IDENTIFYING THE CAUSES OF HYDROCARBON RELEASES ON OFFSHORE PLATFORMS

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A high percentage of hydrocarbon releases are due entirely or in part to human intervention (Step Change in Safety UK, 2009. Hydrocarbon Release Reduction Toolkit). Typically however, organisations focus heavily on immediate asset issues when investigating the causes of releases and omit to investigate the reasons for human error in operations, maintenance and/or inspection of the equipment, or organisational contributors. When the real root causes for incidents are not understood, underlying problems remain and releases will continue.

In 2010, Nexen UK Ltd initiated a multi-pronged project aimed at reducing hydrocarbon releases on their North Sea production platforms. The LR Scandpower Human Factors team has supported this project by undertaking a human factors focussed organisational assessment into the underlying contributory factors to hydrocarbon releases that are occurring on these platforms. Using the LR Scandpower Organisational Integrity model, a robust interviewing framework was devised to systematically explore the breadth of potential human influences on releases. This was used to guide interviews and focus groups with offshore and onshore staff members, from a wide cross-section of roles and levels of seniority. The qualitative data produced was analysed todraw out common conclusions.

This presentation provides an overview of the approach, key findings and actionsarising from the human factors assessment.

BACKGROUND TO HYDROCARBON RELEASES

Hydrocarbon releases (HCR) are a major problem offshore, and most importantly are seen as a direct precursor to potential major accidents (MAs) (Oil and Gas UK, 2010). Though reporting in the UK suggests that overall HCRs have reduced since records began in 1992, the rate of reduction in the past 5 to 6 years has stagnated with around 150 releases still occurring each year (HSE, 2012). The UK HSE believe that of the occurring HCRs, 50–70% have causes linked in part or in whole to "things people do (or don't do) when designing, maintaining and operating systems", (Step Change in Safety, 2010) i.e. issues associated with Human Factors (HF).

Step Change in Safety, the UK HSE-led industry safety initiative, coordinated an agreement between operators to reduce HCRs within the UK sector by 50% by the end of March 2013 (Oil and Gas UK, 2010). This was an important action in the industry's efforts to continually reduce HCR.

AIM OF STUDY

An offshore operator contracted LR Scandpower to conduct an independent HF-focussed organisational assessment into the underlying contributory factors to HCRs on their platforms, in order to support their own internal initiatives to reduce HCRs and their commitment to the industry initiative. The organisation had already begun a major internal initiative that included a number of activities aimed to increase HCR awareness of all employees, including: demonstration of the fire and explosive potential of HCR, consultation with all employees regarding why they believe HCRs occur on their platforms, and promotion of HCR identification through rewarding HCR reporting.

The aim of LR Scandpower's assessment was to help the organisation confirm and identify the key areas of focus in order to combat HCRs and prioritise further actions going forward.

HUMAN FACTORS CONTRIBUTION TO HCR INITIATIVE

LR Scandpower adopted a four step approach to systematically investigate the HF contributions to HCR on the organisation's platforms. The following activities were carried out:

- Thematic Analysis – A review was conducted of the organisation's HCR incident reports over the past 5 years and internal information held on the HF contributions to HCR on their platforms. A thematic analysis was carried out on the data to identify HF trends. Six emergent HF themes were identified which were then used to guide the rest of the investigation, as shown in Figure 1.
- Offshore interviews – A combination of focus groups and one-to-one interviews were conducted with the platform personnel to investigate evidence for (or against) the six HF themes. Focus groups were held with staff that worked within the same discipline and were of equal grade; whereas one-to-one interviews were used with staff that manage others and/or were in singular disciplines. The interviews were open and exploratory in style. The individuals interviewed were drawn from a wide range of disciplines and grade levels, which provided the interviewers with access to a broad pool of operational knowledge and experience.
- Onshore interviews – A series of one-to-one interviews with onshore personnel were held. These interviews

