric air protection" from 16.10.1992;
- Actual rules on emissions limitation: "Norms of limit admissible emissions of pollution agents from stationary sources" – adopted by Ministry for Environmental Protection of Ukraine 27.06.2006, #309 issued Ministry of and registered in Ministry of Justice of Ukraine 01.09.2006, #912/12786.

| D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored: | | |
|---|---|---|
| Data *(Indicate table and ID number)* | Uncertainty level of data (high/medium/low) | Explain QA/QC procedures planned for these data, or why such procedures are not necessary. |
| 1.1. Amount of natural gas consumed by boiler houses.<br>1.2. Amount of coal consumed by boiler houses. | Low for gas.<br>Medium for coal | Measuring instruments must be calibrated according to national regulations (usually every year) |
| 2. Amount of electric power consumed by boiler houses. | Low | Measuring instruments must be calibrated according to national regulations (every 4-16 years) |
| 3. Fuel quality (Net Calorific Values). | Low | Even though there is no need to mistrust fuel suppliers, the Supplier will periodically check the data provided by fuel suppliers through performing chemical analyzes of supplied fuel (usually once per heating season). |
| 4. Carbon emission factors for fuels<br>5. Carbon emission factor for electricity consumption | Low<br>Low | Normative documents data. No quality assurance is needed. |
| 6. Outside temperature | Low | Outside temperature data from two boiler houses located in the same town should be similar. |
| 7. Inside temperature | Low | Each boiler house operator who uses services of the boiler house he operates will be responsible for accurate data acquisition during heating season. |
| 8. Number of customers of hot water supply service | Low | Statistic data. No quality assurance is needed. |

| | | |
|---|---|---|
| 9. Heating area.<br>11. Heating area of buildings (previously existed in the base year) with the renewed (improved) thermal insulation.<br>12. Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) | Low<br>Low<br>Low | Statistic data. No quality assurance is needed. |
| 10. Average heat transfer factor of heated buildings.<br>13. Heat transfer factor of buildings with new thermal insulation | Low | Normative documents data. No quality assurance is needed. |
| 14. Heating period duration.<br>15. Duration of period of hot water supply service | Low<br>Low | Statistic data. No quality assurance is needed. |

| | | |
|---|---|---|
| 16. Connected load to the boiler-house for heating.<br>17. Connected load to the boiler-house for hot water supply service. | Low | Calculated data (data are calculated taking into account connected heating area and number of customers of hot water supply service respectively by methodology of normative documents). No quality assurance is needed. |
| 18. Standard specific discharge of hot water per personal account | Low | Normative documents data. No quality assurance is needed. |

According to valid legislation, all measuring equipment in Ukraine should meet the specified requirements of corresponding standards and is subject to the periodical verifying and calibration (usually once per year, for some equipment once per two and three years).

For example, the gas flow meters of the SG type should meet the requirements of the standard TU 4213-001-07513518-02, in particular the measurement error should be 111not more than ± 2% in the flow range from Qmin to 0,2Qmax; ± 1% - in the range from 0,2Qmax to Qmax.
In case of failure of measurement equipment, it should be replaced or repaired as soon as possible. Such cases should be noted in monitoring reports.

If expected monitored data for the boiler-house in any project year are unavailable:

- for statistic data unavailable the default values from IPCC reports will be taken;
- for non-statistic data unavailable, the calculations for this boiler-house in this year will not be made, in according to principle of conservatism the estimated emission reductions for this boiler-house in this year will be assumed equal to 0.

**D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:**

The scheme identifying the responsibilities and the authority regarding the monitoring activities for the parameters to be monitored are presented in Annex 3.

**D.4. Name of person(s)/entity(ies) establishing the monitoring plan:**

The monitoring plan is determined by the Institute of Engineering Ecology (IEE), project developer, Concern "Mis'ki teplovi merezhi", organization that implements the project, and OJSC "Oblteplocomunenergo", the project participant - supplier.

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## SECTION E. Estimation of greenhouse gas emission reductions

### E.1. Estimated project emissions:

Project Carbon Emission Factors are assumed equal to the Baseline Carbon Emission Factors.

**Calculation of Project Activity Level**

Project's activity level, estimated by fuel and power consumption, will be reduced comparing to the baseline activity level due to fuel saving.

| Types of project activity | Energy resources consumption |
|---|---|
| Gas consumtion by Concern "MTM" with industrial SER utilization, saving due to boiler houses rehabilitation, CHSS, IHSS installation, ths. $m^3$ | 316 012.2 |
| Gas consumption by CHP units for HPS and CHP | 30 697 |

*Table E.1. Project Energy resources consumption*

Detailed information is presented in **Appendices 1 - 8.**

**Appendix 1-2-8 (Boilers, Network) and Appendix 3-7, v.2, (CHP, HPS+CHP)**.

**Estimation of Direct Project Emissions**

| Project emissions | Project emissions, t $CO_2$ |
|---|---|
| E1r | 603 328 |
| E2r | 58 606 |
| **Total** | 729 333 |

*Table E.2. Project Emissions of $CO_2e$ after project implementation*

Project emissions are ~ **729 333** t $CO_2$

**E.2. Estimated leakage:**

We assume that possible leakage is negligible that is less than 1% of the total direct emissions. These indirect emissions are not under control of project developer so we do not include them in calculations.

**E.3. The sum of E.1. and E.2.:**

Project Emissions + Leakages = 729 333 + 0 = 729 333 t $CO_2$.

**E.4. Estimated baseline emissions:**

Baseline emissions consist of three types of GHG emissions:

| Baseline emissions by the sources of GHG emission | Baseline emissions, t $CO_2$ |
|---|---|
| $CO_2$ emissions from fuel consumption by boiler-houses operated by Concern "Mis'ki teplovi merezhi" and from fuel consumption by boiler-house for hot water supply service, which will be replace after installation of CHP and HPS+CHP | 848 925 |
| $CO_2$ emissions from electricity consumption from grid by boiler houses and central Heating Points | 72 140 |
| $CO_2$ emissions from electricity production to the grid after installation of CHP units | 89 334 |
| **Total** | 1 010 399 |

*Table E.3. Baseline Emissions of $CO_2$*

Baseline emissions ~ **1 010 399** t $CO_2$.

More detailed calculation of resulting annual Baseline Carbon Emissions, that would take place during typical heating season if Concern «Mis'ki teplovi merezhi» DH system remains unchanged, see in **Appendix 1-2-8 (Total)**.

**E.5. Difference between E.4. and E.3. representing the emission reductions of the project:**

Project Emission Reduction = Baseline emission - (Project emission +Estimated leakage)

**E.6. Table providing values obtained when applying formulae above:**

| Year | Estimated project emissions (tones of $CO_2$ equivalent) | Estimated leakage (tonnes of $CO_2$ equivalent) | Estimated baseline emissions (tonnes of $CO_2$ equivalent) | Estimated emissions reductions (tonnes of $CO_2$ equivalent) |
|---|---|---|---|---|
| 2006 | 834 751 | 0 | 874 207 | 39 456 |
| 2007 | 812 484 | 0 | 874 207 | 64 834 |
| Total ($tCO_2$ equivalent) | **1 647 235** | **0** | **1 748 414** | **101 180** |

*Table E.4. Table containing results of emission reductions estimation before the first commitment period*

| Year | Estimated project emissions (tones of $CO_2$ equivalent) | Estimated leakage (tonnes of $CO_2$ equivalent) | Estimated baseline emissions (tonnes of $CO_2$ equivalent) | Estimated emissions reductions (tonnes of $CO_2$ equivalent) |
|---|---|---|---|---|
| 2008 | 788 649 | 0 | 874 207 | 85 558 |
| 2009 | 771 028 | 0 | 874 207 | 103 180 |
| 2010 | 746 645 | 0 | 874 207 | 127 562 |
| 2011 | 684 892 | 0 | 874 207 | 189 315 |
| 2012 | 729 333 | 0 | 1 010 399 | 281 066 |
| **Total (tonnes of $CO_2$ equivalent)** | **3 720 547** | **0** | **4 507 228** | **786 681** |

*Table E.5 Table containing results of emission reductions estimation during the first commitment period*

| Year | Estimated project emissions (tones of $CO_2$ equivalent) | Estimated leakage (tonnes of $CO_2$ equivalent) | Estimated baseline emissions (tonnes of $CO_2$ equivalent) | Estimated emissions reductions (tonnes of $CO_2$ equivalent) |
|---|---|---|---|---|
| 2013 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2014 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2015 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2016 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2017 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2018 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2019 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2020 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2021 | 729 333 | 0 | 1 010 399 | 281 066 |

| | | | | |
|---|---|---|---|---|
| 2022 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2023 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2024 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2025 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2026 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2027 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2028 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2029 | 729 333 | 0 | 1 010 399 | 281 066 |
| 2030 | 729 333 | 0 | 1 010 399 | 281 066 |
| **Total (tonnes of $CO_2$ equivalent)** | **13 127 994** | **0** | **18 187 182** | **5 059 188** |

*Table E.6. Table containing results of emission reductions estimation after the first commitment period*

## SECTION F. Environmental impacts

### F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

According to the Ukrainian regulations, the design documentation for the new building, reconstruction and technical re-equipment of industrial and civil objects must include the environmental impact assessment, the main requirements for which are listed in the State Building Norms of Ukraine A.2.2-1-2003.

