

LEAK REDUCTION AT NATURAL GAS COMPRESSOR STATIONS OF GAS TRANSITION SYSTEM OF THE UKRAINE

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PAPER ABSTRACT

Annual losses of gas together with gas leaks from components of gas transition system make thousand dollars in money terms. The department of ecology of "Cherkasytransgas" management has developed the project « the Program on energy saving and environmental protection » which has won the Ecolinks Partner's grant. The basic purpose of the project is to save gas due to gas leak reduction and accordingly to lower its influence on the environment.

The project includes: leaks detection and measuring, development of leak repair plan aimed on elimination of methane emissions, repair works followed by leak measuring and summarizing.

Works under the project were carried out in 2002 due to Ecolinks grant at two compressor stations: KS Zadniprovskaja and ?? Kremenchug of "Cherkasytransgas" together with "Indaco Air Quality Services, Inc " (USA). Leak measurement techniques were developed by " Indaco".

The results of measurements showed that methane loss from leakage at these two sites totaled over 2958 thousand of m³ per year. Measurements taken after implementation of the repair program demonstrated that gas leaks were reduced by 1954 thousand of m³ per year, which amounted 101,3 thousand of US dollars per one year, taking in account that 1 thousand of cub. meter costed 51,7 USD.

Payback period of the project is less than a year.

The project allowed not only to reduce gas leaks but also to estimate leak reduction and to determine the cost effectiveness of leak measurement and repair techniques. The works including quantitative gas leak measurements and estimation of real leak rates were carried out for the first time in Ukraine.

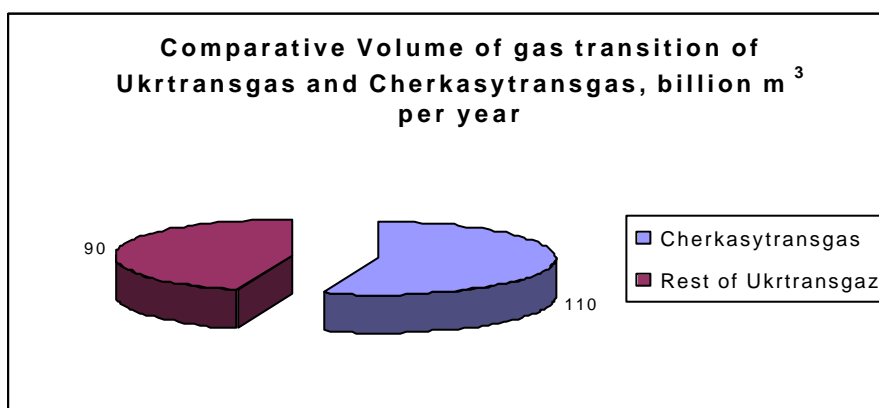
INTRODUCTION

Branch Company "Ukrtransgas" is the main « gas bridge » between Russia - the greatest gas extracting country and consumers in the countries of Central and Western Europe, which annually pumps over 190-200 billion m³

of gas. Ukraine is located in the center of Europe and borders Russia in the east and Poland, Slovakia, Hungary, Moldova and Romania in the west (photo 1).



Gas transmission system of Ukraine is the second on capacity in Europe after RAO Gazprom, including 35 thousand km of gas mains, 171 compressor stations. "Cherkasytransgas" is one of 6 divisions in the structure of Ukrtransgaz. More than 5 thousand kms of gas mains, 23 compressor stations, 191 gas distribution stations are on its balance. "Cherkasytransgas"



Management transports 100-120 billion m³ of natural gas annually (photo 2).

In case of emergency or infringement of a technological process the gas complex is considered to be an object of high risk, a potential source of environmental contamination.

Existing technological processes, moral and physical deterioration of the equipment at compressor stations and pipelines cause environmental contamination even under normal conditions of operation.

The main component of emissions in gas transmission system is natural gas containing 98% of methane. Methane is one of the most widespread greenhouse gases. Reduction of natural gas emissions is not only an environmental problem, but also a problem of energy saving. Losses of gas due to leaking components in money terms make hundred thousands US dollars per one year.