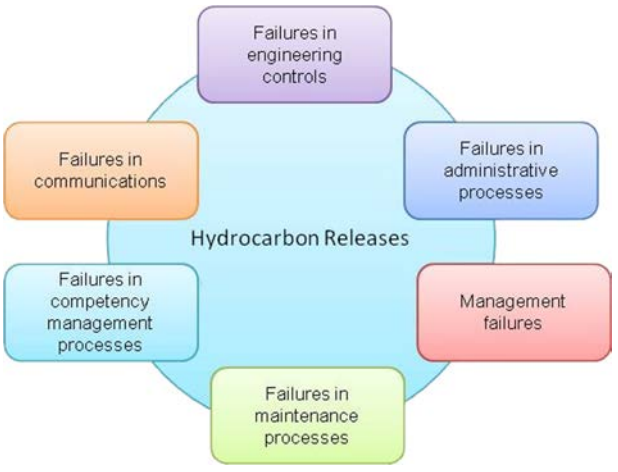

Figure 1. The 6 HF themes initially identified as contributing to HCRs

were used to confirm issues that had been raised offshore, and to identify and explore additional evidence or issues. Again, a large number of staff from a broad role and grade pool were interviewed.

- Analysis – The following strategies were used to analyse the data collected from the offshore and onshore interviews:
  1. Coding – The notes from each interview and focus group were reviewed. Significant comments were coded to support the six themes and any emergent sub-themes.
  2. Clustering and commonality – The coded data was then collated into common areas. Grouping into common themes facilitated a deeper understanding of the main issues and common causes, and helped the project team to identify repeatedly reported issues.
  3. Expert opinion – The LR Scandpower team used their expert judgement to extract the most pertinent factors from interview transcripts in order to identify common threads. The interview data was also used to evaluate the wider link to organisational issues and determine whether comments made in the interviews were beliefs held by individuals or were in fact evidence of the deeper issues that contribute to HCRs. No links were made between the contributory factors raised and wider organisational issues without these being verified through interview.

STUDY FINDINGS

The analysis of the interview and focus group output yielded a wide variety of HF and organisational failures that have contributed to the occurrence of HCRs. However, the analysis did not indicate that there was any one significant factor that had contributed more than others to HCR events. However, the issues reported by staff often fell into common themes, and thus these were focussed on as being priority contributory factors.

Similar studies carried out by LR Scandpower in a variety of industries have found a similar pattern of results. When a good cross-section of staff are interviewed with regards to organisational issues such as safety culture or safety behaviours, then common themes are found even though many different perspectives and pieces of evidence may be presented.

An understanding of organisational psychology tells us that a problem is rarely caused by one or two specific failings. In the case of HCRs, there are contributory factors at many levels, which may themselves be caused by secondary factors. For example, a person may fail to clear up a worksite which then leads to an incident; but they may have failed to clear the worksite due to pressure being put on them to start a new job. In turn, that pressure may have been put on them because onshore planners have not communicated with the correct individuals offshore and have developed an unworkable plan.

This complexity can be illustrated using the LR Scandpower Framework of Organisational Integrity, which shows that safety culture and staff behaviour is affected by many organisational issues, all of which are inter-connected, and all of which can have weaknesses – See Figure 2.

The analysis of the interview and focus group data led to the definition of eight overall HF themes, which were expanded and developed from the six initial HF themes defined from the Thematic Analysis. Figure 3 below shows the final themes and groupings that were identified.

The evidence supporting the eight HF Themes was then scrutinised to identify the main prioritisation areas for action. These priority areas represented “headlines”