Concern "Mis'ki teplovi merezhi"- has the necessary Environmental Impact Assessment for its activity according to Ukrainian legislation (the State Building Norms of Ukraine A.2.2-1-2003)

Overall, the project "Rehabilitation of the District Heating System of Zaporizhzhia City" will have a positive effect on environment. Following points will give detailed information on environmental benefits.

1. Project implementation will reduce $CO_2$ emissions in Zaporizhzhia city due to increased heat supply system boilers efficiencies, achieved through installation of up-to-date boiler equipment, particularly new boilers, burners, cogeneration units, heat utilizers, CHSS rehabilitation, replacement of heating network pipes by pre-insulated.

2. Due to fuel saving and new environmentally friendlier technologies of fuel combustion, project implementation will reduce emissions of $SO_x$, $NO_x$, CO and particulate matter (co-products of combustion).

3. It is expected that due to the better heat supply service population of Zaporizhzhia city will reduce electricity consumption from electric heaters thus reducing power plants emissions of $CO_2$, $SO_x$, $NO_x$, CO and particulate matter.

**F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to supporting documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:**

**Impact on the water medium**

Impact on the water medium is present. Impact on water resources is will be the same as in baseline scenario. The existing technology of heat energy production exploited at the objects concern "Mis'ki teplovi merezhi" - foresees discharging of waste water to the sewage network with obligatory chemical control in accordance to Water Code of Ukraine, GOST 28.74-82 "Hygienic regulations and quality control", SNiP 4630-92 on determining maximum concentration limits for internal water bodies. Discharge of wastewater to the open water bodies will not take place.

This is confirmed by the State Administration of Environmental Protection in the Zaporizhzhia region (Resolution № Ukr 5194/Zap from 12.01.2010, on the special use Time: Up to 31.12.2010).

Project implementation will have positive environmental effect. It will allow to decrease the water consumption and as a result – to decrease the amount of waste water.

**Effects on the ambient air**

The project implementation will have positive effect on ambient air:

1) Reduction of $NO_x$, $SO_x$, CO and PM due to application of cleaner technologies at boiler houses;
2) Reduction of electricity consumption results in lower emissions of the same air pollutants;
3) Heat stress on the atmosphere (due to lower temperatures of flue gases);
4) Lower emissions per unit of fuel at the same load on boiler house.

This is confirmed by the Ministry of Environmental Protection of Ukraine (Resolution № 2310136700-78 on 27.10.2009, the emission of pollutants into the atmosphere by stationary sources. Validity: 10/26/2014 to city).

**Effects on land use**

Impact on the land medium is not present.

Relevant regulation is the sphere of land use is presented by the Land Code of Ukraine. National technological practice / standard: GOST 17.4.1.02.-83 "Protection of Nature, Soils. Classification of chemical substances for pollution control".

**Effects on biodiversity**

Impact on biodiversity is not present.

**Waste generation, treatment and disposal**

Waste generation, treatment and disposal are present. In the process of project implementation the generation of waste will occur after disassembling of physically and morally obsolete equipment,

burners, pipes, etc. Also there will occur some construction waste due to destruction of boiler settling, boiler house foundations, etc.

Possible recycling of the old equipment will by definition have a positive effect on the environment.

This is confirmed by the State Administration of Environmental Protection in the Zaporizhzhia region (Resolution № 01.664/11 on 06.09.2010, at the disposal of waste in 2011 Validity: 12/31/2011).

## SECTION G. Stakeholders' comments

### G.1. Information on stakeholders' comments on the project, as appropriate:

The project activity does not include a negative impact on the environment and the negative social impact. Consultations with stakeholders weren't carried out. Zaporizhzhia city authorities expressed support for this project.

According to Ukrainian law, the owners of enterprises that introduced new construction projects, reconstruction and modernization of industrial and civil projects requiring EIA shall inform the public through local authorities (State Building Codes of Ukraine A.2.2-1-2003, paragraph 1.6).

Accordingly, the concern "Mis'ki teplovi merezhi" gives advertises in the local press about the implementation of each sub-project included in this project. Stakeholder comments are presented in the publication:

Diveev S. Zaporizhzhia: bitva za teplo//Spozhyvcha varta. Region – 2010. Vup. 1. – P.42-43

No stakeholders' comments were received.

In addition, it should be noted that the project "Rehabilitation of the District Heating System of Zaporizhzhia City" was presented at the XXth International Conference "Problems of Ecology and operation of energy facilities" (Yalta, June 8-12, 2010), which was extensively discussed by representatives of district heating public organizations.

Annex 1

## CONTACT INFORMATION ON PROJECT PARTICIPANTS

**Supplier:**

| | |
|---|---|
| Organisation: | OJSC "Oblteplocomunenergo" |
| Street/P.O.Box: | Komsomolska str. |
| Building: | 55 b |
| City: | Chernihiv |
| State/Region: | Chernihiv |
| Postal code: | 14000 |
| Country: | Ukraine |
| Phone: | +38(0462) 27-43-24 , |
| Fax: | +38(0462) 27-43-24 |
| E-mail: | otke@teplo.cn.ua |
| URL: | |
| Represented by: | |
| Title: | Head of the Board |
| Salutation: | Mr. |
| Last name: | Barbarov |
| Middle name: | Anatoliyovych |
| First name: | Yuri |
| Department: | |
| Phone (direct): | +38 (0462) 27 43 24 |
| Fax (direct): | +38 (0462) 27 43 24 |
| Mobile: | |
| Personal e-mail: | |

**Partner –Buyer**

| | |
|---|---|
| Organisation: | |
| Street/P.O.Box: | |
| Building: | |
| City: | |
| State/Region: | |
| Postal code: | |
| Country: | |
| Phone: | |
| Fax: | |
| E-mail: | |
| URL: | |
| Represented by: | |
| Title: | |
| Salutation: | |
| Last name: | |
| Middle name: | |
| First name: | |
| Department: | |
| Phone (direct): | |
| Fax (direct): | |
| Mobile: | |
| Personal e-mail: | |

Annex 2

## BASELINE INFORMATION

The main Baseline information is listed in **Section B.** In this Annex 2 some detailed are represented.

**Information on the power grid Baseline situation:**

Ukraine has united state power grid, therefore the averaged values for Carbon Emission factors (CEF) for electricity production in Ukraine should be used for the project calculations.

For calculations the values of the carbon emission factors at the combined approach base are used:

- for 2004-2005– according to the Table B1 "Baseline carbon emission factors for JI projects generating electricity" and Table B2 "Baseline carbon emission factors for JI projects reducing electricity consumption" of Operational Guidelines for PDD's of JI projects. Volume 1: General guidelines Version 2.3. Ministry of Economic Affairs of the Netherlands, 2004 (ERUPT 4, Senter, the Netherlands)[30]:

| Parameter /Year | 2005 |
|---|---|
| $CEF_g$ $tCO_2e/MWh$ | 0.740 |
| $CEF_c$ $tCO_2e/MWh$ | 0.896 |

*Table An.2-1. Carbon Emission factors (CEF) for projects reducing electricity consumption in Ukraine*

- for 2006-2012 (and for the later period in the forecasting calculations in PDD as well) – according to the Table 8 "Emission Factors for the Ukrainian grid 2006-2012" of Annex 2 "Standardized Emission Factors for the Ukrainian Electricity Grid" to "Ukraine - Assessment of new calculation of CEF", verified by TUV SUD Industrie Service GmbH 17.08.2007[31]:

| Parameter /Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| $CEF_g$ $tCO_2e/MWh$ | 0.807 | 0.807 | 0.807 | 0.807 | 0.807 | 0.807 | 0.807 |
| $CEF_c$ $tCO_2e/MWh$ | 0.896 | 0.896 | 0.896 | 0.896 | 0.896 | 0.896 | 0.896 |

*Table An.2-2. New Carbon Emission factors (CEF) for electricity generation and consumption in Ukraine*

It should be noted that according to "Ukraine - Assessment of new calculation of CEF" : "This baseline can be used as ex-ante (fixed for the period 2006 – 2012) or ex-post. In case an ex-post baseline is chosen the data of the Ukrainian grid have to be obtained of the year in which the emission reductions are being claimed. Monitoring will have to be done in accordance with the monitoring plan of ACM0002 with the following exceptions:
• the Monitoring Plan should also include monitoring of the grid losses in year y;
• power plants at which JI projects take place should be excluded. Such a JI project should have been approved by Ukraine and have been determined by an Accredited Independent Entity."

Thus. TUV SUD Industrie Service GmbH has validated the certain value of CEF for 2006 and possibly future up to 2012, as well as the methodology for calculations of this factor, and its "team recommends

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

[31] *Guidance "Standardized emission factors for Ukrainian electrical grid" (version 5, February 02 2007), executed by Global Carbon B.V* "

updating the calculation annually depending on point of time when national consolidated data are available", with taking into account the above monitoring conditions.

EBRD in 2009 expressed that "these factors are in need for an update further to a request from the Ministry of Fuel and Power of Ukraine and the National Environmental Investment Agency of Ukraine."[32]

According to this, after obtaining the more recent input data for calculations according to the methodology developed by Global Carbon and validated by TÜV SÜD (or may be another one developed by EBRD, after its acceptance), the grid emission factor may and should be renewed annually, to be in line with actual situation.

