APPENDICIES

REDUCTION OF GREENHOUSE GASES BY GASIFICATION

in Varna Municipality

JI Project Design Document

ERUPT 5

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Appendix 4: Plan for construction of gas distribution network (GDN) and facilities in Varna Municipality

	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total GDN, m	79 181	35 536	16 161	18 252	19 836	5 605	11 397		185 968
High pressure GDN (16 bar и 10 bar), m	10 908								10 908
Middle pressure GDN (4 bar), m	68 273	35 536	16 161	18 252	19 836	5 605	11 397		175 060
Facilities, units:	1 586	3 631	2 255	2 448	4 490	3 092	3 038	1 771	22 311
Gas regulation station	1	1		1		1			4
Facilities for public and administrative, and industrial sectors	66	90	76	24	93	4	7		360
Facilities for households.	1 519	3 540	2 179	2 423	4 397	3 087	3 031	1 771	21 947

Appendix 5: Number of the end users provided for gasification in Varna Municipality, by years and sectors

	2005	2006	2007	2008	2009	2010	2011	2012
Total number of consumers of natural gas (number)	**1 585**	**5 215**	**7 470**	**9 917**	**14 407**	**17 498**	**20 536**	**22 307**
Industrial sector	7	8	8	8	8	8	8	8
Public and administrative sector	59	148	224	248	341	345	352	352
Residential sector	1 519	5 059	7 238	9 661	14 058	17 145	20 176	21 947

Appendix 6: Prices of energy sources

Prices	*2002*	*2003*	*2004*	*2005*	*2006 – 2012*
Heavy fuel oil with VAT, EUR/kWh	0.0258	0.0277	0.0234	0.0234	0.0234
Industrial gas oil with VAT, EUR/kWh	0.0458	0.0485	0.0640	0.0640	0.0640
Price of electricity for household needs with VAT, EUR/kWh	0.0495	0.0616	0.0719	0.0755	0.0755
Heating energy price with VAT, EUR/kWh	0.0205	0.0236	0.0255	0.0280	0.0280
Natural gas price at AGRS without VAT, EUR/1000 m^3	124	119	114	116	111
Margin of natural gas transportation by gas distribution network without VAT, EUR/1000 m^3					
Industrial users			33	35	38
Public and administrative users			59	62	68
Residential users			104	109	118
Price of natural gas sold by "Varnagas" AD with VAT, EUR/1000 m^3					
Industrial users			176	181	179
Public and administrative users			208	214	215
Residential users			262	270	275
Price of natural gas sold by "Varnagas" AD with VAT, EUR/kWh					
Industrial users			0.0189	0.0195	0.0192
Public and administrative users			0.0224	0.0230	0.0231
Residential users			0.0282	0.0290	0.0296

Appendix 7: Company procedures of Overgas Inc. AD ensuring the quality in the operation, identification and removal of unregulated outflow of natural gas and measuring of natural gas

1. INSTRUCTION for monitoring and diagnostics of the technical conditions of the Distribution Gas Pipelines for natural gas leakages

The Instruction presents a method for monitoring underground and ground gas pipelines, equipment and installations in case of any breakage and leaking of natural gas, as well as their classification, depending on their potential danger and the undertaking of measures against leakage and for damage elimination.

2. **INSTRUCTION for measuring of the protection polarization potentials of underground metallic equipment, protected from soil corrosion by cathode and protector protection.**

This working document presents to the operational staff in the gas distribution enterprises the requirements and methods of measuring the protection polarization potentials of underground metallic pieces of equipment, protected from soil corrosion by cathodes of protector protection

3. INSTRUCTRION for technical servicing and repair of gas regulation points and boards and gas regulation and metering points and boards.

The intervals of time and the complex of operations for performing the preventive measures and repairs of the gas regulation points and boards and of gas regulators and metering points and boards are determined. The manner and the times for carrying out of inspections/calibration of metering devices used are also specified.

4. INSTRUCTION for the operation, servicing and maintenance of distribution gas pipelines and the appurtenant equipment.

It specified the activities of the operational staff for securing safe and emergency-free operation of gas pipelines and their maintenance and repairs in accordance with the Ordinance for the Structure and Safe Operation of the Transportation and Distribution Gas Pipelines of equipment, installation and apparatus for natural gas and the times for making the necessary metering.

5. INSTRUCTION for carrying out gas-risk operations

The Instruction supplies indications and determines the technical rules valid for all planned and emergency repair works on gas pipelines and pieces of equipment in the gas distribution networks which are executed in gas-containing medium or in which there is a danger of gas leakage.