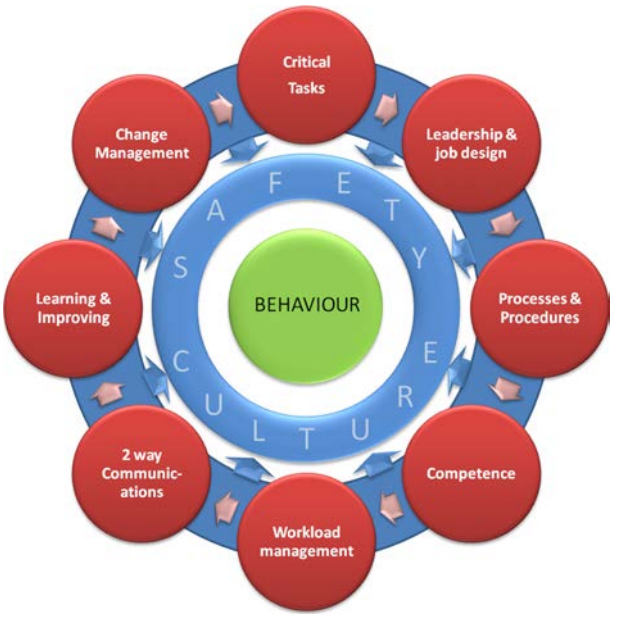

Figure 2. LR Scandpower’s Framework of Organisational Integrity

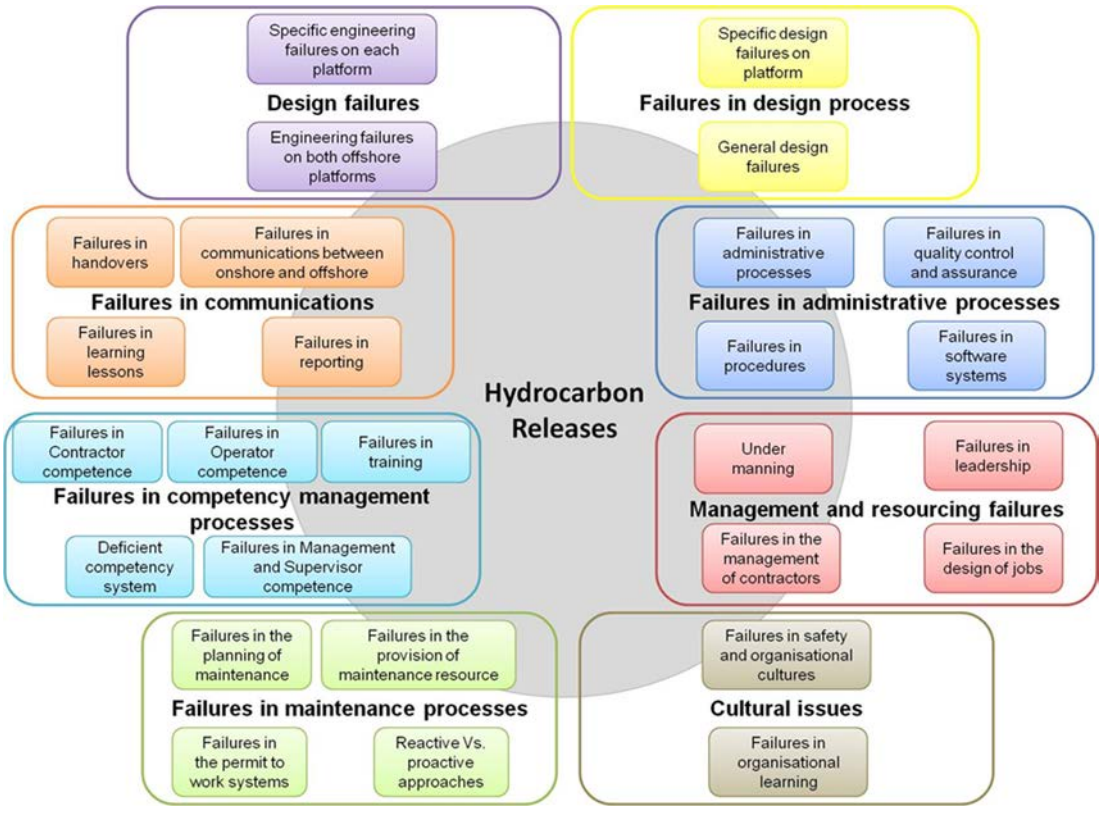

Figure 3. The 8 identified HF themes and sub-themes

that had been frequently cited by staff as significant and/or issues that were influenced by many underlying factors. Within these there were sub-themes, which can be seen in Figure 3.

Eight priority areas for action were identified, as follows:

1. Poor organisational learning
2. Lack of planning
3. Reactive approach
4. Poor procedures
5. Lack of competency management
6. Silo working
7. Under manning
8. Platform design and equipment issues

For each of these eight priority areas, LR Scandpower provided the organisation with specific recommendations for practical and implementable improvements and/or remedial actions to deal with identified contributory factors. In some cases, the organisation had already identified some of the issues and had put initiatives in place. In these circumstances, the recommendations were linked into these improvement projects that were already planned or being carried out.

