Safety Information — Human Factors

Prepared by WG16 for the Safety Advisory Council

Safety Info HF - 03/25 (Revision of Info HF – 03/17)

Organisation

"Human Factors in Incident Investigation"

Human factors in incident investigation focuses on the management system failures and human failures that can make people lose control over hazards. To prevent or reduce the chance of such failures, we have to know what the failures are and what causes them. These failures often form a 'chain' that leads from people in the company who made decisions, long before an incident, to the person who seems to be immediately responsible. We need to understand this chain and be able to move logically forwards along it – to do risk assessments; and backwards – to do incident investigations.

Root causes are the underlying primary reasons for an incident.

Root cause analysis methods are a means of tracing the origins of incidents. They help organisations to learn from these experiences and indicate what steps to take to prevent future occurrences. Many incidents are blamed on the actions or omissions of an individual who was directly involved in operational or maintenance work. This typical, but short-sighted, response ignores the fundamental failures which create the situation leading to the incident. These are usually rooted deeper in the organisation's design, management and decision-making functions.

Active failures have an immediate consequence and are usually made by front-line people such as drivers, control room staff, cylinder fill operators or machine operators. In a situation where there is no room for error these active failures have an immediate impact on health and safety.

Latent failures are made by people whose tasks are separated in time or space from operational activities, e.g. designers, decision makers and managers. Latent failures are typically failures in the design, implementation or monitoring of health and safety management systems. Examples of latent failures are:

- Poor design of plant and equipment;
- Ineffective training;
- Inadequate supervision;
- Inadequate or insufficient preventative maintenance;
- Ineffective communications;
- Inadequate resources (e.g. people, time or equipment), and
- Uncertainties in roles and responsibilities.

Latent failures provide as great, if not a greater, potential danger to health and safety as active failures. Latent failures are usually hidden within an organisation until they are triggered by an event likely to have serious consequences.

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

EUROPEAN INDUSTRIAL GASES ASSOCIATION *AISBL*
AVENUE DE L'ASTRONOMIE 30 - B-1210 BRUSSELS
PHONE +32 2 217 70 98 s E-mail : info@eiga.eu - www.eiga.eu

Learning more about human factors in incident investigations

If the answer to any of the questions below is 'no', then you need to take action.

1. Are incident investigations carried out by multi-functional teams? ☐
2. Are one or more task performers included in the investigation team where appropriate? ☐
3. Do investigations recognise that incidents normally have more than one cause? ☐
4. Do investigations identify underlying causes, human factors and management systems failures? ☐
5. Do investigations recognise that there are different types of failures that involve human factors, and take appropriate remedial action (i.e. avoiding superficial answers, such as "mistake" rather than exploring the factors leading to that "mistake")? ☐
6. Do investigations of failures look for root causes involving human factors or performance influencing factors [10]? ☐
7. Are individuals ***only*** "blamed" when an incident investigation determines that they have knowingly breached a rule or procedure? ☐
8. Are the people carrying out investigations properly trained and do they collectively have the right skills and competence? ☐
9. Do identified corrective and preventative actions address human factors and management system failures? ☐
10. Are the investigation findings and actions communicated to similar facilities, within the company and where there are learnings, shared with industrial and medical gas associations? ☐

What can I do about it?

- Report all incidents, near misses, unsafe conditions and unsafe acts.
- Actively participate in incident investigations.
- Help to identify all causes of the incident including potential Human Factors.
- Ensure evidence from an incident is preserved for the investigation team.
- Help communicate the incident, findings and actions to fellow employees and contractors.
- Act on the actions identified from the investigation process.

What should my company do about it?

All EIGA member companies should have an incident management system in place and:

- Have a culture where it is 'safe' for people to report incidents; reporting is encouraged.
- Have a good system to allow personnel to report incidents.
- Have competent incident investigators, whose experience includes interview techniques to ensure all facts are revealed.
- Thoroughly and systematically investigate all incidents, ensuring that human factors are properly identified during root cause analysis of incidents (see reference list for examples of methods identifying human factors).
- Identify corrective and preventive actions that people accept and that are effective in addressing the human factor causes.
- Always act on the actions items identified by the investigation team.
- Communicate the outcomes of the incident investigations and completion of key

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

actions to relevant personnel.

