

## RISK ASSESSMENT AND ACTIONS TO REDUCTION OF RISK IN EXPLOSIVE ENVIRONMENT

Tomáš PAULIČEK, Peter ČIČO, Juraj ZAUJEC, Marek BURDA  
Slovak Agricultural University in Nitra

### Abstract:

This article deals with assessment and risk reduction measures in explosive atmospheres, respectively of natural gas filling station CNG for cars, lorries and buses. The filling station was monitored for two years and FMEA have been applied to define and evaluate deficiencies, suggest corrective measures to reduce the number of failures in the system. Application of the method FMEA helped by identifying and minimizing the likelihood of failures in the system, which is of great importance from the viewpoint of preventing the occurrence of adverse events.

**Key words:** risk, disorder, FMEA, adverse event

### INTRODUCTION

Possible dangers of origin fire and explosion represent the parts of technological equipment, where during the production process participate combustible substances and those parts of the process equipment in which flammable substances are manufactured, blended, stored, pumped, refilled, exhausted or are consumed.

The gas filling station CNG are located various technological equipment's, parts of equipment and components that are exactly specified under the legislation as dedicated technical equipment involved in the functional technological unit. The CNG filling stations as the main used medium is natural gas that is compressed, pumped and distributed, and finally filled into tanks of motor vehicles.

Safety is a key term in the issue with deals the risks, their examination and minimizing. The safety of technical equipment is state of the technical equipment and method of its use, in which is not endangered safety and the health of the employee [3, 6].

The aim of paper is the exact specification of the monitored technological equipment, in which have been identified the failures for two years. Realize them quantify that would expresses the total amount of hazardous events with the possibility of explosion and fire. Of this amount of hazardous events determine the importance and the assign to individual dangers the criterion of seriousness. To identify the origin of the risk of explosion and fire equipment's that are operated in an explosive environment. Effectively manage the assessed risks and suggest remedies to minimize loss of property, lives and environment.

The actual evaluation of failures will be assessed and evaluated by FMEA method – Failure Modes and Effect Analysis – Analysis of failure modes and effects.

### MATERIALS AND METHODS

- **Characteristics of equipment:** gas filling station CNG for cars, lorries and buses.

Its focus is for processing, treatment, transport and filling of natural gas by designated technical equipment's, electric, gas and pressure.



Fig. 1. CNG dispensers - Greenfield A.G.

- **Evaluation of failures:** identification of hazards and threats the traced equipment's and in the performed activity, frequency and severity of failures, identifies the exact causes by method FMEA.

- **Propose of remedies:** Specification of design and exact remedies to eradicate and prevent the potential of origin risk of explosive environment in accordance with legal requirements and current legislation. (Laws, decrees, regulations and technical standards).

**Method of FMEA application:**

- Definition of the monitored system,
- Defining of the monitored subsystem,
- Determination of damaged part,
- Define the causes, resp. display of failure,
- Determination of failure effect,

- Determination of failure frequency,
- Propose of corrective actions leading to minimizing the likelihood of the failure origin.

**RESULTS AND DISCUSSION**

Applied method FMEA includes defined system and subsequently subsystem. Also defines the damaged parts, their symptoms/causes of origin and the consequences after possible origin of failure. Lists the number of failures over a period of two years and define corrective actions that lead to minimizing the likelihood of adverse events.

**Table 1**  
**The FMEA form**

System: gas filling station CNG						
No.	Subsystem	Damaged part	Cause/display of failure	Effect of failure	Num. of f.	Remedy (Corrective action)
1	Compressor station- compressor	rubber sealing O - ring on sump of compressor	vibrations of the compressor		11	
2	pressure-relief valve RAMSEYER	aluminium sealing ring	vibrations of the compressor, the different thermal construction changes	escape of gas, origin of explosive concentration	8	Training of work safety, personal protective equipment - respiratory filters, ventilation, space, fire procedure, suitable fire extinguishers S5, PG6
3	Quick coupler MGU BN	sealing parts of quick coupler MGU BN	Operator attention forgotten, connected dispenser gun in a motor vehicle, movement of the vehicle		15	
4	off pressurizing valve Böhmer Kugelhähne	aluminium sealing ring	vibrations of the compressor, the different thermal structure changes		3	
5	filling hose SWA-GELOCK CCNG	filling hose	low temperature causing rigidity and burst hoses, violent handling by operators, breakage of issuance gun screwing		8	
6	Throttle Böhmer Kugelhähne		Vibration of issuance stand, different heat changes of constructions, pressure changes in the system	escape of gas, origin of explosive concentrations injury of the operators	7	Control of equipment, operator training, personal protective , fire-fighting equipment
7	Safety valve ANDERSON	aluminium sealing ring	different thermal changes of constructions, pressure changes in the system		2	
8	Safety valve LESER	aluminium sealing ring	different thermal changes of constructions, vibration compressor		4	Training of health and safety, personal protective equipment –protect gloves, ventilation of space, first aid, suitable fire extinguishers S5, PG6
9	Electric valve LUCIFER		vibrations of the compressor	escape of gas, origin of explosive concentration	6	
10	Issuance stand CNG – GreenField A.G	sealing ring Cu	failure of electric motor conversor		5	
11	Issuance gun of stand GREEN FIELD	body of quick coupler transfer of hose and gun	unprofessional manipulation of operators, bad load of quick coupler	escape of gas, origin of explosive concentration, injury of the operators	18	Operator training, personal protective equipment, safety manual for customers
12	Suction equipment of air for venting of inside space issuance stand GreenField	intake velves	create ice on the intake airhole	cut-off of equipment, equipment is not under control at escape of gas, origin of explosive concentration, injury of the operators	5	

## CONCLUSION

Quality of a production process can be evaluated on the basis of product assessment of productivity and non-conformities. Critical elements (risk, threat, and danger) which are necessary to analyse closer and to define prevention (reduction) can enter to the manufacturing process. When assessing the process quality it is very important to place also the risk assessment [1, 4, 5].

The primary aim in risk assessment and risk reduction remedies in an explosive environment is the exact specification of traced technological equipment. Gradually, we come to determine the potential of damaged parts and their expression and result after origin of adverse occurrence. Was determined the number of arisen failures over a period of two years and to identify remedies leading to minimizing the likelihood of undesirable event.

Failure the most numerous part (18 failures) is a body quick coupler, transfer of hose and gun, which falls under the subsystem issuance gun stand GREEN FIELD. The second most failure numerous part (15 failures) are sealing parts of quick coupler MGU BN and the third part (11) is a rubber sealing O – ring on sump of compressor. In the form of FMEA here are nine other damaged parts that were damaged in two years less than ten times.

After application of remedies it is expected to reduce the number of failures of individual components which will be further examined.

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Ing. Tomáš Pauliček  
 doc. Ing. Peter Čičo CSc.  
 Ing. Juraj Zaujec  
 Ing. Marek Burda  
 Slovak Agricultural University in Nitra  
 Faculty of Engineering  
 Department of Quality and Engineering Technologies  
 Tr. A. Hlinka 2, 949 76 Nitra, SLOVAKIA  
 e-mail: t.paulicek@gmail.com