IMPLEMENTATION OF REMOTE MONITORING SYSTEMS AND COMMERCIAL MEASUREMENT

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ABSTRACT. Intelligent energy metering systems in the gas industry are innovative solutions with many advantages. Smart meters and systems are a method of modernization and automation not only in the industrial but also in the domestic sector. The system monitors and enables control of all activities. It provides an efficient and reliable bidirectional flow of data and information between the company and consumers. The basic principle in building smart energy metering systems is to integrate the metering devices into a single remote transmission system into a common database. From the consumer's point of view, this means correct accounting of the energy used and access to real-time information on natural gas consumption, which allows for corrections in current consumption and behaviour, resulting in high energy efficiency of homes and buildings.

Keywords: natural gas, automated control, metering device, energy efficiency

ИМПЛЕМЕНТАЦИЯТА НА СИСТЕМИ ЗА ДИСТАНЦИОННО НАБЛЮДЕНИЕ И УПРАВЛЕНИЕ НА СРЕДСТВА ЗА ТЪРГОВСКО ИЗМЕРВАНЕ

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РЕЗЮМЕ. Интелигентните системи за измерване на енергия в газовата промишленост са иновативни решения с много предимства. „Умните" измервателни устройства и системи са метод за модернизация и автоматизация не само в промишления, но и в битовия сектор. Системата следи и дава възможност за контрол на всички дейности. Тя осигурява ефикасен и надежден двупосочен поток от данни и информация между компанията и потребителите. Основният принцип при изграждането на интелигентни системи за измерване на енергия е обединяването на измервателните устройства в една единствена система за отдалечено предаване в обща база данни. От гледна точка на потребителя това означава коректно отчитане на използваната енергия и достъп до информация за консумацията на природен газ в реално време, което позволява корекции в текущото потребление и поведения, което води до висока енергийна ефективност на домовете и сградите.

Ключови думи: природен газ, автоматизирано управление, измервателно устройство, енергийна ефективност

Introduction

The smart metering device is an electrical device that records consumption at intervals of one hour or less and transmits this information at least once a day back to the information system of the gas distribution company for monitoring and invoicing purposes.

The main feature of intelligent measurement is the ability to provide finite customers more information about their energy consumption. According to a study by implementing Smart metering, end users can save between 5% and 10% of their energy consumption when such information is provided. [1] [2] [5] [6] [3] [9]

Intelligent measurement has the following characteristics: automated processing, transfer, management and use of measurement data; automatic control of the measuring device; two-way data communication with the measuring device; provides meaningful and timely information to the relevant countries and their systems; support for services that improve the energy efficiency of energy consumption and the energy system (generation, transmission, distribution and especially final consumption).

All intelligent commercial metering devices purchased for invoicing purposes in Europe must comply with the Measuring Instruments Directive [MID 2004]. This sets out the minimum requirements for fiscal meters, including their accuracy, divided into several different classes suitable for different market applications. The MID standard specifies the quantities that the gas flow meter must measure: In Energy (if this is provided by the calorific value of the gas); instantaneous flow (for ultrasonic and similar gas flow meters); Maximum demand. Smoothed consumption data approximating to the steady heat output (where the boiler is modulated through a simple on / off control).

All these qualities can be used as a resource to build a smart measurement scheme. For energy use feedback purposes, it is possible to provide additional information based on those measured quantities: Anticipation of the next account; transmission interval - 60 min; detailed data on customer behaviour; closing and opening the gas shut-off valve; remote gas stop; manual release of gas from the point of view of safety; dynamic tariffs; up to eight registers are considered in intelligent accounting for the UK [SMOF] specification, with a tariff set for each register; Availability of configuration options

on the Smart flow meter or the device that connects to it. [2] [3] [4] [10]

Feedback from users to receive information from smart meters can be done in several ways: the use of the Internet as a communication environment and the construction of a WEB-based application in which each user will have access to track their consumption, to receive historical information for the past period, etc.; the use of specialized devices in the home, through which the consumer will be able to receive various information about his consumption; the transmission of data from the smart measuring device to a specialized device (display) in the home is a relatively new approach and will require the application of new technologies. This implies the need for a LAN (Local Area Network) to support this feedback, where the location of the meter is not suitable for direct customer feedback. This LAN can provide a number of other functions as well as display streaming data; providing connection to other utility measuring devices; providing connection to the home device (display); When using the devices described above, the following specifics must be taken into account: the quality of the display, what color range it will contain; the power supply of the displays; batteries for single use; rechargeable batteries; direct power supply from 220V network.