- Have a system to follow actions to completion
- Use information from the investigation process to update risk assessments, procedures and training.
- Have a system of incident classification that considers the potential severity of the event, as well as the actual consequences and includes human factors classification of causes. [5, 6]

Investigating the causes of incidents.

Finding out both the immediate and the underlying causes of an incident is the key to preventing similar incidents through the design of effective control measures.
Investigations into the root causes and contributing factors of incidents, often make little attempt to find root causes of human failures [4, 5].
Examples of causes and contributing factors for human failures are given below:

Organisation factors

- Lack of visible safety leadership, in making decisions and setting priorities
- Managers' actions inconsistent with safety communications
- Lack of two-way communication between managers and employees
- Inadequate resource or poor work planning, leading to excessive workload
- Ineffective or missing safety systems and safeguards
- Inadequate or insufficient information, instruction or training
- Procedures not appropriate, accurate or current
- Ineffective change management
- Inadequate responses to lessons learned from previous incidents
- Poor co-ordination and unclear responsibilities including contractor selection and management
- Conflict or negative interactions within and between work teams

Task factors

- Illogical design of equipment and instruments
- Constant disturbances and interruptions
- Missing or unclear instructions
- Poorly maintained equipment
- High workload
- Noisy and unpleasant working conditions

Individual factors

- Low skill and competence levels
- Fatigue
- Lack of motivation
- Private personal, medical or family matters
- Stress and psycho-social issues

Other individual factors can be identified by questioning: knowledge, ability and willingness. For example;

- Does the person **know** how to follow the instruction?
- Is the person **able** to follow the instruction in the actual work environment?
- Is the person **willing** to follow the instruction?

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

Risk management and incident investigation logic

Risk management and incident investigation should examine the same potential chain of events, but from different perspectives.

Table 1 [2] below demonstrates this and can be used in two ways. As a guide for incident investigations, it shows the logic of working from what happened, down to find different underlying causes. Separately the same logic can be used as a guide to risk management (without waiting for an incident), it leads logically from hazards up to possible undesired outcomes in order to identify which factors could contribute to incidents.

In the centre column, the text in *italics* gives an example case study about moving flammable gas cylinders across a worksite.

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

EUROPEAN INDUSTRIAL GASES ASSOCIATION *AISBL*
AVENUE DE L'ASTRONOMIE 30 - B-1210 BRUSSELS
PHONE +32 2 217 70 98 s E-mail : info@eiga.eu - www.eiga.eu

Table 1: Risk management and incident investigation logic

Incident Investigation (What did happen and how?)	Incident Sequence	Risk Management (What could happen and how?)
Start here and work down the column		*Start at the bottom of this column and work up*
Gather facts about the incident.	**HARMFUL OUTCOME** *Personnel injury, plant damage by fire, loss of product.*	What is the worst consequence of the events identified below?
What were the immediate causes of the incident outcome? What happened just before the loss, damage or injury?	**EVENT(S)** *1. Operator pushes trolley into door post;* *2. Gas cylinders fall off and roll down stairwell;* *3. Valves get damaged and leak* 4. *Gas ignites.*	Could the human failures identified earlier still lead to an incident with the hazard? What are the likely consequences of those failures?
What safeguards were reduced, removed or missing, that allowed the event to take place?	**SAFEGUARDS** *Restraining straps are the main physical safeguard; operator competence is Human Factor safeguard*	Are there enough safeguards in place to keep the hazard under control? Do they sufficiently reduce the risk? What other safeguards are needed?
What organisation, task or individual factors contributed to the event? What particularly reduced the effectiveness of those safeguard(s) against the hazard?	**PERFORMANCE INFLUENCING FACTORS** *Divided attention – truck driver exerting pressure on operator*	What could influence performance? What can make an undesired outcome more likely? Surroundings, operator fatigue, excessive work pressure, competence? What could we have lost control over?
What did the person(s) performing the task do (or not do) that reduced their control over the hazard? What factors contributed to this?	**HUMAN FAILURES (ACTIVE)** *Operator does not fasten restraining straps;* *rushes to cargo lift.*	Could a mistake, slip (skill-based error), lapse (memory) or violation lead to an incident? (Or even a Seveso Major Accident?)
Were there any earlier human or system failures that contributed to the incident?	**LATENT FAILURES** *Operator is not fully trained; poor design of workplace (doors too narrow); procurement of poorly designed restraining device.*	Are we confident that there are no 'latent failures' in our systems (i.e. all organisation, task and individual factors are adequately controlled)?
What was the task meant to achieve? What were the critical aspects of the task (those things which the operator had to do to keep the hazard under control)?	**TASK** *To move flammable gas cylinders by trolley to the truck loading area.*	What are the tasks involving this hazard? (Look for tasks where human failure could result in a loss or harmful outcome).
What hazard needed to be kept under control? Can you remove the hazard or contain it? If not, did you design suitable systems of work or protective clothing/safety equipment to reduce risk?	**HAZARD** *Flammable gas in large cylinders*	What hazards do we have on this site? Make a list. Take each one in turn and move up this column. ***Start here and work up the column***

