

ADJUSTMENT OF METERING PLACES FOR METERING OF VIBRATIONS OF ROTATING MACHINES FOR SECURING SAFE WORK PERFORMANCE

1 Case metadata

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2 Organisations involved

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3 Description of the case

3.1 Introduction

The basic mission of Eurostream, a.s. is to transport natural gas in Slovakia and through Slovakia to the European markets. To this end, they operate a large-scale high-pressure gas transmission system in the territory of the Slovak Republic. This transmission system represents an important energy link between the Commonwealth of Independent States (CIS) and the European Union. In other words, they are the main entry gate and the biggest highway for Russian gas in the EU. The business name "Eustream" is intended to reflect this specific role they have.

Since 1968, Eustream has secured the transmission of more than 2 trillion (2,128,000,000,000) cubic meters of natural gas across the territory of the Slovak Republic. The company therefore successfully continues the tradition of the Slovak gas industry, which dates back over 150 years.

The annual capacity of the transmission system operated and maintained by Eustream is more than 90 billion cubic meters, which equals roughly 15 times the overall domestic gas consumption of the Slovak Republic. This demonstrates how a large part of our work concerns international gas transit. In 2010, we actually transported 71.4 billion cubic meters of gas, which is about 14% of the total EU consumption.

Thanks to the continual modernization and upgrading of infrastructure, Eustream contributes to ensuring safe and reliable gas supplies to Central and Western Europe whilst doing its utmost to reduce the environmental impact of its activities.

The task of today is the safety of machines and workers performing work on the machines as well as in their surroundings. In addition, it is also the reliability and the prolongation of the life cycle of the machinery.

The basic indicator of metering and assessment of the state of the rotating machines, besides other things, is represented by machinery vibrations whose process of metering must comply with specifically prescribed technical standards.

Vibrations of any rotating machines are metered under their running. The metering places are determined by technical standards depending on the type of the metered equipment. These are mostly places close to most stressed parts, such as bearings.

Positioning of the sensor for vibrations metering has also its specifically defined rules.

During the walk inspection metering the diagnostician must comply with all these conditions. This is why it happens that by doing that he concurrently puts his health and safety in danger.



Figure 1. Former metering procedure

The diagnostician, who is to perform vibrations metering at all the metering places, must overcome several obstacles:

- Overcome physical and constructional obstacles of adjacent auxiliary equipment forming part of the facility;
- Withstand the high temperature impact during the metering;
- Metering is being carried out on the machine in operation, which produces noise;
- Some places are poorly illuminated;
- The risk of injury under insufficiently secured space (pipeline, spilt oil, etc.).

3.2 Aims

The purpose of the work was to propose such a system of metering of vibrations within the preventive maintenance of machines which would increase the **safety of personnel** executing the metering activities and decrease the risk of injury and bodily harm.

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A walk-through inspection metering of vibrations on the turbo-sets as well as other equipment brings along many risks in performing the work. The risk connected with bodily harm due to high noise levels of the environment, high heat loads, vibrations as well as risk of occupational injury due to hardly accessible metering places. The above has formed the basis for the task on the following solution.



Figure 2. Former metering procedure

3.3 What was done, and how?

For the sake of increasing the safety of service workers and decreasing the risk, Eustream proceeded towards the solution in two alternatives. Both alternatives considerably increased the safety at work as well as health protection.

Alternative 1:

The principle of metering preserved the walk inspection data collection, the solution is represented only in the adjustment of metering places.

The strategy of preventive maintenance has been implemented.

At a specific metering place a metering plate was positioned in the form of a square to which three sensors were fixed firmly in the vertical, horizontal and axial directions whereby conditions predefined by the metering requirement were fulfilled. The connecting cables of these sensors were installed into the switch box located at the closest safe place on the bearing pylon of the structure in the hall. From this place the diagnostician, metering engineer, can safely connect his metering device through a connector and read the actual vibration data of the machine. He is not exposed to any risk of high temperature, vibrations or any other danger.

Depending on the available equipment it is possible to concurrently collect vibrations from one, two or several sensors at a time. The presence of a worker within the risky area has been considerably

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reduced and the time spent within the area of operation (production) hall is shorter. In addition it will improve the quality of performance of the diagnostic metering by more stable fixing of the metering sensors.

Alternative 2:

This alternative applies the principle of strategy of predictive maintenance.

The sensors are steadily fixed on the relevant metering places and through cable connection they lead to the information net. The vibration metering takes place from all the metering places of the machine at the same time.

