International Gas Union Research Conference 2011

GAS DISTRIBUTION NETWORKS: DEVELOPMENT OF AN INCIDENT ANALYSIS METHOD INTEGRATING TECHNICAL, HUMAN AND ORGANIZATIONAL FACTORS

Main author

O. Turc[1]

France

Co-authors

Y. Belec[1], P. Desideri[2], F. Loth[2], O. Mozar[1], M. Zarea[1]

France

[1]*GDF SUEZ – Research and Innovation Division, 361 avenue Président Wilson, 93 211 Saint-Denis-la-Plaine, France*

[2]*GrDF - 6 rue Condorcet, 75009 Paris, France*

1. Abstract

GrDF is the GDF SUEZ Group subsidiary responsible for operating the natural gas distribution network in France. It builds, maintains and operates more than 190,000 km of pipes serving 9,340 towns and 11 million customers, with a constant concern to improve reliability and safety.

In 2008, GrDF decided to revitalize and bolster its feedback process by involving and giving advanced training to all employees at its operating units, by expanding the range of events studied to include operating incidents and by deciding to include human and organizational factors in its analyses.

To that end, GrDF commissioned the GDF SUEZ Group's Research and Innovation Division to develop an analysis method that more fully involves the operators who actually experience the event so as to unearth the underlying causes of a greater number of events and to make the sharing of feedback more efficient.

This article describes the process implemented to develop the event analysis method, the method itself and its inclusion in the GrDF feedback process. After two years of use within the operational units, it has become clear that the method has helped to significantly improve risk management by promoting a better understanding of events and has helped bolster the safety culture among internal and external stakeholders.

CONTENTS

2. Introduction

GrDF is the GDF SUEZ Group subsidiary responsible for operating the natural gas distribution network in France. It builds, maintains and operates more than 190,000 km of pipelines serving 9,340 towns and 11 million customers. It strives at all times to ensure reliability and safety. Top management in GrDF puts safety at the heart of its performance.
So, GrDF's goal is to have zero victims – be they third parties, employees or contractors' employees - caused by incidents or accidents on the distribution networks it operates. Accordingly, collecting and analysing feedback from operational activities are key activities in the GrDF risk management process.
Historically, the feedback process was focused on collecting technical data pertaining to operational incidents, of which there are around 150,000 per year. Only accidents impacting on the health and safety of people were analysed, the other incidents were treated verbally during informal meetings specific to the local operational unit. The analyses were carried out using traditional methods, such as the fault tree, in the presence of the safety expert from the operating unit. This often resulted in a bias, prompting an investigation into the technical aspects of the event, while downplaying the role of the human and organizational aspects.
In 2008, as a part of its continuous improvement loop in terms of risk management, GrDF decided to revitalize and bolster its feedback process by involving and giving advanced training to all employees at its operational units, by expanding the range of events studied to include operating incidents and by deciding to include human and organizational factors in its analyses. To that end, GrDF commissioned the GDF SUEZ Group's Research and Innovation Division to develop an analysis method that more fully involves the operators who actually experience the event so as to unearth the underlying causes of a greater number of events and to make the sharing of feedback more efficient. This work was done in collaboration with the Chair of Industrial Safety at Mines ParisTech Engineering School.
This paper describes the process used to develop the event analysis method, the method itself, its initial pre-testing in the GrDF feedback process and its contributions after two years of deployment at GrDF.

3. Methodology used to develop the method

The method developed by the GDF SUEZ Group Research and Innovation Division needed to meet the following objectives:

- Enhance the collection of technical factors
- Enable the collection of human and organizational factors
- Enable an analysis of all such factors
- Enable the scaling-up of the feedback process

Historically, the feedback process focused on collecting technical data pertaining to operational incidents. Since 2000, collection has been systematic as soon as an incident is reported to GrDF. Data is collected as close as possible to the field by the operator involved in the incident. The feedback addresses around 150,000 incidents per year.
While the collection of technical information had already been decentralized – i.e. had been carried out as close to the field as possible – the analyses were centralized nationally and were carried out by a team of experts. The experts could either carry out general statistical studies or, in the case of accidents impacting on the health and safety of people, carry out analyses in the field. The information collected was and still is recorded in a national database.