Because of the organisation-specific nature of these recommendations and client confidentiality issues, these recommendations are not discussed here. However, each priority area is described below at a high-level, with some background on the key evidence found and the relevance to HCRs explained.

1. ORGANISATIONAL LEARNING

Organisational learning refers to how a company seeks information and applies it to make improvements. This can include teams and managers, as well as organisation-wide strategies and processes.

Examples of organisation learning failures found during the study included:

- Observations of underlying issues not being investigated despite repeated failures,
- Limited use of failure trend data,
- Limited innovation in approaches and technologies.

Failures in organisational learning impact on HCRs in the following ways:

- When lessons are not learned and a company does not strive for continuous improvement, mistakes are repeated, not recognised and not improved.
- When underlying causes are not dealt with, only the immediately obvious problems may be tackled, leaving the real contributory factors in place. For example, an individual who made a mistake may be blamed, but his competency and the competency of all his

colleagues also may be poor due to a lack of training and support.

Many wider contributory factors to HCRs were identified during the study, and most were known to have been a problem for some time yet had not been adequately addressed by the organisation. However, the organisation was in the process of initiating an internal project to rationalise, streamline and guide all internal improvement projects.

2. LACK OF PLANNING

Failures in planning were identified in various areas of the organisation's work and processes. Examples included:

- Emergency shutdowns not being used effectively to carry out opportunistic maintenance,
- Limited communications between onshore planners and individuals offshore making work requests,
- Support services often being omitted from planning of work.

Lack of planning of work can increase the vulnerability of the system, including the occurrence of HCRs, in the following ways:

- When routine maintenance is postponed or delayed,
- When urgent maintenance needs are not addressed promptly,
- When work is not planned thoroughly, maintenance may get postponed or delayed.

3. REACTIVE APPROACH

A commonly held perception amongst the organisation's employees that were interviewed was that the organisation took a short-term reactive 'fire-fighting' approach and did not put longer term, pre-emptive measures in place. For instance, there was a backlog of maintenance work which led to temporary fixes and 'make do' maintenance being undertaken.

This has an impact on the likelihood of HCRs in the following ways:

- Similar to planning, if only short-term/quick repairs are carried out and underlying problems are not fixed, then the system can be left vulnerable to further deterioration or failure which could lead to an HCR.
- Patchwork fixes on plant and equipment can leave systems vulnerable to damage and/or can result in processes operating outside of desirable parameters, increasing the chance of a HCR arising.
- Beginning initiatives and approaches too quickly and without appropriate planning can lead to poorer implementation/application. This is being addressed by an internal project aimed to improve the implementation of their initiatives.

4. POOR PROCEDURES

Many procedure design faults were identified. For example, many procedures were long and difficult to follow, and some included mistakes as they had not been updated or had not been designed using staff consultation. Some procedures were also difficult to find within the organisation's internal document control system.

Procedures that are poorly written or include mistakes will increase the likelihood of errors being made when undertaking the task. In addition, if procedures are difficult to use, people may:

- Try to adopt an alternative method to conduct the task, based on their previous experience in carrying out a similar task,
- Choose to follow another, inappropriate, procedure (for instance a similar procedure which applies to similar but different plant),
- Fail to use the procedure at all.

In all instances, the end result is that processes may not be followed correctly or consistently and plant or equipment may be operated incorrectly or outside of desirable operating parameters; all failings which could potentially contribute to an HCR.

The organisation has re-designed one procedure taking due consideration of HF in its style and presentation, and based on consultation with end-users. It was recommended that this approach be taken for all other procedures.

5. COMPETENCY MANAGEMENT

A competency management system (CMS) is the process by which an organisation ensures that its staff has the necessary skills and can apply them. It includes ensuring that individuals have received appropriate training, development and assessment to perform their tasks, and that they maintain or improve their competence over time (ORR, 2007). The organisation was found to lack a formal competency management system, including issues relating to the effective management of contractor competency. These omissions are relevant to the occurrence of HCRs in the following ways:

- If individuals are not fully competent to work on the system, they are likely to make mistakes. For example, if an operator cannot use the maintenance database correctly they may not input required data about maintenance work that needs to be done, and thus an HCR could occur because the work is not carried out.
- Anyone working with the system who is not fully competent could make a mistake and either:
  - Initiate an HCR;
  - Contribute to a series of events that leads to an HCR;
  - Escalate an HCR; and/or,
  - Fail to mitigate and control an HCR.