Therefore, the following CEF values are used in calculations in PDD:

| Year | 2005 | 2006-2012 | 2013-2020 |
|---|---|---|---|
| $CEF_g$, t $CO_2$/MWh | 0.740 | 0.807 | 0.807 |
| $CEF_c$, t $CO_2$/MWh | 0.896 | 0.896 | 0.896 |

*Table An.2-3. The baseline Carbon Emission factors (CEF) used for calculations in PDD*

In course of development of the Monitoring reports for this project, if available, the valid at that time CEF values for corresponding period will be used.

[32] *TERMS OF REFERENCE. Development of the electricity carbon emission factors for Russia and Ukraine for the period 2009 – 2020. EBRD, 2009*

Annex 3

## MONITORING PLAN

In course of development of the project "Rehabilitation of the District Heating System of Zaporizhzhia City", the own-developed methodology for projects on District Heating was used. It is already approved by IAEs for the similar JI projects for the Chernigov region, AR Crimea and Donetsk region, the cities of Kharkiv, Rivne, Luhansk, etc.

The developed project specific "Methodology" is based on the permanent monitoring of fuel consumption and on the account of various other factors, such as connection or disconnection of the consumers, change of fuel heating value, weather conditions change, ratio of the heat consumption for heating and for hot water supply, consumption for own needs, etc.

The baseline study will be fulfilled every reported year, to correct adjustment factors which have an influence at the dynamic baseline.

Monitoring methodology developed for "District Heating" projects in Ukrainian conditions

Monitoring methodology developed for "District Heating" projects in Ukrainian conditions is presented in section D.1.1. of this PDD (Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario).

**Monitoring of baseline and project emissions**

Parameters to be monitored

Monitoring methodology identifies and takes into account the parameters that are need to be measured or monitored at regular intervals. These parameters will then be input into a project Tracking Database, which will be an Excel based spreadsheet that will track GHG emission reductions annually.
List of parameters to be monitored are in the table below.

| | **Symbol** | Data variable | Data unit | Measured (m), calculated (c), estimated (e) |
|---|---|---|---|---|
| 1 | ($\mathbf{B_b}$) and ($\mathbf{B_r}$) | Fuel consumption by boiler-houses (Natural gas) | ths.$m^3$ | m |
| 2 | ($\mathbf{NCV_b}$) and ($\mathbf{NCV_r}$) | Average annual Net Calorific Value of Natural Gas | GJ/ ths.$m^3$ | m, c |
| 3 | ($\mathbf{T_{out\ b}}$) and ($\mathbf{T_{out\ r}}$) | Average outside temperature during the heating season | $^0$C (K) | m, c |
| 4 | ($\mathbf{T_{in\ b}}$) and ($\mathbf{T_{in\ r}}$) | Average inside temperature during the heating season | $^0$C (K) | m, c |
| 5 | ($\mathbf{n_{wb}}$ and ($\mathbf{n_{\ wr}}$) | Number of Customers | | Statistics |

| | | | | |
|---|---|---|---|---|
| 6 | ($F_{h\,b}$ and $F_{h\,r}$) | Heating area (total) | $m^2$ | Statistics |
| 7 | ($k_{hb}$) | Average heat transfer factor of heated buildings in the base year | $W/m^2*K$ | c |
| 8 | ($F_{h\,t\,r}$) | Heating area of buildings (previously existed in the base year) with the renewed (improved) thermal insulation in the reported year | $m^2$ | Statistics |
| 9 | ($F_{h\,n\,r}$) | Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reported year | $m^2$ | Statistics |
| 10 | ($k_{h\,n}$) | Heat transfer factor of buildings with the new thermal insulation | $W/m^2*K$ | Normative documents |
| 11 | ($N_{h\,b}$) and ($N_{h\,r}$) | Duration of the heating period | Hours | m |
| 12 | ($N_{w\,b}$) and ($N_{w\,r}$) | Duration of the hot water supply period | Hours | m |
| 13 | ($L_h^b$) and ($L_h^r$) | Maximum connected load to the boiler-house, that is required for heating | MW | c |
| 14 | ($L_w^b$) and ($L_w^r$) | Connected load to the boiler-house, that is required for hot water supply service | MW | c |
| 15 | ($v_{w\,r}$) and ($v_{w\,b}$) | Standard specific discharge of hot water per personal account | kWh/h | "State building norms Ukraine Buildings Public Health Institutions" DBN B.2.2-10-2001[33] |
| 16 | ($EF_{CO2,NGr}$) and ($EF_{CO2,NGb}$) | Carbon emission factor (Natural Gas) | t $CO_2$/GJ | IPCC, 1996 Volume 2 |
| 17 | **g** | Recalculating factor for average load during heating period | | Statistics |
| 18 | ($W_c$) | Electric power production by the installed new CHP units | MWh | m |
| 19 | ($W_b$) and ($W_r$) | Electric power consumption | MWh | m |
| 20 | ($Q_b$) | Heat energy production by the all new CHP units and heat pump stations | MWh | m |
| 21 | ($P_b$) and ($P_r$) | Electric power consumption by the boiler-houses and heating points where energy saving measures are scheduled to be implemented | MWh | m |

[33] http://zakon.nau.ua/doc/?uid=1041.2346.0

Parameters to be monitored

| **Parameter number and name** | **1** Natural gas consumption at boiler houses |
|---|---|
| Description | Natural gas consumption at boiler houses.<br>Consumption of fuel is the main parameter affecting greenhouse gas emissions. The most objective and accurate indicator of project performance will therefore be the changes in fuel consumption. Changes in fuel consumption in result of the project implementation, when compared to baseline fuel consumption, will integrate all other relevant indicators such as improvement of boiler efficiency, reduction of network losses, etc. |
| Monitoring method | Gas meters |
| Recording frequency | Daily |
| Background data | Instrument readings are registered in the paper journals at every boiler-house. |
| Calculation method | n.a. |

| **Parameter number and name** | **2** Average annual Net Calorific Value of Natural Gas |
|---|---|
| Description | Average annual Heating Value of Natural Gas calculated by Lower Heating Value for every town |
| Monitoring method | Accepted in accordance with reference or telephone message from natural gas supplier |
| Recording frequency | Data is provided by natural gas suppliers usually 3 times per month |
| Background data | Registered in the paper journal |
| Calculation method | Weighted average value |

| **Parameter number and name** | **3.** Average outside temperature during the heating season |
|---|---|
| Description | Average outside temperature during the heating season |
| Monitoring method | Average outside temperature during the heating season is calculated by Concern "Mis'ki teplovi merezhi" from the daily outside temperature values taken by dispatcher of the enterprise from Zaporizhzhia Meteorological Centre from 10 to 11 a.m. every day of heating season. |
| Recording frequency | Once per heating season.<br>Daily temperature is registered every day of heating season |
| Background data | Meteorological Centre sends the Report every decade or month for every day of heating season. Reports are filed in special |

| | |
|---|---|
| | journals |
| Calculation method | Average value |

| **Parameter number and name** | **4.** Average inside temperature during the heating season |
|---|---|
| Description | Average inside temperature during the heating season is calculated from the sum of returned payments caused by insufficient heating (in case of normative level (18 $^0$C) is not satisfied)<br><br>Above 18 $^0$C – is treated as 18 $^0$C (according to the conservatism principle) and as meeting the normative.<br>Below 18 $^0$C – is treated as not meeting the normative, and is calculated as below. |
| Monitoring method | Sum of returned payments |
| Recording frequency | Once per heating season |
| Background data | Sums of return payment |
| Calculation method | According to "Rules of rendering of heat and hot water supply service to population" № 1497 from 30.12.1997, the enterprises must make the return payments to population for delivery less than necessary amount of heat. The normative inside temperature should be not lower than 18 $^o$ C.<br>Amount of the return payment is:<br>– 5% from normative payment for every degree from 18 to 12 $^o$C;<br>– 10% from normative payment for every degree from 12 to 5 $^o$C;<br>– when inside temperature is lower than 5 $^o$C the payment is to be returned completely.<br><br>Therefore the inside temperature will be calculated by formulae:<br>If R = 0 (according to conservatism principle for the baseline assume R < 0.05):<br>$\mathbf{T_{in\ b}}$ = 18 $^o$C.<br>If 0.05 < R ≤ 0.3 NP:<br>$\mathbf{T_{in\ b}}$ = 18 – (R/5) [$^o$C]<br>If 0.3 NP < R < NP:<br>$\mathbf{T_{in\ b}}$ = 12 – [(R – 0.3 NP)/10] [$^o$C]<br>where:<br>R - % of return payment from NP;<br>NP – amount of normative payment.<br><br>Thus if the inside temperature will be 18 $^o$C or higher we will accept it as 18 $^o$C according to conservatism principle, if it will be lower than 18 $^o$C it will be calculated from return payments by the methodology presented before. |

| **Parameter number and name** | **5.** Number of Customers for hot water supply service |
|---|---|

| | |
|---|---|
| Description | Number of Customers for hot water supply service for every boiler houses |
| Monitoring method | Statistics of Concern "Mis'ki teplovi merezhi" |
| Recording frequency | Contracts with population, organizations and legal entities are concludes directly with Concern "Mis'ki teplovi merezhi". They are updated once per year. |
| Background data | The information is collected in special electronic journals "Registration of income from population" (for inhabitants). For organizations and legal entities such information is taken from contracts concluded with them |
| Calculation method | |