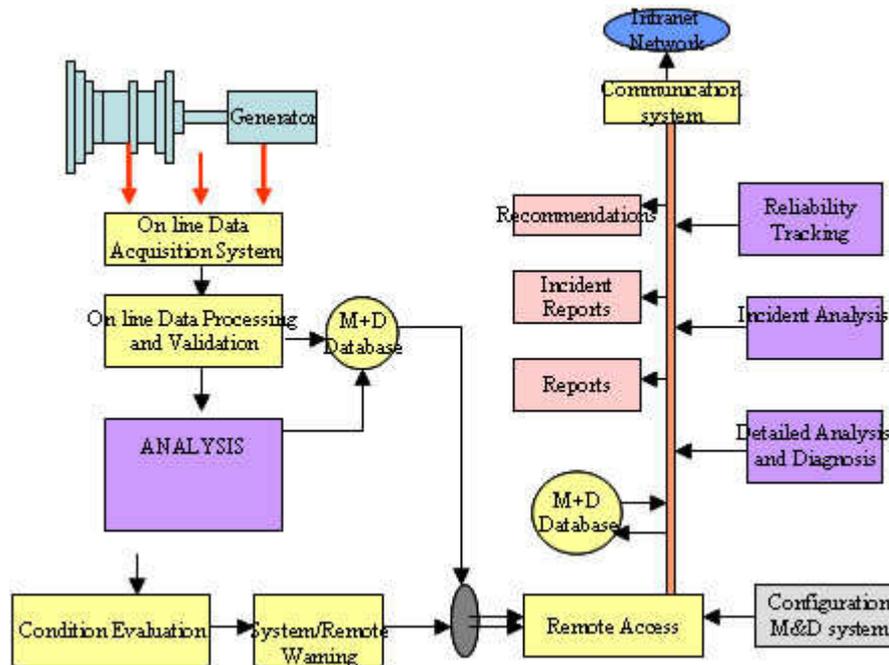


Figure 3. Information Flow

The remote communication enables transmission of all the metered data, independently of the distance, from all the machines, to the diagnostic centre, practically in real time, by means of a standard protocol TCP/IP using LAN or possibly WANS.

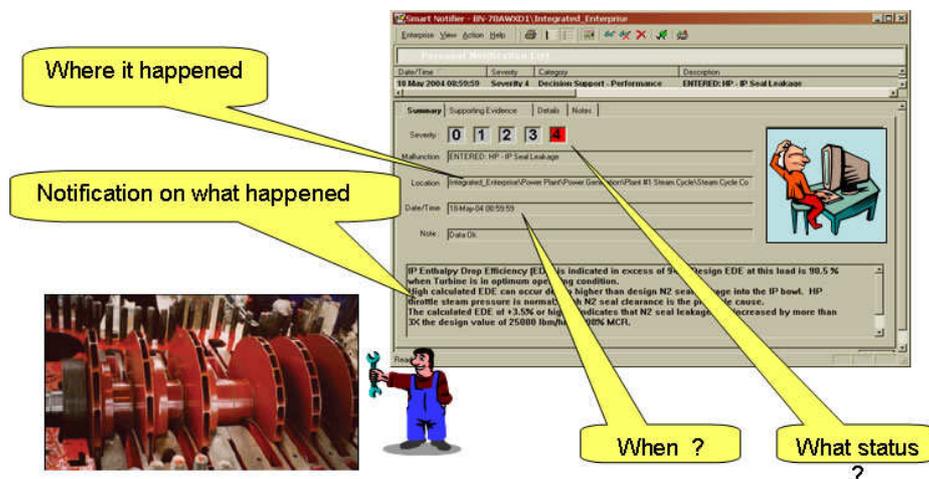


Figure 4. Monitoring system

In this way the diagnostician can comfortably, on his monitor, follow and evaluate the technical conditions of the equipment, as well as the functionality of the whole metering chain starting with the sensor.

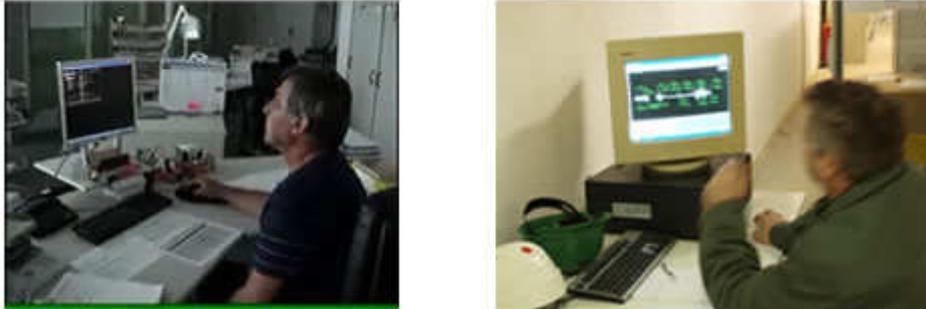


Figure 5. Remote monitoring of the machines

The worker is thus protected from the risk with which he otherwise has to cope when being present directly at the site of machines in operation. In case of working paces distanced from the centre he does not have to cover long distances in a motor vehicle.

The second alternative is financially more demanding, nevertheless brings along more information and benefits for safety, reliability, availability as well as effective operation of critical production facilities.

Both proposed alternative solutions will improve safety and health protection of workers implementing the diagnostic activities.

3.4 What was achieved?

By adjusting the metering places the following benefits have been achieved:

- Increased safety of workers implementing metering as well as increased safety of operation of the facilities;
- In case of alternative 1 the worker's presence at the site of machines in operation is shorter. He is not exposed to any risk of high temperature, vibrations or any other load danger, in case of alternative 2, he does not have to be present at the site of operation at all, which eliminates the risk altogether;
- Repair costs reduction;
- Machinery life increase.

3.5 Success factors

- In order to further improve operations, Eustream, a.s. has set up an integrated management system that focuses not only on the quality of their services, but also on environmental protection and occupational health and safety. The continuous endeavour to improve is also reflected in the ISO certification. Eustream is certified to comply with the requirements of the ISO 14001 and the OHSAS 18001 standards. In addition, the centralised maintenance section, covering maintenance activities related to all technical equipment and facilities, is certified to comply with the requirements of the ISO 9001 and ISO 3834-2 standards.
- They inspect the fulfilment of obligations in the field of health and safety at work in the form of regular internal audits carried out by their own professional employees.

- Among systematic and preventive measures for ensuring safety and protection of health at work, they focus on prevention and education, make periodic evaluations of harmful factors in the working environment and implement corrective measures.

3.6 Further information

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3.7 Transferability

Such solution is applicable in all permanent operations where the deployment of production facilities is high and activities outage would cause high economic losses, health or even life risks, as well as harm to the environment. It mostly concerns energy facilities, production lines with permanent operation, or meterings near conveyer belts with moving parts etc.

4 References, resources:

- <http://www.eustream.sk/>
- Information provided by the organisation in the framework of the Good Practice Award Competition 2010/2011.