6. INSTRUCTION for safety technology and fire safety in operation with SPOTLEAK 1005 deodorant.

The purpose of this Instruction is to make the operational staff of the gas distribution enterprises familiar with the requirements of safety technology and fire safety in operation with the SPOT LEAK 1005 deodorant in operation, health and environmental protection.

7. INSTRUCTION for the initial filling of the gas distribution network with natural gas.

The Instruction determines the required initial conditions, the participants and the technological sequence of works in filling the gas distribution network with natural gas.

8. INSTRUCTION for operation with repair brackets.

The Instruction shows the potentials of using and assembling repair brackets intended for temporary sealing of localized breakage and leakage in steel and polyethylene gas pipelines.

9. INSTRUCTION for operating with gripping tools for polyethylene gas pipelines.
The instruction supplies the technical rules in the operation with gripping tools (hand-screws) of polyethylene gas pipelines in operation for stopping the gas flow.

10. PLAN for the operation in case of the origination of a major production emergency in the gas transportation network in the territory of municipality
The plan includes the prevention of allowing any origination of emergency situations, prognostication of the nature and the aftermath of any emergencies in the gas distribution network, specifying the operations and the duties of the operational staff.

11. INSTRUCTION for residential users about the safe utilization of natural gas and the operation of installations and gas-employed devices.
The purpose of the Instruction is to acquaint the consumers (owners or users) with their obligations for safe work with natural gas of assembled installations and gas-using appliances in residential buildings.

12. INSTRUCTION for setting of gas regulation points and boards.
The Instruction includes instructions for the sequence and technology of operations carried out in setting the regulation and the safety equipment in the installations of the gas distribution network.

13. INSTRUCTION for putting into operation and subsequent monitoring of building gas installations of residential users.
The work document supplies the necessary instructions for the operational staff of the Distribution Enterprises in putting into operation and subsequent monitoring of the building gas installations of residential users.

14. INSTRUCTION for adjusting the reading of natural gas flow meter systems.
The purpose of this document is to give instructions about the transition to standard conditions for comparison in reading the supplied natural gas quantities to the users in the OVERGAS system.

15. COMPANY STANDARD for natural gas odoring.
The purpose of the Company Standard is to give a definition of the concept of odoring, the general requirements to means of odoring, the types of odorants, the safety measures and the inspection intervals for the determination of the odorant concentration in the Gas Distribution Network, and the odoring intensity intended to facilitate the detection of leakage in the Gas Distribution Network, the equipment, the installations and the natural gas appliances.

16. Operating Guidelines during breakdowns and emergencies
These guidelines stipulate the required actions and participants in cases of breakdown and emergencies related with the gas distribution network and end users' installations.

Appendix 8: Description of the automatic dispatcher system OVERCOMM 2.0.

The system OVERCOMM 2.0. consists of the following three main component parts:

1. Automation tools for the GDN:

- Adjusters of natural gas consumption with the following functions: calculation of gas consumption in standard units, recording emergency values of the technological parameters, 500 log books of hours, 20 log books of work shifts, 35 log books of days and 13 log books of months with entries of the consumption and technological parameters, 10 log books for emergency situations;
- Controllers of odorizing installations, which control the proportioning of odorant in the GDN and maintain records of the odorant consumption.

2. The system OVERCOMM 2.0 uses the GSM network as a carrier medium. The communications are organized in the following two flows:

- Reading of current values of technological parameters, hourly, shift, daily and monthly logbook entries by the gas consumption adjusters and the odorizing stations, as well as remote configuring of electronic devices is done following the initiative of the dispatcher center and is carried out through a switchable connection (the DATA CALL service) between a GSM communication module mounted on the gas unit and a GSM modem at the dispatcher center;
- The transmission of alarm signals about the above mentioned emergency situations is done following the initiative of the GSM communication module mounted on the gas unit to the dispatcher center by means of priority SMS messages. The high priority of SMS messages is guaranteed by an agreement with the GSM operator.

3. Software for automated dispatcher system with the following main functions:

- Automatic initiation of cycles for collection of logbook data from the equipment;
- Additional data gathering;
- Processing, recording and filing of alarm SMS messages;
- Automatic notification to the operator and the emergency response group about alarms;
- Recording the actions performed by the dispatcher staff;
- Automatic generation of information and analysis from the system database;
- Information export for further processing in CSV format;
- User identification with all tools of MS Windows ’98, NT4, 2000 and XP.