| **Parameter number and name** | **6.** Heating area (Total) |
|---|---|
| Description | Heating area for every boiler houses |
| Monitoring method | Statistics of Concern "Mis'ki teplovi merezhi" |
| Recording frequency | The revise is made in case of new contracts with Customers or in case of contracts break. |
| Background data | The information is collected at the sale departments of concern "Mis'ki teplovi merezhi"by the certificates of owners in accordance with technical passport of building.<br>Total area with balconies and stairs and Heating area are displayed in the special journal |
| Calculation method | The data is taken for January, 01 for every year |

| **Parameter number and name** | **7.** Heat transfer factor of buildings |
|---|---|
| Description | Heat transfer factor of buildings for every boiler-house |
| Monitoring method | Statistics of Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Heat transfer factor is recorded ones per year at recording of connection or disconnection of any heating area to boiler-houses included in project. |
| Background data | |
| Calculation method | For calculation of Heat transfer factor of buildings for every boiler-house, the method of Weighted average value was used, that depends on heating area of existing buildings and heating area of the new buildings. Values of the heat transfer factor for existing buildings were taken from SNiP 2-3-79 (1998) - not higher than 0.63. Values of the heat transfer factor of new buildings were taken according to State Buildings Norms (B.2.6-31:2006) - not higher than 0.36. |

| **Parameter number and name** | **8.** Heating area of buildings (previously existed in the base year) with the renewed (improved) thermal insulation in the reported year |
|---|---|
| Description | Heating area of reconstructed buildings with application of new insulations for walls |
| Monitoring method | Statistics of Concern «Mis'ki teplovi merezhi» |

| | |
|---|---|
| Recording frequency | Once per year |
| Background data | |
| Calculation method | |

| **Parameter number and name** | **9.** Heating area of newly connected buildings (assumed with the new (improved) thermal insulation) in the reported year |
|---|---|
| Description | Heating area of newly connected buildings with application of the new insulation for walls |
| Monitoring method | Statistics of Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per year |
| Background data | |
| Calculation method | |

| **Parameter number and name**) | **10.** Heat transfer factor of new buildings and buildings with new thermal insulation |
|---|---|
| Description | Heat transfer factor of buildings with new thermal insulation |
| Monitoring method | According to State Buildings Norms (B.2.6-31:2006) |
| Recording frequency | |
| Background data | |
| Calculation method | |

| **Parameter number and name** | **11.** Heating period duration |
|---|---|
| Description | Heating period duration in every town |
| Monitoring method | Measured by Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per year |
| Background data | The duration of the Heating period is accepted in accordance with item 7.9.4 of "Rules of technical exploitation of heating equipment and networks. 2007". Beginning and ending of the heating period are determined in every town separately. The heating period begins if the average daily outside temperature is 8 $^{o}$C or lower during 3 days, and finishes if average daily outside temperature is 8 $^{o}$C or higher during 3 days.<br>According to SNiP 2.01.01-84 (Climatology in heating engineering) the duration of heating period for project development is to be taken as 174 days. |
| Calculation method | |

| **Parameter number and name** | **12.** Duration of the hot water supply period |
|---|---|
| Description | Duration of the period of hot water supply service for every boiler house. |
| Monitoring method | Measured by Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per day |
| Background data | Hot water supply service is realized by hot water delivery |

| | |
|---|---|
| | schedule for every boiler-house.<br>Hot water supply service is foreseen. There is a plan of disconnection of load for Hot water supply service for maintenance and preventive measures for every boiler-house. |
| Calculation method | |

| **Parameter number and name** | **13.** Maximum connected load to the boiler-house, that is required for heating |
|---|---|
| Description | Maximum connected load to the boiler-house, that is required for heating. |
| Monitoring method | Calculated by Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per year |
| Background data | Maximum connected load to the boiler-house, that is required for heating, is calculated by Concern «Mis'ki teplovi merezhi» for every heating season. It is calculated according to heat demand at outside temperature -22 $^{o}$C. |
| Calculation method | |

| **Parameter number and name** | **14.** Connected load to the boiler-house, that is required for hot water supply service |
|---|---|
| Description | Connected load to the boiler-house, that is required for providing the hot water supply service |
| Monitoring method | Calculated by Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per year |
| Background data | Connected load to the boiler-house, that is required for hot water supply service, is calculated by Concern «Mis'ki teplovi merezhi» every year according to contracts with consumers. |
| Calculation method | |

| **Parameter number and name** | **15.** Standard specific discharge of hot water per personal account |
|---|---|
| Description | Standard specific discharge of hot water per personal account |
| Monitoring method | Normative documents |
| Recording frequency | Once per year |
| Background data | At present the standard specific discharge of hot water is valid in Ukraine that was established by the "KTM 204 Ukraine 244-94" in 1993, and no information is available on any propositions to change it. |
| Calculation method | |

| **Parameter number and name** | **16.** Carbon emission factor |
|---|---|
| Description | Carbon emission factor for different fuels |
| Monitoring method | Normative documents |
| Recording frequency | Once per year |
| Background data | For all fuels we used $CO_2$ emission factors from the data table |

| | |
|---|---|
| | provided in IPCC 1996 Guidelines for National Greenhouse Gas Inventories, Volume 2].<br>$EF_{CO2,NG}$ = 0.0561 $ktCO_2/TJ$; |
| Calculation method | |

| **Parameter number and name** | **17.** Recalculating factor for average load during heating period |
|---|---|
| Description | Recalculating factor for determination of the average load during heating period |
| Monitoring method | Statistics of Concern «Mis'ki teplovi merezhi» |
| Recording frequency | Once per year |
| Background data | Recalculating factor for average load during heating period is determined for each boiler-house on historical base, usually it is in the range (0.4 – 0.8) |
| Calculation method | $g = Q_{av}/Q_{max} = F_h*k_h*(T_{in} - T_{out\ av})/F_h*k_h*(T_{in} - T_{out\ min})$<br>where:<br>g – recalculating factor for average load during heating period;<br>$F_h$ – heating area of buildings, $m^2$;<br>$k_h$ – average heat transfer factor of heated buildings,$(W/m^2*K)$;<br>$T_{in}$ – average inside temperature for the heating period, K ;<br>$T_{out\ av}$ – average outside temperature for the heating period, K (or $^0C$);<br>$T_{out\ min}$ – minimal outside temperature for the heating period, K (or $^0C$). |

| **Parameter number and name** | **18.** Electric power production by the installed new CHP units |
|---|---|
| Description | Electric power generation by the installed new CHP units |
| Monitoring method | Measurement of generated electricity by power meter |
| Recording frequency | Every day |
| Background data | |
| Calculation method | |

| **Parameter number and name** | **19.** Electric power consumption by the installed new heat pumps station |
|---|---|
| Description | Electric power consumption by the installed new heat pumps station. |
| Monitoring method | Measurement of consumed electricity by power meter |
| Recording frequency | Every day |
| Background data | |
| Calculation method | |

These dates are required for verification and are archived for two years after the last transfer of ERUs for the project.

**Equipment for monitoring**

Equipment to be used by the project's developer for monitoring of corresponding parameters is given in Table An.3.1. Table also provides the information about type of equipment, calibration procedure and procedure of actions in case of malfunction.

| No. and name of parameter | Equipment | Class of accuracy | Verification body | Frequency | Procedure of actions in case of malfunction |
|---|---|---|---|---|---|
| 1. Natural gas consumption | Gas meters | +/- (0.5…2)% Usually 1% | "Standart metrologia" Ltd. | Once per 1-5 years, usually once per 2 years | In cases of malfunctions it is necessary to inform the project's manager or chief engineer hereof. If the malfunctions are not eliminated during 48 hours, it is necessary to appeal to equipment supplier for necessary repair conducting. If the repair is impossible the equipment shall be replaced by equivalent one. Data about malfunctions shall be recorded in the special registration book. |
| 18. Electric energy consumption | Power supply meters | +/- (0.2…0.5) % Usually 0.2% | JSC "Zaporizhzhiaoblenergo" | Once per 1-5 years, usually once per 4 years | In cases of malfunctions it is necessary to inform the project's manager or chief engineer hereof. If the malfunctions are not eliminated during 48 hours, it is necessary to appeal to equipment supplier for necessary repair conducting. If the repair is impossible |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | the equipment shall be replaced by equivalent one. Data about malfunctions shall be recorded in the special registration book. |

*Table An.3.1.Equipment for monitoring*

Scheme of monitoring system

The control and monitoring system comes to fuel consumption measurement. Other parameters are defined by calculations or taken from statistic data. Fuel consumption measurement is realized at the Gas distributing units of the boiler-houses. Gas registration is carried out in volume units reduced to standard conditions by means of automatic correction for temperature and pressure. The scheme of typical Gas distribution unit is shown at the Fig. 1.

The typical Gas distributing system usually consists of the following equipment:

- Gas filter;
- Control and measuring devices for gas operation pressure measurement and control of pressure difference at the gas filter;
- Gas flow meter;
- stop valve;
- bypass facility.