This new method was developed in three phases:

- Phase 1: An initial diagnosis phase, at national level and in some operational units
- Phase 2: Development of the analysis method
- Phase 3: Communication and preliminary tests at national level and in some operational units.

Phase 1 (preliminary diagnosis) consisted of carrying out a series of interviews with functional managers at the national level and, at the regional units, with managers, operations supervisors and operators involved in the scheduled and emergency works on gas facilities. The aim of the initial diagnosis was to identify those factors that hold back and promote developments in the analysis method designed to enhance the collection and analysis of technical, human and organizational factors, and to place operators at the heart of the feedback process.

Phase 2 (developing the method) used as a starting point the results of the above-mentioned initial diagnosis. This resulted in dividing the method into two levels:

- Level 1 consists primarily of an exchange between managers and operators who actually experienced the event as close as possible to the incident. This sequence corresponds to a debriefing. It enables those involved to review the events experienced in a factual manner by collecting predefined exhaustive information. This sequence must facilitate transparency and establish confidence. Level 1 enables managers and other involved personnel to have access to the key information and a timeline of what happened before and after the incident - a basis for analysis – and to decide on whether or not to proceed to Level 2 (Detailed analysis). This level 1 is more related to management activities within GrDF and will not be detailed in this paper.

- Level 2 was developed by simplifying and modifying the CREAM[1] method [1] to bring it in line with the situation in the gas distribution industry. CREAM, developed by the E. Hollnagel, currently in charge of the Chair of Industrial Safety at Mines ParisTech Engineering School (Paris School of Mines), is used to analyze human and organizational factors in greater depth. This sequence is based on 9 Common Performance Conditions (CPCs) and the associated data. The CPCs describe how conditions under which activities are performed can influence the quality of operators' work.. Level 2 consist of collecting the relevant data to identify the CPCs and then analyzing these circumstances.

In Phase 3, the analysis method is presented to a few operational units for preliminary testing, with the help of guidelines for practical use. These few operational units used it in order to collect feedback from managers and operators, specifically with regard to the relevance of the data items that have to be collected and their interpretation sequences for actual incidents. The feedback from this preliminary testing phase was used to update the tool and improve its suitability to the purpose.

This close collaboration work between GDF SUEZ Research & Innovation, Mines ParisTech and GrDF was one of the key factors in the successful development of the analysis method.

4. Presentation of the analysis method developed

Phase 1 of the diagnosis was first used to validate a list of types of events to be analysed in line with GrDF's industrial safety objectives. It also made it possible to highlight the predominance of an oral culture leading to ongoing difficulties in collecting information and sharing the lessons

[1] Cognitive Reliability and Error Analysis Method

learned from feedback with as many people as possible, and ultimately all operators and managers in the entity or even GrDF as a whole.
The diagnosis also confirmed that the time reserved for the on-the-spot analysis – along with its lack of structure – resulted in analyses that were often overly brief, thus leading to quick consensus on the general technical causes. It also emerged that the new analysis method should make it possible to encourage listening to the parties involved, seeking out 'weak signals' and identifying factual conditions influencing human, individual and collective performance.

Based on observations made during the diagnosis, the decision was taken to divide the method into two levels in order to adapt it to the operation of a operational unit:

- Level 1 (on-the-spot analysis), to make it possible to collect the maximum amount of information as close to the event as possible, and then to structure that information so as to provide an initial level of analysis;

- Level 2 (detailed analysis), to make it possible to study the event in depth and in hindsight in terms of the technical, human and organizational aspects, with all of the stakeholders in the operating unit, or even – depending on the case in question and where possible – with the external stakeholders (excavating contractors, fire brigade, etc.).

Level 1 is not detailed in this paper because it corresponds more to a component of GrDF's management activities. Nevertheless, it made it possible to structure the on-the-spot analysis around the occurrence of the incident (before and after), highlighting the difficulties encountered and the major causes. This sequence also makes it possible to highlight good practices and protective measures used.

This sequence also resulted in expanding the technical information to be collected, specifically:

- the characteristics of the area around the incident scene: rural or urban, under a pavement, road, garden, waterway, etc.;
- the choice and justification of the emergency response strategy: valve manipulations, pipes squeezing for sealing purposes, etc.;
- the gas migration path possibly illustrated on a diagram, if necessary;
- the detailed characteristics of the gas installation and compliance with the procedures in case of damage caused during scheduled work.