NARRATIVE PART

The department of ecology of " Cherkasyransgas " develops the project « Program on energy saving and environmental protection » .

The project was submitted to "Ecolinks" (USA) in order to win the Challenge partners' grant. 86 Ukrainian enterprises took part in competition and 7 of them, including our management, received the grant amounted to 50 thousand dollars. Due to the grant we managed to carry out the project together with our partner " Indaco Air Quality Services, Inc."(USA).

The main aim of the project is saving of fuel and energy resources, namely, gas leak reduction at compressor stations and gas mains, and also lowering of negative influence of emissions on an environment.

The project includes:

- 1) natural gas leak detection and leak measurements;
- 2) development of the work-plan for implementation of project activities directed on reduction of methane emissions;
- 3) leak repairs;
- 4) leak measurements after repair, estimation of results.

Work under the project was carried out at two compressor stations of Kremenchuk Linear Management together with " Indaco Air Quality Services, Inc." (photo 3, 4).



All the equipment of Compressor Stations and connection units selected for survey were screened for leaks using a combination of soap solution and natural gas electronic detectors. (photo 5).

Each leak found was tagged with Tyvek tag and assigned an individual leak number. Leak measurement techniques used by us were developed by " Indaco " and were used before in over 250 natural gas facilities of Northern America, Europe and Russia.

Each of these leaks was measured using three measuring techniques depending on the leak size.

- 1) Leak measuring using Hi-Flow Sampler (Indaco Air Quality Services, Inc)
- 2) "Vent-Bags" method " using calibrated bags made of anti-static plastic.
- 3) Leak measuring using anemometer.

The Indaco sampler makes leak rate measurements essentially using the same method as enclosure measurements but at a speed approaching

that of leak detection screening instruments. This sampler uses a high flow rate of air and a modified enclosure to completely capture the gas leaking from the component. A catalytic oxidation/thermal conductivity sensor is used to measure the sample concentration in the air stream through the system. The sampler uses only electronic components that are intrinsically safe. The error of the device does not exceed 10 % (photo 6). The Indaco sampler essentially makes rapid vacuum enclosure measurements so that emissions are calculated as follows:

$$Q_{CH_4} = F_{purge} \times (C_{main} - C_{back})$$

where:

Q_{CH_4} = leak rate of methane from the leaking component (cfm),

F_{purge} = the sample flow rate of the sampler (cfm),

C_{main} = the concentration of methane in the sample flow (percent), and

C_{back} = the concentration of methane in the background near the component (percent).

The background concentration must be subtracted from the main sample concentration because it may be elevated due to other leaks in the vicinity of the leak being measured. Variables such as wind speed and wind direction may cause the background concentration to fluctuate, so the background is measured simultaneously with the sample concentration. Indaco Sampler can make measurement with leak size up to 13,6 m³ / hour.

To make measurements on leaks bigger than 13,6 m³ / hour (which is typical for vents) we use fabricated calibrated bags of anti-static plastic of various sizes with a special neck to fit over vent openings (photo 7). These "Vent-Bags" were calibrated in Indaco laboratory. The bags were attached to the vent and the time required to fill the bags was timed using a stopwatch. The bag gas temperature and composition were monitored to correct the leak rate to standard conditions.

Using anemometer we measured the gas leak rate and the inner diameter of the leaking vent.

Results of measurements were entered into a spreadsheet.

169 leaks with a total leakage of 2209 thousand m³/year were found at Zadniprovsckaya compressor station.

112 leaks with a total leakage of 749,0 thousand m³/year were found at Kremenchugskaya compressor station.

The carried out analysis has shown, that 70 % of the total leakage at each site comes from 20 % of the leaking components.

An accurate catalogue of leak rates at a facility allowed repair efforts to be targeted where they were most cost effective. According to the leak data, focusing on the key leaks taking in account the technical opportunities the repair program for effective leak reduction was worked out.