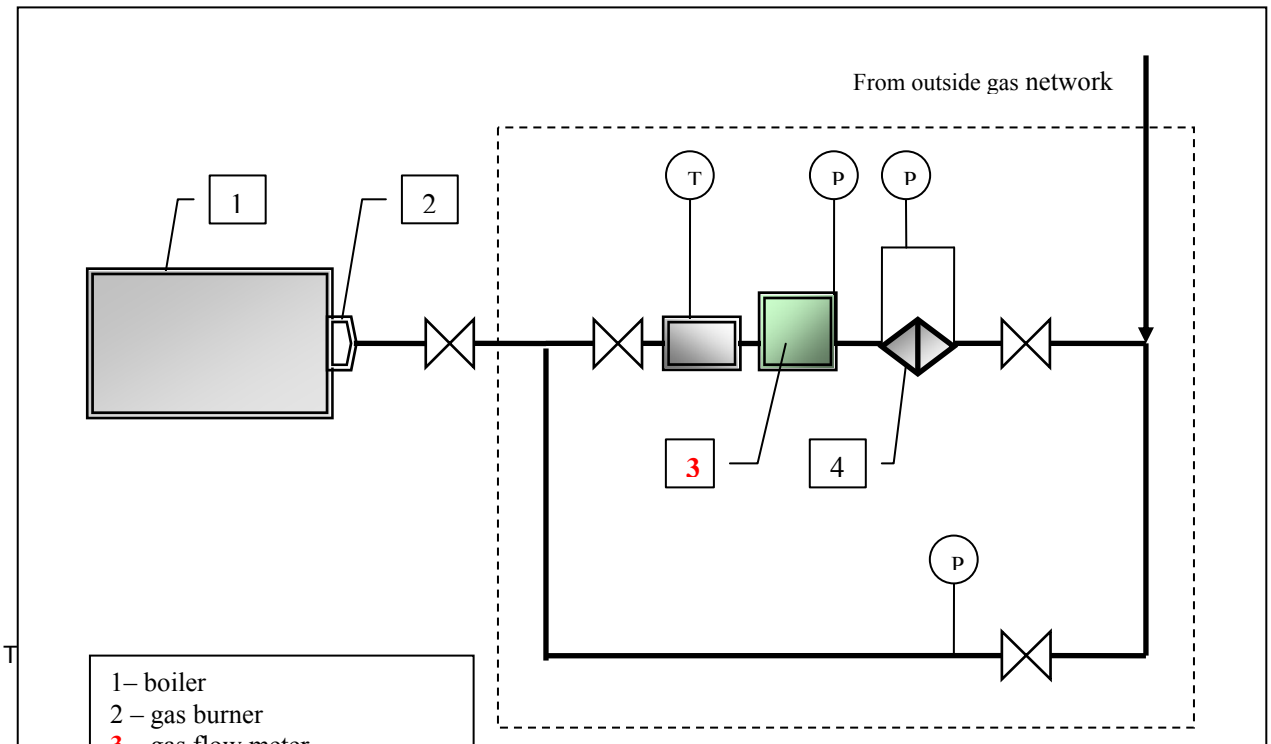

*Fig. An.3.1. Scheme of the Gas distribution system*

The typical scheme of monitoring system for boiler-house where the CHP units will be installed is shown at the Fig.An. 2. Usually it consists of the following equipment:

GFM – gas flow meter;
HFM – heat flow meter with sensors;
GEM - generated electricity meter;
CP - control panel of gas engine-generator machine

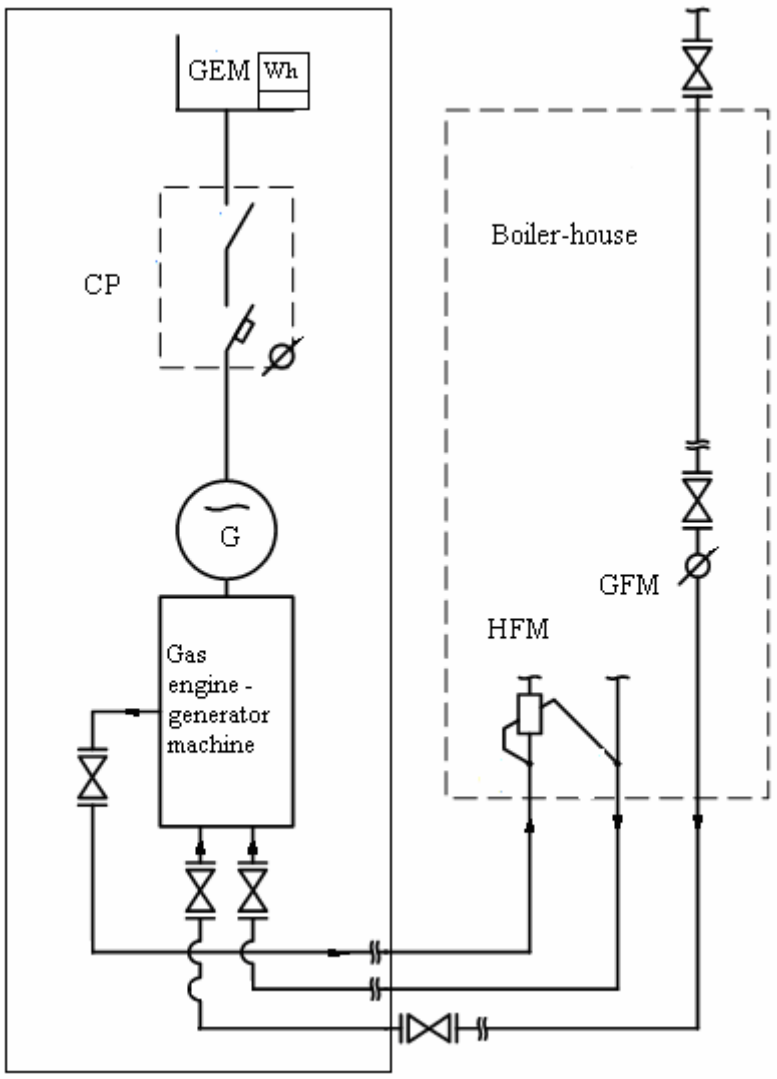


*Fig. An.3.2. Scheme of monitoring system for boiler-house where the CHP units will be installed*

**Monitoring equipment**

Equipment to be used for implementing the project monitoring of relevant parameters, erected in Table An.3-2. The table also provides information about the type of equipment, calibration procedure and the procedure for handling cases of malfunction.

| Measured parameters | Type | Place of location | Producer | Serial # | Accuracy | Calibration organization | Date of the last calibration | Calibration interval | Procedure for handling cases of failure |
|---|---|---|---|---|---|---|---|---|---|
| Natural gas, ths. $m^3$ | Universal-0,1,<br>EIA-110A,<br>MIDA-DA- EH,<br>TSPU | Paramonova st., 15a, | Ltd. NPF „Grempis” Ukraine<br>„Yakogawa” Japan<br>„Midaus”Russia<br>«Lvivprilad» Ukraine | №5044<br>№91F934115<br>№06100475 | ±0,1%<br>±0,1%<br>±0,25 %,<br>±0,5% | Ltd. ”Standart metrologia” | 03.06.10<br>03.06.10<br>03.06.10<br>03.06.10 | 2<br>2<br>2<br>1 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01,<br>KPLG-1,02R | Zhasminna st., 5 | TOV VKF „Kurs” Ukraine<br>„Radmirtehx” Ltd. Ukraine | №01057<br>№01308 | $Q_{min}$±2%<br>$Q_{max}$±1%<br>±0,5 % | Ltd. ”Standart methodology | 02.07.10<br>15.09.10 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01,<br>KPLG-1,02R | Orikhivske shose.st, 10 | TOV VKF „Kurs” Ukraine<br>„Radmirteh” Ltd. Ukraine | №01311<br>№01058 | $Q_{min}$±2%$Q_{max}$<br>±1%<br>±0,5 % | Ltd. ”Standart methodology | 07.07.10<br>21.07.10 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | LG-K-150-400,<br>KPLG-1,02R, | Stepova st., 7a | Ltd. «Promprilad» Ukraine<br>„Radmirteh” Ltd. Ukraine | №4484<br>№01710 | $Q_{min}$±2%$Q_{max}$<br>±1%<br>±0,5 % | Ltd. ”Standart methodology | 26.06.10;<br>05.08.10 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01,<br>KPLG-1,02R, | Doslidna st., 78a | TOV VKF „Kurs” Ukraine<br>„Radmirteh” Ltd. Ukraine | №02013<br>№01884 | $Q_{min}$±2%$Q_{max}$<br>±1%<br>±0,5 % | Ltd. ”Standart methodology | 28.05.09<br>26.05.09 | 2<br>2 | Repair, additional calibration or |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | replacement |
| Natural gas, ths. $m^3$ | GMS-G160-80, KPLG-1,02 | Kosmichna st., 3v | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №064712 №00381 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5, % | Ltd. "Standart methodology | 11.08.09 12.08.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | KURS-01, KPLG-1,02R | Skladska st., 2 | TOV VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02132 №01697 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 11.08.09 12.08.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | GMS-G25-40, KPLG-1,02R | Chapaeva st., 16 v | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №063519 №01412 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 20.05.09 20.05.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Novokuznecka st, 45 | TOV VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02268 №01713 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 09.07.09 13.07.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Chubanova st., 3d | TOV VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №4132 №02914 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 06.07.10 07.07.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | GMS-G25-40, KPLG-1,02R | Komsomolska st., 13 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №053150 №01450 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 16.06.09 16.06.09 | 2 2 | Repair, additional calibration or |