Level 2 is a more in-depth analysis level. It goes into details before and after the incident to understand the origin of the incident and assess its importance.
The analysis is divided into 9 Common Performance Conditions (CPCs) and the associated data. CPCs describe how conditions under which activities are performed can influence the quality of operators' work. of The method consists of collecting the relevant data to identify the CPCs and then analyzing these circumstances, which are listed below:

- Working conditions
- Tooling
- Compliance with regulations and procedures
- Gas installations mapping and identification
- Workload
- Time management
- Adequacy of training and experience
- Team collaboration quality
- Technical management of the incident

Each CPC is broken down into specific items which the parties involved in the analysis – operators and managers from the operational teams in question – evaluate using a 5-level scale, ranging from highly unfavorable to highly favorable. In other terms, the positive or adverse effect of each item on either human and / or group performance is clearly visible. This approach helps to determine the underlying causes of the incident and any aggravating factors.

For example, the CPC dedicated "Working Conditions" is broken in three specific items:

- Working environment: for instance, it aims at describing if the operators could avoid working in blind conditions or adopting important postural constraints. It also deals with the workplace that could be free or busy (i.e. media, firefighters, Mayor, etc.)
- Personal protective equipments: it concerns the equipments availabilities and conditions (e.g. level of wear for safety shoes or protective glasses) and if they were correctly worn.
- Temperature, noise, lightness: it aims at describing if high heat, cold or frost has made the intervention harder. It can concern noise that may disrupt communication between operators. It can also concern a lack or an excess of brightness that may interfere with the operators.

Figure 1 shows an excerpt from an analysis for the Working Conditions (in French), taken from a software application developed specifically by GrDF and available on its intranet. The application is used to produce and share analyses.

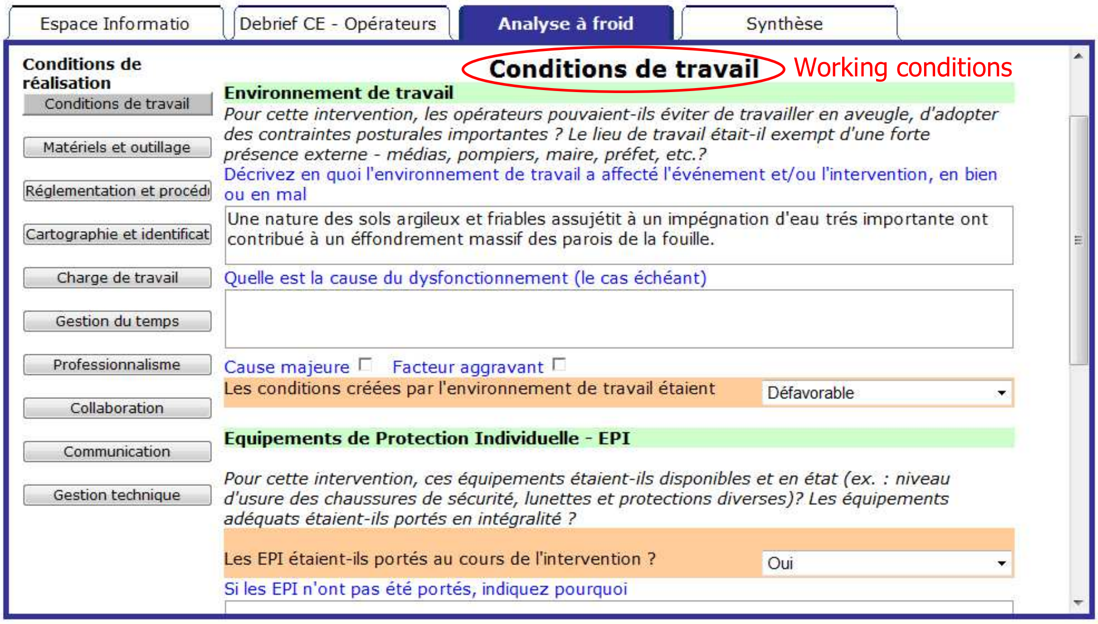

Figure 1: Screenshot of a sample Level 2 detailed analysis

At the end of the Level 2 analysis, there is a summary of what the participants entered into the system. The summary is created automatically in the application.