Some of the functions of the specialized device for the home are: information about the calorific value of the gas; sound signal when an alarm occurs; communication signal level information; information on the degree of discharge of the battery power supply; sending an alarm / event signal; overflow warning; tariff information; historical data for the past period; energy consumption and its price expression; The effectiveness of the final customer feedback includes a balance of price and quality. Data security and customer privacy.

- The first and most important condition for intelligent measurement systems is considered to be data security and preservation of customer integrity. The user must be able to decide individually how and by whom his personal data and consumption data (except for the minimum necessary for the implementation of regulatory requirements by the company) will be used and disseminated. Consent and full transparency in the collection of consumer information are required, and it is the company's obligation to provide this information (for a "reasonable" fee) upon request by the consumer.

- Taken out of context, it can be concluded that the provision of information on the consumption of household customers once a month is considered sufficient. The same must be free of charge and can be done through various channels (SMS, customer service center, Internet-based, etc.). For paper accounts, companies may require a "reasonable" fee. The information must be presented in detail and in an understandable form. It is explicitly mentioned that the interval of actual reporting and the period of summary data provided to users differ.

- Provision of reports on current consumption and the resulting financial costs at the request of the client must be carried out through various information channels (SMS, customer service center, Internet-based, etc.) without additional fees. The same goes for access to historical consumption data.

- Remote interval reading and archiving of information in registers should facilitate a change of provider or changes in contract terms.

- Remote consumption monitors the actual consumption in a timely manner and eliminates the forecast and "balancing" bills and "based" bills.

- Development of new tariff formulas, according to certain periods and taking into account the volatility of consumption, at least on a daily basis. For this purpose and to avoid the processing of a large number of reported periodic data (hourly for example), it is recommended to have at least 3 time (ToU - Time of Use) registers, according to the national specifics of consumption. These registers can store time-based consumption, divided into, for example, peak / peak, normal and minimum consumption, or seasonal.

Regulatory framework in Bulgaria in the implementation of systems for remote monitoring and control of commercial metering devices

As part of the in-depth analysis of the current situation on the energy market, as well as the rules and frameworks for the activity of the gas distribution company, in the context of which this paper is prepared, a detailed analysis of the current state of regulations, current laws, decisions and standards was made. including: Energy Law, Promulgated, SG no. 107 of 9.12.2003, last ed. no. 56 of 24.07.2015 Ordinance on the essential requirements and conformity assessment of measuring instruments Ordinance on the essential requirements and conformity assessment for electromagnetic compatibility, adopted by Decree № 76 of the Council of Ministers of 2007 (promulgated, SG No. 32/2007, amended, SG No. 50/2014) The Technical Requirements for Products Act (LTRP).

Ordinance № 6 of 25 November 2004, amended, no. 1 of 2012 for technical rules and regulations for design, construction and use of sites and facilities for transmission, storage, distribution and supply of natural gas;

Ordinance № 4 of 5 November 2013 on connection to the gas transmission and distribution networks - issued by SEWRC, Prom. DV. issue 105 of December 6, 2013.

Ordinance №2 of March 19, 2013 on the regulation of natural gas prices - Prom. DV. issue 33 of April 5, 2013, supplement DV. issue 17 of 28 February 2014, amended DV. No. 65 of August 25, 2015, amended. and ext. DV. issue 94 of December 4, 2015.

Ordinance № 3 of March 21, 2013 on licensing of activities in the energy sector, prom. DV. issue 33 of April 5, 2013 Rules for trade in natural gas - issued by SEWRC, Prom. DV. issue 59 of August 4, 2015.

Rules for granting access to the gas transmission and / or gas distribution networks and for access to the natural gas storage facilities - adopted by protocol Decision № P-1 of 14.03.2013 of SEWRC, Prom. DV. issue 36 of 16 April 2013, amended And extra. DV. No. 59 of 4 August 2015.

Rules for management and technical rules of the gas transmission networks, adopted by the State Commission for Energy and Water Regulation on the grounds of Art. 170, para 3 in conjunction with art. 21, para. 1, item 9 of the Energy Act with Protocol Decision № 124 of 19.08.2013 under item 4.

Rules for management of the gas distribution networks - adopted by the State Commission for Energy and Water Regulation on the grounds of Art. 171, para. 2 in conjunction with Art. 21, para. 1, item 9 of the Energy Act with Protocol Decision № 124 of 19.08.2013 under item 5.