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| | | | | | | | | | replacement |
| Natural gas, ths. $m^3$ | GMS-G25-40, KPLG,-2,01R | Ambulatorna st., 10 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №053200 №00868 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 16.06.09 12.08.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Kosmichna st.,78a | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02270 №01696 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 06.08.09 12.08.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB, PTVM-30 | Adm. Ushakova st., 251 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5622 №02257 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 11.06.09 19.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB | TVG-8 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5710 №02258 | ±1% ±0,5, % | Ltd. "Standart methodology | 11.06.09 19.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | LG-K-100-250; KPLG-1,02 | Bilkina st., 27a | OJSC «Promprilad» Ukraine „Radmirteh" Ltd. Ukraine | №4738 №02033 | 0,2$Q_{min}$±2%$Q_{max}$±1% ±0,5% | Ltd. "Standart methodology | 19.07.10 13.07.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | LG-K-80-160-EX; KPLG-1,02 | Sosnova st., 24 | OJSC «Promprilad» Ukraine „Radmirteh" Ltd. Ukraine | №4898 №02228 | 0,2$Q_{min}$±2%$Q_{max}$±1% ±0,5 % | Ltd. "Standart methodology | 19.07.10 13.07.10 | 2 2 | Repair, additional calibration or |

| | | | | | | | | | |
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| | | | | | | | | | replacement |
| Natural gas, ths. $m^3$ | GMS-G16-32, KPLG-1,02R | Mashinna st., 117 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №051079 №01437 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5% | Ltd. "Standart methodology | 13.07.10 13.07.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB | Artema st., 79a thread#1 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5723 №02202 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 20.05.09 02.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB | thread#2 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5725 №02203 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 20.09.09 02.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB | thread#№3 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5724 №02205 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 11.06.09 19.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02RB | Heroiv Stalingrada st., 2 | NPP"Irvis" SP "Radmirteh" | №5687 №00692 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 08.04.09 14.10.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Angolenko st., 15 | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №03910 №02947 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5% | Ltd. "Standart methodology | 19.05.09 08.09.10 | 2 2 | Repair, additional calibration or |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | replacement |
| Natural gas, ths. $m^3$ | RG-K 100, KPLG-1,02R | Gorkogo st., 6 | OJSC «Promprilad» Ukraine „Radmirteh" Ltd. Ukraine | №8632 №02239 | $0,2Q_{min}$±2%$Q_{max}$±1% ±0,5% | Ltd. "Standart methodology | 01.09.10 27.08.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Glisserna st., 14 | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №01908 №02026 | | Ltd. "Standart methodology | 08.06.10 20.05.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02R | Admirala Nakhimova st., 4 Right thread | NPP "Irvis" SP "Radmirteh" | №5727 №02625 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 14.06.09 14.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02R | left thread | NPP "Irvis" Sp "Radmirteh" | №02627 №5678 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 14.06.09 14.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | LG-K-150-650, Universal-02 MIDA-DA-EH | island Khortica 52 | OJSC «Promprilad» Ukraine | №4816 №2720 №04104061 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 30.07.10 26.07.10 | 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02R | Schasliva st., 2a | Ltd. NPF„Grempis" Ukraine „MIDAUS"Russia | №5680 №00688 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 02.07.09 02.07.09 | 2 2 | Repair, additional calibration or |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | replacement |
| Natural gas, ths. $m^3$ | IRVIS-K-300, KPLG-1,02RB | Metalurhiv st., 32 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5846 №02837 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 25.05.10 25.05.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | IRVIS-K-300, KPLG-1,02PB | Dnipropetrovske av., 11 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5890 №02834 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 07.07.10 07.07.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | KURS-01G400, KPLG-1,02R | Taganska st., 1 | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02438 №01893 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 06.05.09 06.05.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Irvis K-300, KPLG-1,02PB | Khakaska st., 4 | NPP «Irvis» Russia „Radmirteh" Ltd.Ukraine | №5679 №00695 | $Q_{min}$±2%$Q_{max}$ ±1% ±0,5 % | Ltd. "Standart methodology | 11.06.09 11.06.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | GMS-G16-32, KPLG-1.02R | Tovariska st., 47 GRP-2 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №057172 №02818 | 0,05$Q_{min}$±2% $Q_{max}$±1% ±0,5 % | Ltd. "Standart methodology | 17.0510 17.05.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | AVV265DS, AVV AMD-261, GAMMA FLOU-01 | Tovariska st.,47 GRP-1 | Company „Hartman Braun" Germany Company „Hartman Braun" Germany | №265DS660 0007670 №650500222 №300 | ±0,075% ±0,15% ±1% | DP"ZAPORI ZHZHIAST ANDARTM ETROLOGY | 15.04.09 15.04.09 15.04.09 | 2 2 2 | Repair, additional calibration or |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | CHNPP „Softservice” Ukraine | | | | | | replacement |
| Natural gas, ths. $m^3$ | GMS-G250-80, KPLG-1,02R | 40 rokiv Zhovtnya, 50a | TP factory «Arsenal» Ukraine<br>„Radmirteh” Ltd. Ukraine | №088063<br>№02941 | 0,05$Q_{min}$±2%<br>$Q_{max}$±1%<br>±1 % | Ltd. ”Standart methodology | 17.05.10<br>21.05.09 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Metran-100-DD, MIDA-DA-01<br>Metran-100-DD, Metran—22DA-13P-01Eh, SPG-761 | Citrusova st., 9 (GRP 1,GRP 2) | CJSC PG «Metran» Russia<br>„MIDAUS” Russia<br>CJSC PG «Metran» Russia<br>CJSC PG «Metran» Russia<br>NPF «Logikaa» Russia | №71240<br>№01138041<br>№384348<br>№22593<br>№9398 | ±0,075%<br>±0,25%<br>±0,075%<br>±0,075%<br>±0.25% | DP” ZAPORIZHZHIASTANDARTMETROLOGY Ltd. ”Standart methodology | 25.05.10<br>25.05.10<br>25.05.10<br>25.05.10<br>25.08.10 | 2<br>2<br>2<br>2.<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | IRVIS-K-300, KPLG-1,02PV | K.-Karogo st., 21b | NPP «Irvis» Russia<br>„Radmirteh” Ltd.Ukraine | №5894<br>№02842 | ±1%<br>±0,5 % | Ltd. ”Standart methodology | 08.06.10<br>08.06.10 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01G-65-A1, KPLG-1,02R | Chervonopolyanska st., 2 | Ltd. VKF„Kurs” Ukraine<br>„Radmirteh” Ltd. Ukraine | №02168<br>№01978 | $Q_{min}$±2%$Q_{max}$<br>±1%<br>±0,5 % | Ltd. ”Standart methodology | 17.06.10<br>17.06.10 | 2<br>2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Delta-2040-40, KPLG-1.02R | Ceglna st., 8 | DP „Aktaris” Ukraine<br>„Radmirteh” Ltd. Ukraine | №K529680301<br>№02905 | $Q_{min}$±2%$Q_{max}$<br>±1%<br>±0,5 % | Ltd. ”Standart methodology | 01.07.10<br>30.06.10 | 2<br>2 | Repair, additional calibration or replacement |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Natural gas, ths. $m^3$ | KURS-01G-160, KPLG-1,02R | Uralska st., 1 | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02157 №01707 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 14.05.09 18.09.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | GMS-G100-80; KPLG1,02R | 8 Bereznya st., 31 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №090626 №01529 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 01.07.10 30.06.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | KURS-01, KPLG-1,02R | Viyskbud st.,124b | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №02197 №01929 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 04.08.09 30.07.09 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | Kurs-01, KPLG-1,02R | Zustrichniy prov.,10 | Ltd. VKF„Kurs" Ukraine „Radmirteh" Ltd. Ukraine | №3961 №02944 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 01.07.10 30.06.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | RG-K-1/30 G-250, Tandem-TR | Panfyorova st.,146a | OJSC «Promprilad» Ukraine СПД „Bartosh" AP Ukraine | №0309 №0639 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 24.06.10 24.06.10 | 2 2 | Repair, additional calibration or replacement |
| Natural gas, ths. $m^3$ | GMS-G100-80, KPLG-1,01 | Khorticke shose st., 4 | TP factory «Arsenal» Ukraine „Radmirteh" Ltd. Ukraine | №030263 №00177 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 17.02.10 17.02.10 | 2. 2 | Repair, additional calibration or replacement |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Natural gas, ths. $m^3$ | IRVIS K-300, Gamma-Flow | Zadniprovska st., 7 | NPP «Irvis» Russia CHNPP „Softservice"Ukraine | №5456 №381 | $Q_{min}$±2%$Q_{max}$ ±1% ±1 % | Ltd. "Standart methodology | 20.05.10 20.05.10 | 2 2 | Repair, additional calibration or replacement |