Figure 2 shows an excerpt from a summary (in French). Each comment entered during the analysis should help to identify underlying causes. A color code appears according to the note (i.e. red for unfavorable, blue for no impact or green for favorable). The participants have then to assess for each cause if it corresponds to a major cause or an aggravating factor.

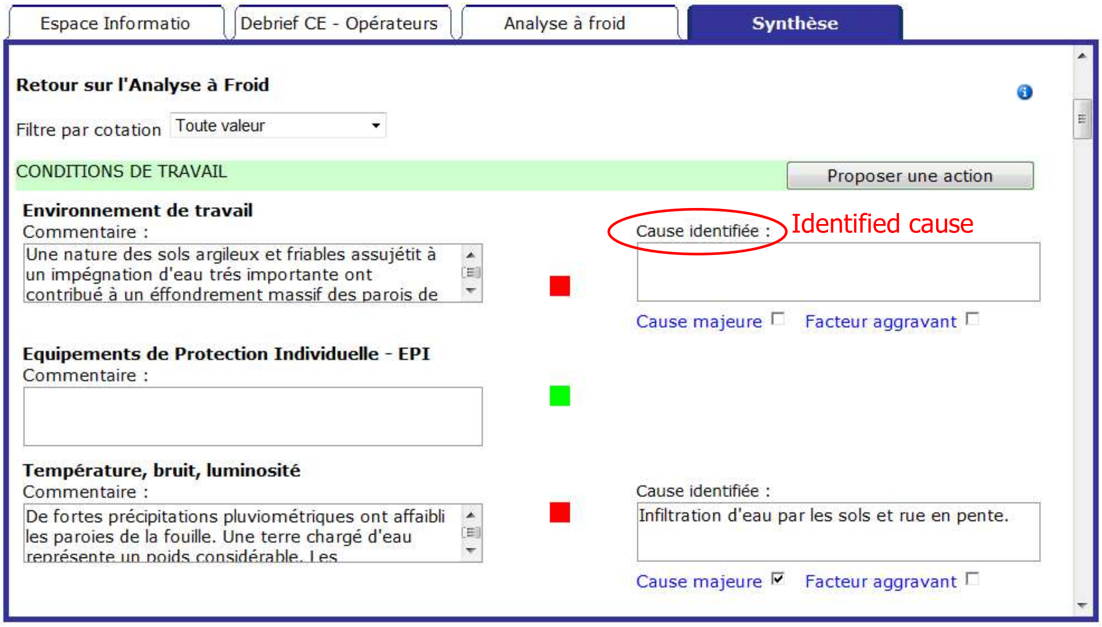

Figure 2: Excerpt from a sample summary of the two analysis levels

The Level 2 analysis forces the participants to think not just about the technical failures, but also about human and collective performance.

Taking account of human and organizational factors in analyses helped bring about a change of approach at GrDF when analyzing feedback. Shifting the analysis level from national entity experts to those involved and front-line managers also made it possible to scale up the feedback process and strengthen the culture of safety at all levels within the company.

5. Conclusion

This innovative event analysis method has been in use for two years in all GrDF operating units. It had been deployed company-wide over the intranet via OCEANIE[2], an application developed by GrDF.
The deployment of this innovative process, based on a new management method and a new method for analysing events, enhances risk management by improving the understanding of events, revitalizing the operations management improvement loop and promoting advanced training via sharing in teams and learning situations. The method has also led to more sharing of the safety culture between internal stakeholders (within the operating units) and external stakeholders (specifically excavation contractors and the fire brigade). Feedback is handled as close to the field as possible.
By directly involving the operators, this method has also made it possible to scale up the feedback process.
This upscaling and additional analysis depth illustrate how successful the collaboration between gas industry Research & Innovation, academic research and operating companies can be by delivering the adequate tools to help management decisions that aim to strengthen safety and reliability.

[2] Outil de Capitalisation, d'Echange et d'ANalyse des Incidents et Evénements [Tool for Building On Experience, Sharing and Analysing Incidents and Events]

6. References

[1] Hollnagel, E. (1998), Cognitive reliability and error analysis method. Oxford, UK: Elsevier Science.

7. List of Figures