Natural gas balance for identifying leakages is done on the basis of filed data about the gas consumption at the input and output points of the GDN

Appendix 9: Data collected to perform monitoring (tracing the project activity)

ID	Data type	Data variable	Unit	Measured, calculated or estimated	Method of recording and filing	Recording frequency
1	Pressure /average per hour/	P	Bar	Measured	electronic	1 hour
2	Temperature /average per hour/	T	ºC	Measured	electronic	1 hour
3	Unadjusted consumption /per hour/	Vb	m^3	Measured	electronic	1 hour
4	Adjusted consumption /per hour/	Vn	Stm^3	Calculated	electronic	1 hour
5	Lower technological alarm level of pressure	LTP	Bar	Measured	electronic	Upon occurrence
6	Upper technological alarm level of pressure	HTP	Bar	Measured	electronic	Upon occurrence
7	Lower technological alarm level of temperature	LTT	ºC	Measured	electronic	Upon occurrence
8	Upper technological alarm level of temperature	HTT	ºC	Measured	electronic	Upon occurrence
9	Lower sensor alarm level of pressure	LSP	mA	Measured	electronic	Upon occurrence
10	Upper sensor alarm level of pressure	HSP	mA	Measured	electronic	Upon occurrence
11	Lower sensor alarm level of temperature	LST	Ω	Measured	electronic	Upon occurrence
12	Upper sensor alarm level of pressure	HST	Ω	Measured	electronic	Upon occurrence
13	Availability of supply voltage at the measuring units	OFF/ON	V	Measured	electronic	In case of change in condition (drop off/reoccurrence)

14	Alarm SMS from a consumer	ALARM C C-consumer code	Text	Measured	electronic	When a button is pressed
15	Gas losses from the GDN	ΔV	Stm^3	Calculated	electronic	1 hour
16	Availability of methane along the GDN route	% CH_4	ppm (VOL %)	Measured	electronic	**Steel:** $P_{operating} \leq 0,5$ MPa – 4 years $0,5 < P_{oper} \leq 1,6$ MPa – 2 years **PE-HD:** $P_{oper} \leq 0,01$ MPa – 6 years $0,01 < P_{oper} \leq 0,1$ MPa – 4 years $0,1 < P_{oper} \leq 0,5$ MPa – 2 years $0,5 < P_{oper} \leq 1,0$ Mpa – 1 year
17	Availability of methane in the facilities	% CH_4	ppm (VOL %)	Measured	electronic	3 months
18	Odorant concentration in the gas	C_n	mg/m^3	Measured	electronic	1 month
19	Gas odor intensity	THT/TBM	grate	Estimated	paper	1 month
20	Output electric current from the Cathodic Protection System (CPS)	$I_{изх}$	A	Measured	electronic	1 month
21	Output voltage from the CPS	$U_{изх}$	V	Measured	electronic	1 month
22	Polarization potential at a drainage contact point	$U_{пол.др.}$	V	Measured	electronic	1 month
23	Polarization potential at check points	$U_{пол.}$	V	Measured	electronic	1 month
24	Total potential in check points	$U_{с-з}$	V	Measured	electronic	1 month

Methods formeasurement of indicators and callibration of measurement appliances			
Measuring method	***Institution/function, which will take measurements***	***Calibration method***	***Calibration frequency***
Measuring of pressure, lower and upper technological alarm levels of pressure by means of transmitter for pressure with output 4-20mA	"Varnagas" AD	Comparison with standard pressure	1 year
Measuring of temperature, lower and upper technological alarm levels of temperature by means of platinum thermal resistance Pt100	"Varnagas" AD	Comparison with standard resistance	1 year
Measuring of non-adjusted volume of gas, by means of turbine, rotary, membrane or aperture consumption meter /to be selected depending on the consumer characteristics or the unit in the GDN	"Varnagas" AD	Comparison with standard consumption meter	2 years – for rotary and turbine ones 3 years – for membrane ones
Calculation of adjusted consumption by means of specialized electronic adjuster, in the configuration of which coefficients are set	P_{atm}, bar = average annual atmospheric pressure in the region; Tb=293,15 K Pb=101,325 kPa Kz – is set or calculated as per ISO 12213-2:1997 "Natural gas – calculation of compression factor. Part 2: Calculation using molar – composition analysis." Or as per document DVGW G9 "Calculation of natural gas factor /saturation factor / and the contractility factor".	Comparison with standard current signal and standard resistance /calibrator with standard current signal 4-20mA, decade with standard.	2 years