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

EUROPEAN INDUSTRIAL GASES ASSOCIATION *AISBL*
AVENUE DE L'ASTRONOMIE 30 - B-1210 BRUSSELS
PHONE +32 2 217 70 98 s E-mail : info@eiga.eu - www.eiga.eu

Useful Reference Information

1. *Root Cause Analysis*, Human Factors Briefing Notes No 15. Energy Institute. publishing.energyinst.org
2. *Humans and Risk*, HSE Human Factors Briefing Note No 3. Health and Safety Executive. https://www.hse.gov.uk
3. *HSE Human Factors Toolkit,* October 2005. Health and Safety Executive. https://www.hse.gov.uk/
4. EIGA Doc 90 *Incident /Accident Investigation and Analysis*. www.eiga.eu
5. EIGA Doc 910 *SAC Data Bank (members only)*. www.eiga.eu
6. EIGA Doc 904 *Work Injury Statistics (members only)*. www.eiga.eu
7. *The Management Oversight and Risk Tree (MORT).see Chapter 11 in Modern Accident Investigation and Analysis by Ted S. Ferry, 18 February 1988 Print ISBN:9780471624813 |Online ISBN:9780470172230 |DOI:10.1002/9780470172230TapRooT®*. Systems Improvements, Inc. Knoxville, Tennessee, USA. https://onlinelibrary.wiley.com
8. Dan Petersen Model*. Human Error Reduction and Safety Management, 3rd Edition.* Daniel Petersen. ISBN: 978-0-471-28740-7. https://www.wiley-vch.de
9. *Apollo Root Cause Analysis Methodology*. https://rca.bakerhughes.com/
10. Health and Safety Executive, Reducing Error and Influencing Behaviour, HSG48, 1999, HSE Books ISBN 9780717624522. https://www.hse.gov.uk

DISCLAIMER

All technical publications of EIGA or under EIGA's name, including Codes of practice, Safety procedures and any other technical information contained in such publications were obtained from sources believed to be reliable and are based on technical information and experience currently available from members of EIGA and others at the date of their issuance.

While EIGA recommends reference to or use of its publications by its members, such reference to or use of EIGA's publications by its members or third parties are purely voluntary and not binding. Therefore, EIGA or its members make no guarantee of the results and assume no liability or responsibility in connection with the reference to or use of information or suggestions contained in EIGA's publications.

EIGA has no control whatsoever as regards, performance or non performance, misinterpretation, proper or improper use of any information or suggestions contained in EIGA's publications by any person or entity (including EIGA members) and EIGA expressly disclaims any liability in connection thereto.

EIGA's publications are subject to periodic review and users are cautioned to obtain the latest edition.

© EIGA grants permission to reproduce this publication provided the Association is acknowledged as the source

EUROPEAN INDUSTRIAL GASES ASSOCIATION *AISBL*
AVENUE DE L'ASTRONOMIE 30 - B-1210 BRUSSELS
PHONE +32 2 217 70 98 s E-mail : info@eiga.eu - www.eiga.eu