Methodology for determining the eligible amounts of technological costs for transmission, distribution and storage of natural gas - adopted by protocol Decision № 117 of 16.07.2012 under item 3 of SEWRC.

Internal rules of SEWRC for work on complaints and requests for voluntary settlement of disputes under the Energy Act Transposed requirements in the Bulgarian legislation of DIRECTIVE 2004/22 / EC of 31 March 2004 on measuring instruments. Project for energy strategy of the Republic of Bulgaria until 2020.

Ordinance on the essential requirements and conformity assessment of measuring instruments, which introduces into the Bulgarian legislation DIRECTIVE 2004/22 / EC of 31 March 2004 (MID) on measuring instruments defines the requirements that each measuring device or system must meet, to be placed on the market. The annexes accompanying the directive define the basic concepts and essential requirements for end measuring instruments such as accuracy class, tolerances, climatic conditions and environment, mechanical and electromagnetic classes, resolution and sensitivity, stability, reliability, suitability, protection, additional information, tests, trials, etc. It is important to note that the directive does not currently cite requirements for ultrasonic flow meters and an addition is forthcoming. [10] [11] [12] [13]

There is currently a new Ordinance on essential requirements and conformity assessment for electromagnetic compatibility, which aims to introduce the provisions of Directive 2014/30 / EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (OJ L 96/79 of 29 March 2014). The new elements in Directive 2014/30 / EU, and respectively in an ordinance, are related to the introduction of more detailed provisions on the obligations of economic operators and the traceability of products throughout the supply chain to facilitate market surveillance.

The Ordinance on the essential requirements and conformity assessment of equipment and protection systems intended for operation in potentially explosive atmospheres, which introduces into Bulgarian legislation Directive 94/9 / EC (ATEX) defines parameters for equipment related to explosion and accident protection. Many of the smart flow meters offered and implemented in Europe meet the requirements of the regulation to varying degrees (Zone 0, Zone 1 and Zone 2).

In Bulgaria, the transition to systems for remote monitoring and control of commercial metering devices (JTI) from a regulatory point of view is left entirely to the competence of the State Commission for Energy and Water Regulation. One of the few actions of SEWRC in this direction is related to the consideration of feasibility studies provided in 2013 by each of the three major electricity distribution companies in the form of a detailed cost-benefit analysis, assessed on the basis of experience gained from pilot projects. In preparing these models, the companies considered 2 scenarios: the first follows the set European targets of 80% coverage with smart meters by 2024, in the second, each company follows its own investment program. The obtained results are grounds for decision №IS-1 from 31.07.2013 of SEWRC, in which the regulator concludes that the introduction of intelligent systems for measuring electricity at the moment is economically unjustified.

Accordingly, given the lack of a positive assessment, SEWRC does not prepare a mandatory schedule for the introduction of smart metering systems in Bulgaria, but only recommends the introduction of smart metering systems up to 20%, but not less than 10% by 2021. As their introduction must be financed with public funds under European programs, which does not lead to an increase in the prices of end customers.

Practical application and benefits of the implementation of systems for remote monitoring and control of commercial metering devices (Smart Metering)

Table 1. *Practical application and use of the data obtained from systems for remote monitoring and control of commercial metering devices.*

Temperature in Celsius °C	***t°***	***t°***	***t°***	***t°***
	2	***3***	***4***	***5***
	14.4.2020	**15.4.2020**	**16.4.2020**	**17.4.2020**
8:00	14,2	1,3	1,6	5,9
9:00	13,9	1,6	4,8	8,8
10:00	15,7	2,3	8,0	12,9
11:00	19,3	3,4	10,2	16,8
12:00	19,5	4,4	12,3	19,1
13:00	18,6	4,8	13,7	20,6
14:00	18,9	5,0	15,2	21,8
15:00	19,6	4,8	16,0	22,6
16:00	19,1	4,8	16,9	23,0
17:00	17,4	5,3	17,1	23,2
18:00	15,3	5,6	16,7	22,7
19:00	13,9	4,9	15,5	21,5
20:00	12,5	3,6	12,4	17,7
21:00	11,1	2,6	9,7	15,0
22:00	10,3	1,4	8,5	12,5
23:00	8,7	1,2	7,3	11,1
0:00	3,5	1,2	7,0	15,5
1:00	5,2	0,7	6,9	12,8
2:00	4,6	0,7	6,1	11,9
3:00	3,9	0,6	6,0	11,6
4:00	3,1	0,4	5,9	11,4
5:00	2,1	0,1	5,9	10,9
6:00	1,6	-0,4	5,4	10,9
7:00	1,1	-0,5	5,2	10,1
MAX t°	***20***	***6***	***17***	***23***
MIN t°	***1***	***-1***	***2***	***6***
Average t°	***11***	***2***	***10***	***15***