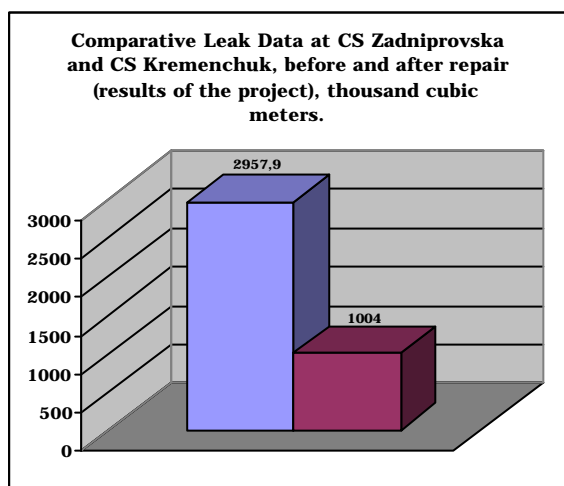
Basically repair works were carried out by our own forces. First of all there were eliminated the leaks demanding the minimal expenses and those

which didn't required the stoppage of the station – the bolts were tightened, the valves were closed fully.

The repair of big leaks, which required the stoppage of the station was done with regard to its economical effectiveness, comparing the repair cost to the cost of the lost gas.

After completion of works the leaks on repaired components were measured again.

The total leakage at two Compressor Stations was reduced by 1954 thousand of m³ per year that makes in money terms 101,3 thousand US dollars per one year at cost of gas of 51,7 US dollars for thousand m³ (photo



8).

Payback period of the project is less than a year and its total cost is 83 thousand US dollars. The cost of the project includes: purchase of Hi-Flow Sampler, consultant services of "Indaco", repair works, transport expenses, seminar expenses and publication of a booklet.

OUTCOMES OF THE PROJECT

The successful fulfillment of the project for the first time in Ukraine has allowed to conduct leak measurements using "Indaco" techniques and to estimate existing leak rates on equipment of natural gas compressor stations and to define the priority of components to be repaired and demonstrate feasibility of such repair. Within the project the gas leaks has been measured twice before and after repair.

Initial leak rate measurements have allowed to create leak database and in view of economic feasibility of leak repair to define the urgency of leak repair. The obtained database has enabled us to develop norms of technological leaks depending on wear and tear of the equipment, considerably to reduce maintenance expenses due to duly repairs, to define the places of the most probable leaks.

Measurements conducted after repair have allowed to define efficiency of repair and to provide the internal monitoring system.

The modernized " Indaco" instrument for leak measurement was bought at the expense of grant (photo 9).

According the completed work and outcomes of our project it has been recognized by Ecolinks the best one among the projects submitted by the companies of CIS countries. The article about the project is placed on "Ecolinks" site: www.ecolinks.org

PROMOTION OF THE PROJECT EXPERIENCE

In March, 2003 on Ecological Conference was held in National Joint – Stock Company "Oil and Gas of Ukraine" we reported on the results of the project works. One of the decisions of the Protocol accepted by the conference was to implement the experience of "Cherkasytransgas" in all divisions gas transition system of Branch Company "Ukrtransgas".

In June 24th,2003 Branch Company "Ukrtransgas" conducted the Seminar "Gas leak reduction in gas transition system of Ukraine"(Cherkasytransgas experience) in Cherkasy.

The specialists from all subdivisions of Branch Company "Ukrtransgas" took part in the Seminar. The issues concerning the practical implementation of our experience in the other Managements of main pipelines of Ukraine and support of "Ukrtransgas" management were discussed.

This year gas leak measurements have been continued at the sites of Cherkasytransgas. Measurements have been done at five compressor stations, linear valves, gas distribution stations (photo 10).

The repair works directed on elimination of leaks according to the registered leak data are in progress. After completion of repair works we'll conduct measurements again. In future we plan to conduct measurements at all compressor stations, gas distribution stations and linear valves, to create database for all the leaks and systemize them for planning of future repairs.