*Table An.3.2. Controlling and measuring equipment for fuel registration*

| Measured parameter | Type | Place of location | Producer | # | Accuracy | Calibration organization | Date of the last calibration | Calibration interval, years | Procedure for handling cases of failure |
|---|---|---|---|---|---|---|---|---|---|
| Electric power | ZMD410CR44 | Boiler-house Hakaska st., 4 | Landis&Gyr Switzerland | №94655726 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 4 quarter. 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Hakaska st., 4 | Landis&Gyr Switzerland | №94655728 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 4 quarter. 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Shasliva st., 2a | Landis&Gyr Switzerland | №94929328 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter. 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Shasliva st., 2a | Landis&Gyr Switzerland | №94929327 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter. 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Tovariska st., 47 | Landis&Gyr Switzerland | №94929388 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter. 2007 | 6 | Check parameterization or replacement |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Electric power | ZMD410CR44 | Boiler-house Tovariska st., 47 | Landis&Gyr Switzerland | №94929387 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter. 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Dnipropetrovs ke shose, 11 | Landis&Gyr Switzerland | №94222075 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter. 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house . Dnipropetrovs ke shose, 11 | Landis&Gyr Switzerland | №94222076 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter. 2007 | 6 | Check parameterization or replacement |
| Electric power | CTK3-10Q2H4K4 | Boiler-house . 40 rokiv Zhovtnya st. | Telecar-pribor, Ukraine | №11849 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 4 quarter. 2009 | 6 | Check parameterization or replacement |
| Electric power | ZMG410CR44 | Boiler-house 40 rokiv Zhovtnya st. | Landis&Gyr Switzerland | №96750143 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter в. 2010 | 6 | Check parameterization or replacement |
| Electric power | CA4У-И672M | CHSS Lenina st., 135 | Russia | №605737 | 2,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter 2007 | 4 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Admirala Nachimova st., 4 | Landis&Gyr Switzerland | №94222072 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Admirala Nachimova st., 4 | Landis&Gyr Switzerland | №94222073 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Citrusova st., 9 | Landis&Gyr Switzerland | №94339355 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Citrusova st., 9 | Landis&Gyr Switzerland | №94339356 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Electric power | STKZ-05Q2T3M | Boiler-house 40 rokiv Zhovtnya st. | Telecar-pribor, Ukraine | №46909 | 0.5 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | STKZ-05Q2T3M | Boiler-house 40 rokiv Zhovtnya st. | Telecar-pribor, Ukraine | №20058 | 0.5 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Artema st., 79a | Landis&Gyr Switzerland | №96076247 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2quarter 2009 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Artema st., 79a | Landis&Gyr Switzerland | №96076248 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 2quarter 2009 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house H. Stalingradu st., 2a | Landis&Gyr Switzerland | №94929358 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house H. Stalingradu st., 2a | Landis&Gyr Switzerland | №94832502 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS H. Stalingradu st., 24a | CJSC "Mintep", Ukraine | №16626 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS H. Stalingradu st., 24a | CJSC "Mintep", Ukraine | №16627 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS H. Stalingradu st., 38-a | CJSC "Mintep", Ukraine | №16640 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS H. Stalingradu, 38-a | CJSC "Mintep", Ukraine | №16652 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Paramonova | Landis&Gyr Switzerland | №94358893 | 1,0 | OJSC "Zaporizhzhiaoblenergo" | 3 quarter 2007 | 6 | Check parameterization |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | st., 19 | | | | LLC SPE “Asuenergoprom | | | or replacement |
| Electric power | ZMD410CR44 | Boiler-house Paramonova st., 19 | Landis&Gyr Switzerland | №94358895 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS Pivnichnokilceva st., 21-a | CJSC “Mintep”, Ukraine | №16648 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS Pivnichnokilceva st., 21-a | CJSC “Mintep”, Ukraine | №16637 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Ushakova st., 251 | Landis&Gyr Switzerland | №94339408 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Ushakova st., 251 | Landis&Gyr Switzerland | №94339416 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Ushakova st., 251 | Landis&Gyr Switzerland | №94339415 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 3 quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-08 | Boiler-house Bilkina st., 27-a | CJSC “Mintep”, Ukraine | №04856 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 4 quarter 2005 | 6 | Check parameterization or replacement |
| | | | | | | | | | |
| Objects on which you the installation of the frequency converter is planned in 2011 – 2012 | | | | | | | | | |
| | | | | | | | | | |
| Electric power | ZMD410CR44 | Boiler-house Chubanova st., 3 | Landis&Gyr Switzerland | №94655720 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 2quarter 2007 | 6 | Check parameterization or replacement |
| Electric power | ZMD410CR44 | Boiler-house Chubanova st., 3 | Landis&Gyr Switzerland | №94339409 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 3quarter 2007 | 6 | Check parameterization or replacement |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Electric power | Delta 8010-02 | CHSS Chumachenko st., 5-a | CJSC "Mintep", Ukraine | №16650 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS Chumachenko st., 5-a | CJSC "Mintep", Ukraine | №16651 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | СА4У-И672М | CHSS Pivnichnokilceva st., 18-a | Russia | №16648 | 2,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 4 | Check parameterization or replacement |
| Electric power | СА4У-И672М | CHSS Pivnichnokilceva st., 18-a | Russia | №16648 | 2,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 4 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS Paramonova st., 11-б | CJSC "Mintep", Ukraine | №15836 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-02 | CHSS Paramonova st., 11-б | CJSC "Mintep", Ukraine | №15826 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-08 | CHSS Paramonova st., 12-a | CJSC "Mintep", Ukraine | №15443 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | Check parameterization or replacement |
| Electric power | Delta 8010-08 | CHSS Paramonova st., 12-a | CJSC "Mintep", Ukraine | №15455 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | -//- |
| Electric power | Delta 8010-08 | CHSS Magara st., 6-a | CJSC "Mintep", Ukraine | №15444 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | -//- |
| Electric power | Delta 8010-08 | CHSS Magara st., 6-a | CJSC "Mintep", Ukraine | №15445 | 1,0 | OJSC "Zaporizhzhiaoblenergo" LLC SPE "Asuenergoprom | 1 quarter 2008 | 6 | -//- |
| Electric power | Delta 8010-02 | CHSS Komarova st., | CJSC "Mintep", | №16636 | 1,0 | OJSC "Zaporizhzhiaoblenergo" | 1 quarter 2008 | 6 | -//- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 21-a | Ukraine | | | LLC SPE “Asuenergoprom | | | |
| Electric power | Delta 8010-02 | CHSS Komarova st., 21-a | CJSC “Mintep”, Ukraine | №16632 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 6 | -//- |
| Electric power | SA4U-I672M | CHSS Chumachenko st., 31-a | Russia | №670243 | 2,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 2 quarter 2008 | 4 | -//- |
| Electric power | SA4U-I672M | CHSS Chumachenko st., 31-a | Russia | №936778 | 2,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 4 | -//- |
| Electric power | Delta 8010-08 | CHSS Ryazanska st., 13-a | CJSC “Mintep”, Ukraine | №16606 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 6 | -//- |
| Electric power | Delta 8010-08 | CHSS Ryazanska st., 13-a | CJSC “Mintep”, Ukraine | №16604 | 1,0 | OJSC “Zaporizhzhiaoblenergo” LLC SPE “Asuenergoprom | 1 quarter 2008 | 6 | -//- |

*Table An.3.3. Controlling and measuring equipment for electricity registration*

**Level of uncertainty and errors**

Possible uncertainty and errors for such type project may arise from two main reasins: measurement and stipulation. Measurement error is due to metering equipment inaccuracies. Stipulation occurs when some values are required to complete calculations, but these values cannot be measured directly. In these cases estimates are used in place of actual measurements, and therefore error may be introduced. The stipulation error itself may be estimated based on the expected accuracy of the stipulated values.

The project error can be calculated from the two error components described above. The total project error (Standard Error, SE) can be calculated by taking the square root of the sum of the squares of the individual error components, as below:
$SE = \sqrt{[(\text{measurement error})^2 + (\text{stipulation error})^2]}$

The monitoring plan developed for this project does not rely on any estimates and is therefore free of any stipulation errors.

Thus, $SE = \sqrt{[(\text{measurement error})^2 + (0)^2]} = (\text{measurement error})$

Although the project has 20 monitoring points, only four of these (quantity of natural gas consumption, power consumption, power production on the new CHP and heat production on the new CHP+ HPS unit) are measured directly. The remaining monitoring points used in calculation of the baseline and project line emissions are taken as statistic data. Furthermore, they are used for adjustment factors calculation. Calculations of adjustment factors are based on reported and base year parameters ratio. For example, temperature change factor is calculated as ratio of inside and outside temperature differences in reported and base years: $K_2 = (T_{in\,r} - T_{out\,r}) / (T_{in\,b} - T_{out\,b})$. Therefore any error in statistic data will be cancelled.

The four measurement errors (maximal values) which impact on the Standard Error and their level of accuracy are presented in Table An.3.4.

| ID number and data variable | Measurement error (maximal) | Comment |
|---|---|---|
| 1. Natural Gas consumption | ± 1.0% | Accuracy of data is high due to necessity of information for commercial account purposes. |
| 18. Power generation by the new CHP unit | ±0.5% | Accuracy of data is high due to necessity of information for account purposes. |
| 19. Heat production by the new CHP + HPS units | ±1.0% | Accuracy of data is high due to necessity of information for account purposes. |
| 20. Power consumption | ± 0.5% | Accuracy of data is high due to necessity of information for commercial account purposes. |

*Table An.3.4: Measurement errors (accuracy) for standard error*

**Procedures for verification**

Measurement equipment (meters, correctors, flow meters, pressure sensors, etc.) that is subject to the state control should have the stamp of state inspection – DP "Zaporizhstandartmetrologia", and should be submitted for this in the prescribed manner. The enterprise has developed and agreed with the organization DP "Zaporizhstandartmetrologia" the schedule of calibration. Calibration procedure is in conformity with the state standards.

## Monitoring of environmental impacts

As the project involves rehabilitation of an existing district heating network leading to an improvement of energy efficiency and therefore better environmental performance of the system, and is not a new building project, no negative environmental impacts are expected, and therefore no formal environmental impact assessment is required by the relevant Ukrainian authorities.

There is therefore no need to monitor specified environmental impact indicators during implementation and operation of the project activities.