sum t°	*308*	*71*	*268*	*421*
Total m3	*135 340*	*186 624*	*138 869*	*105 392*
Representative caloric	10,535	10,535	10,535	10,535
	Nm3	Nm3	Nm3	Nm3
	2	*3*	*4*	*5*
Consumption in Nm3	14.4.2020	15.4.2020	16.4.2020	17.4.2020
8:00	6 194	8 710	9 187	6 411
9:00	6 354	9 802	9 032	6 140
10:00	6 752	9 402	8 486	5 836
11:00	5 375	8 878	7 654	5 680
12:00	5 178	8 428	6 803	5 382
13:00	4 654	8 546	6 623	5 111
14:00	4 510	8 414	6 088	4 571
15:00	4 249	8 172	5 385	4 150
16:00	3 983	7 753	5 083	3 864
17:00	4 903	7 301	4 531	3 720
18:00	5 746	7 578	4 802	3 430
19:00	6 614	7 985	4 776	4 097
20:00	6 885	8 261	5 587	4 245
21:00	6 514	8 553	6 055	4 791
22:00	6 653	8 598	5 975	4 843
23:00	6 533	7 694	5 720	4 457
0:00	5 743	7 149	5 042	4 061
1:00	5 329	6 492	4 762	3 681
2:00	4 905	5 943	4 213	3 395
3:00	4 892	5 921	4 096	2 982
4:00	4 905	5 916	4 190	3 103
5:00	5 156	6 048	4 340	3 359
6:00	5 965	6 717	5 014	3 629
7:00	7 348	8 363	5 425	4 454
Тотал	**135 340**	**186 624**	**138 869**	**105 392**
16:00	**34 507**	**53 766**	**47 785**	**34 560**
%	**25,50%**	**28,81%**	**34,41%**	**32,79%**
23:00	**91 097**	**134 075**	**101 787**	**76 728**
%	67,31%	71,84%	73,30%	72,80%

In (Table 1.) the data obtained for four days from the "Smart" measuring devices and their use for balancing are considered. It is clearly visualized how the consumption of natural gas can be related to the ambient temperature and to predict the future consumption of a given consumer or gas distribution network.

Conclusion and conclusions for the implementation of systems for remote monitoring and control of commercial metering devices (Smart Metering)

In summary of the existing regulatory framework, it should be noted that there are extremely specific and specific requirements for measuring devices (gas flow meters and correctors), including tolerances, climatic conditions and environment, mechanical and electromagnetic classes, resolution and sensitivity, stability, reliability, suitability, protection, additional information, tests, trials, etc. These specific limitations and recommendations should be an integral part of the metering infrastructure.

Apart from the detailed parameters of the field equipment, the regulatory framework lacks mandatory regulated characteristics concerning the transmission environment and infrastructure, methods for data processing and transmission, time intervals, requirements for second-level devices for data archiving and buffering.

The normative documents describe only abstract basic requirements for the methods of visualization and presentation of data, and do not specify real technical solutions - be it a local display, a device connected to HAN (Home Area Network), web-based application and others. There are no mandatory requirements for the Head-End system that manages the automated remote reading, the database, redundancy, security and data storage periods, scalability, etc.

The official institutions of the European Union make recommendations and best practices for the construction of smart metering systems in the member states, avoiding the imposition of mandatory requirements and leaving the policy to national regulators.

The preparation of the CBA is in the interest of each contracting authority and it is desirable to prepare a separate report covering the economic justification of the project based on the proposed technical work provides solutions to provide clarity to each contracting authority about the expected capital and operating costs for construction and maintenance. of systems for remote monitoring and management of commercial metering devices (STI) and the expected economic benefits for each company.

From a regulatory point of view, regulatory requirements related to electromagnetic compatibility, frequency distribution and standards should be considered as legal restrictions on the system, in cases where RF and GSM / GPRS data transmission protocols will be used as part of AMI.

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