Methods formeasurement of indicators and callibration of measurement appliances			
Measuring method	***Institution/function, which will take measurements***	***Calibration method***	***Calibration frequency***
Measuring of lower and upper sensor alarm levels of pressure and temperature by means of electronic scheme included in the structure of the specialized electronic adjuster	"Varnagas" AD	Together with the adjuster calibration by means of comparison with standard current signal and standard resistance /calibrator with standard current signal 4-20mA, decade with standard resistances.	1 year
Measuring the availability of input current of the measuring unit by means of electronic scheme with reserved battery supply included in the structure of the communication device, which ensures the notification by a priority alarm SMS message through the GSM network	"Varnagas" AD	Checks of the daily communication between the measuring unit and the dispatcher center	1 day
Monitoring the condition of the alarm button by means of electronic scheme with reserved battery supply power included in the structure of the communication device, which ensures the notification by a priority alarm SMS message through the GSM network	"Varnagas" AD	Checks of the daily communication between the measuring unit and the dispatcher centre	1 day
Quantitative analysis of the contents of methane in the air by means of a specialized device with electro-chemical sensor	"Varnagas" AD	On a study punched gas pipeline, which provides controlled gas leakages within the sensitivity range of the device. It is conducted by the Gas Distribution Companies	3 months
Balance of input and output volumes for GDN and parts of the GDN – comparative analysis will be prepared	"Varnagas" AD	-	-

Appendix 10: Methods used in determining the consumption of natural gas at standard conditions

The standard (or base) conditions for comparison which are used for measuring the physical parameters (volume, density, etc.) of natural gas in Bulgaria are **293.15 K and 101.325 kPa**, in compliance with Bulgarian State Standard ISO 13443:1999 "Natural gas. Standard comparison conditions" and the General Terms for Concluding Contracts for Sales of Natural Gas, approved by the State Energy Regulatory Commission (SERC).

There are two possible approaches for obtaining the volume under standard conditions:

First approach: by using specialized devices called volume adjusters.

Second approach: by multiplying the volume read on the consumption meter counter by a fixed coefficient determined depending on the meteorological characteristics of the respective geographic region.

The choice of approach depends mostly on the maximum consumption and on the absolute pressure of natural gas in the measuring line.

In both cases the volume of natural gas under standard conditions is done applying the following formula:

$$V_{st} = V_p \frac{P}{P_{st}} \frac{T_{st}}{T} \frac{Z_{st}}{Z} \ldots\ldots \left(m^3\right)$$

where:

V_{st} $\left(m^3\right)$ - Volume of gas under standard conditions (293.15 K и 101.325 kPa), recorded by the adjuster or calculated manually by applying a coefficient;

V_P $\left(m^3\right)$ - Volume of gas measured as per the consumption meter counter;

P $\left(bar\right)$ - Absolute pressure of gas in the measuring line;

P_{st} $\left(bar\right)$ - Standard pressure (P_{st} = 1,01325 bar);

T $\left(K\right)$ - Absolute temperature of gas in the measuring line;

T_{st} $\left(K\right)$ - Standard temperature (for the Republic of Bulgaria T_{st} = 293,15 K);

Z - Over contractility coefficient under working conditions;

Z_{st} - Over contractility coefficient under standard conditions;

Z and Z_{st} – are either set, or calculated as per ISO 12213-2:1997 "Natural gas – calculation of compression factor. Part 2: Calculation using molar – composition analysis", or as per document DVGW G9 "Calculation of the gas factor (saturation index) and contractility coefficient Z ".

Accounting in case of availability of adjuster in the measuring device

The reading for V_{st} in m^3 (20 °C; 1.01325 bar) is reported for directly either by the electronic adjuster, or the consumption meter counter, in case it is equipped with embedded mechanical adjuster of temperature. The reported value accounted for, after deduction of the readings from the preceding report, constitutes the adjusted volume of gas, which the consumer has used during the respective period.

In case an adjuster is missing in the measuring device

For obtaining V_{st} in m^3 (20 °C; 1.01325 bar) the following formula should be applied:

$$V_{st} = V_p \cdot K_{tp} \ldots \left(m^3\right),$$

where:

$$K_{tp} = K_t \,.K_p$$

$$K_t = \frac{T_{st}}{T}$$ - temperatures adjustment coefficient;

$$K_p = \frac{P}{P_{st}}$$ - pressure adjustment coefficient

K_{tp} - coefficient for bringing the consumption meter readings into compliance with standard conditions- t = 20 °C and P = 1.01325 bar;

$V_p = V_{отч} - V_{пр.отч.} \quad \left(m^3\right)$

$V_{отч}$ *and* $V_{пр.отч.}$ - consumption meter counter readings during the preceding and the current periods reported;

The value of the adjustment coefficient K_{tp} is determined depending on:

- Natural gas temperature in the measuring line;

Atmospheric pressure (altitude above sea level) in the population area;