**Project Management Plan**

Responsibility for management and project implementation is imposed on the Head of the Board of OJSC "Oblteplocomunenergo" Barbarov Yuri Anatoliyovych. Mr. Barbarov Yu.A. has appointed a responsible person – Deputy General Director for Development of heat supply systems and energy efficiency of Concern "Mis'ki Teplovi Merezhi" Mr. Laiterman Igor Abramovych. State Concern "Mis'ki Teplovi Merezhi" is also responsible for project activities.
Possible obstacles and mistakes in project implementation should be identified and resolved personnel responsible Concern "Mis'ki Teplovi Merezhi"

Data collection for fuel consumption is providing in the following way:

1. All boiler-houses are equipped with gas flow meters.

2. Operators of all boiler-houses register the instrument readings in the paper journals "Journal of registration of boiler-house's operation parameters" every day.

3. Every day operators transfer values of gas consumption to dispatcher of the regional branch of Concern "Mis'ki teplovi merezhi" by phone.

4. Monthly they transfer the paper report to OJSC "Zaporizhgaz"

5. Regional branches transfer data to Production-Technical Department (PTD) of concern "Mis'ki teplovi merezhi" where they are storing and used for payments with gas suppliers.

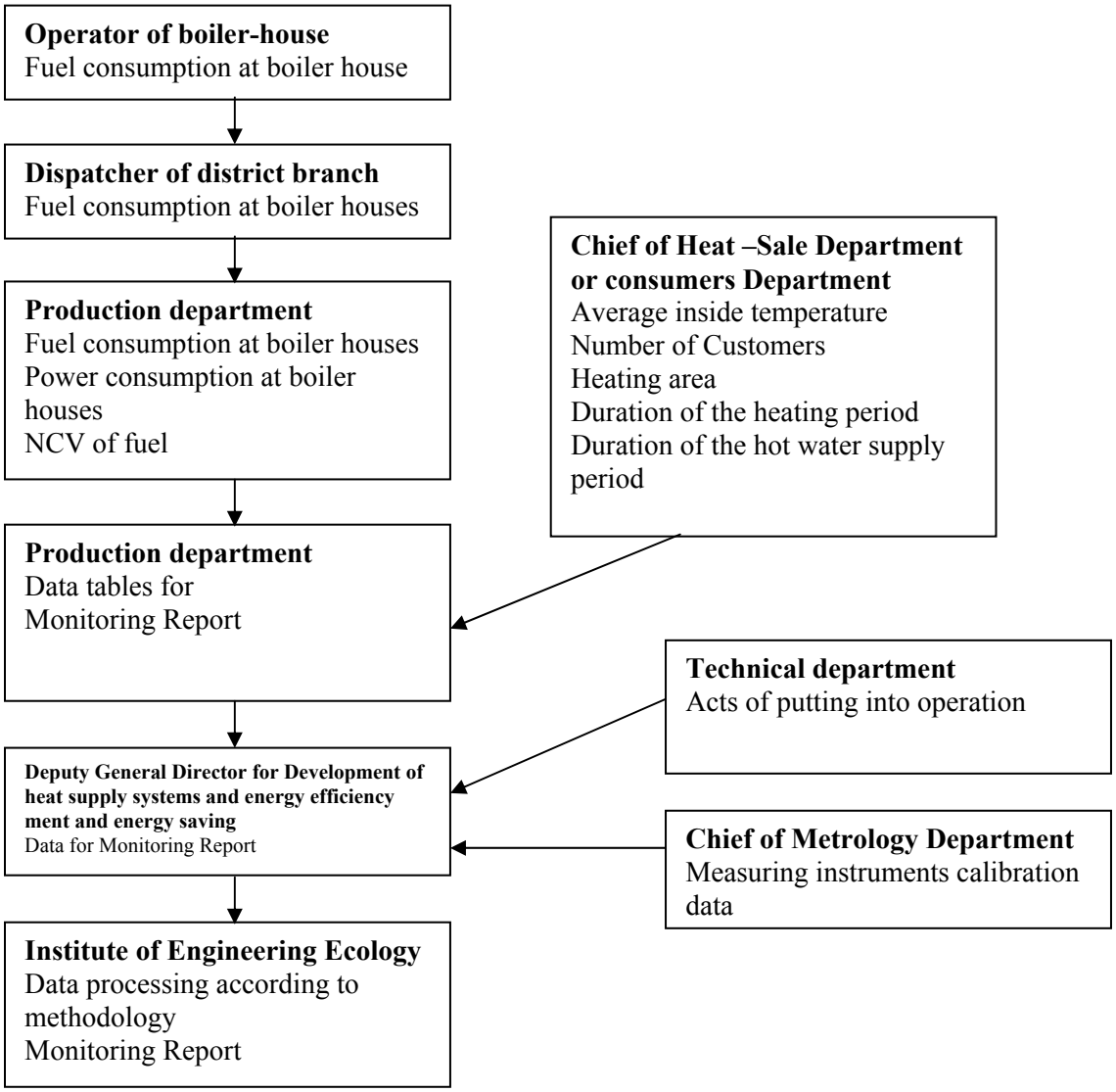


*Fig.An.3.3. Scheme of data collection for Monitoring Report*

Responsibilities for data management

All collected data will be transferred to Igor Laiterman, who will be responsible for data storage and archiving, entry of the data into the monitoring spreadsheets. Nonna Pavliuk will be responsible for the data processing according to methodology and for development of Monitoring Report. Support in co-ordination of verification process will be undertaken by Dmitri Paderno. Responsibilities for data management are presented in Table An.3.5.

| Activity | Responsible person | |
|---|---|---|
| | Name | Position and department |
| Collection and storage of data on fuel consumption and analysis of Net Calorific Value | Pylypchuk L.I. | Engineer of Production department of Concern |
| Collection and storage of data on electricity consumption | Blyznyuk S.I. | Senior engineer of Energy department of Concern |
| Collection and storage of data on verification of controlling and measuring equipment | Punyk V.A.<br>Morozov A.N.<br>Prokopenko V.V.<br>Kurbatov V.G.<br>Zhadovskaya T.V.<br>Tarutina A.K.<br>Kamenev I.V. | KVPiA section chief<br>KVPiA senior master<br>1 group foreman<br>chief engineer - metrologist<br>Technical supervision engineer<br>engineer - metrologist<br>KVPiA foreman |
| Collection and storage of data on environmental protection | Frolova G.P. | Ecologist |
| Repairs and emergency work | Semak Z.C. | Deputy Head of Technical Department of Concern |
| Collection and storage of data, filling in extended tables for the Monitoring Report | Pylypchuk L.I. | MS Concern engineer |
| Data monitoring and reporting, coordination of verification process | Laiterman I.A.. | Deputy General Director for Development of heat supply systems and energy efficiency of Concern |
| Data monitoring and reporting, coordination of verification process | Bardina O.O. | Head of the Legal security of economic activity Department of OJSC “Oblteplocomunenergo” |
| Data processing according to methodology, development of Monitoring Report | Pavliuk N.Yu. | Senior Researcher of Institute of Engineering Ecology |
| Support in coordination of verification process | Paderno D.Yu. | Vice Director of Institute of Engineering Ecology |

*Table An.3.5. Responsibilities for data management*

Monitoring methodology and equipment ensure the reliability of obtaining the necessary data to be monitored by measuring, since all these data are necessary for commercial payments and any failure will be removed as soon as possible.

All data to be monitored are available to Concern “MTM”.

**Trainings**

Concern "Mis'ki teplovi merezhi" (MTM) is constantly working on training, retraining and advanced training of all employees of Concern. To this purpose, the company established a center of production - technical training. The training programs are developed. To conduct studies to attract skilled employees Concern and teachers of other schools.

Training for managers and those responsible for operating the equipment is carried out with a periodicity of once per every three years in various fields with the participation of Derzhgirpromnaglyad.

Staff training on trades (where appropriate) to develop programs of production - theoretical and production - practical training and are equipped classrooms in the beginning of the calendar year in writing reports Concern regional administration Derzhgirpromnaglyad to conduct training at the plant this year.

All training is conducted in the light of normative - legal base in Ukraine. Engineers and technicians are certified on the knowledge of one every three years, workers are certified annually.

Since the main activity of Concern "MTM" will not change with the introduction of a JI project, special technical training for personnel are not needed. Technical staff of the company has adequate knowledge and experience to implement the project and repair conventional equipment.

In the case of establishing a new (this previously was not maintained at the plant equipment, such as: co-generation plants, etc.), equipment, manufacturer of the equipment shall conduct training for personnel.

During the development of JI project (from 2005), the specialists of the Institute of Engineering Ecology conducted extensive consultations and training for the involvement personnel of the Concern to collect the necessary data in accordance with the monitoring plan of the project.

Special training is scheduled to take place before the development of Monitoring Report in December 2010.

The special group was organized consisted of representatives of Concern "Mis'ki teplovi merezhi" and Institute of Engineering Ecology, in particular:

Laiterman I.A. – Concern "Mis'ki teplovi merezhi", Deputy General Director for Development of heat supply systems and energy efficiency of Concern

Kryvoruchko N.A. - Concern "Mis'ki teplovi merezhi", Head of Production and Technical Services

Pavlyuk N.Yu. - Institute of Engineering Ecology, Senior Researcher

Paderno D.Yu. - Institute of Engineering Ecology, Vice Director.

The responcible stuff of the Production-Technical Service of Concern "Mis'ki teplovi merezhi" is involved in this process.