6. SILO WORKING

It was reported that many teams and sometimes individuals in the organisation worked in isolation from each other and there was a particular lack of communication between

onshore and offshore. This tendency towards silo working can influence the likelihood of HCRs in the following ways:

- When individuals do not communicate and work together, important information may not be passed on to those who need to know, or alternatively may be misunderstood, which can lead to mistakes and omissions.
- Additionally, work on the system may be carried out in isolation and may conflict with other work being done, which can leave the system vulnerable to failures.

7. UNDER MANNING

A problem of under manning was found in a number of areas of the organisation, which was exacerbated by some of the other process and design issues; for example, there was a lengthy process to employ staff; similarly a lack of beds on a platform made it difficult to increase personnel.

Insufficient numbers of staff has an impact on the amount of work that could be performed/achieved, which can impact on HCRs in the following ways:

- A lack of staff to carry out work means that maintenance is constantly being compromised, and assets fail because they have not been maintained properly or have only had 'patchwork' fixes carried out on them.
- Insufficient engineering team staff onshore can mean it takes longer to get designs developed and thus there are delays to making engineering changes.

8. PLATFORM DESIGN AND EQUIPMENT ISSUES

A number of specific failures relating to equipment and design issues were identified, each with their own influence on HCRs, including:

- Examples were found where a mismatch between the original design specification and the proposed operability of the system led to process operability being compromised which increased vulnerability to HCRs and other failures.
- Examples of incorrect material selection for the operating working environment were found which resulted in the plant and equipment being more susceptible to deterioration and potentially more vulnerable to HCRs.
- Small bore tubing fittings and defective valves and flanges are known causes of HCRs on the platforms.

Following the analysis conducted by LR Scandpower, the key findings and prioritisation of recommendations to address each of the identified areas of weakness were discussed with senior management and HCR project managers from the organisation, resulting in an agreed action plan.

CONCLUSIONS

The output from the HF-led study identified many different causes and contributory factors in the incidence of HCRs. Despite the study initially identifying a large number of issues, further analysis enabled grouping of these issues into eight key areas, as follows:

1. Poor organisational learning
2. Lack of planning
3. Reactive approach
4. Poor procedures
5. Lack of competency management
6. Silo working
7. Under manning
8. Platform design and equipment issues.

The grouping of the findings into these eight key areas assisted the organisation in the prioritisation of their improvement activities and the development of an action plan.

It was possible to make some very specific and practical recommendations to the organisation that should be reasonably easy to implement (e.g. provision of a Work Permits board).

Other recommendations will involve larger, more significant changes and, without effective change management, barriers to successful change may reduce the effectiveness of the initiatives. However, the organisation is aware of the importance of change management, and thus it is hoped that that appropriate support systems will be put in place to manage new or improved systems, procedures, initiatives and approaches effectively.

Although it was not within the remit of this project to review findings outside of the client organisation, a recent study of HF and HCRs on Norwegian offshore production installations (Lootz *et al.*, 2012) has raised many similar issues. Not all findings have been released at this stage; however, initially identified HF root causes support the findings from LR Scandpower's current study. These include "learning from previous events," "formulation of concrete measures," "Factors relating to the technical design of the system," "Wrong actions stemming from non-observance of prevailing practice/procedures" and "Lack of competence and/or poor understanding of risk".

LESSONS FOR INDUSTRY

The findings in this paper are highly specific to the organisation assessed, and so the transference of conclusions to the wider industry must be treated with a degree of caution. Nevertheless, the following wider lessons are offered for consideration:

Firstly, the results of this study suggest the types of HF-related failings that contribute to the likelihood of HCRs are, not surprisingly, similar to those that are commonly cited as a cause of other organisation, performance and/or safety issues. There is a good understanding within the industry of what constitutes HF good practice and issues such as poor procedures, the lack of an effective competency management system and poor organisational learning are all indicative of an organisation that has not fully taken on board consideration of HF.

This study therefore supports the case for better integration of HF within the early stages of the design process

in order to reduce the likelihood of mismatches between human capability, organisational demands and system design during the latter stages of projects or in operation. Planning for a dedicated HF programme at the initial design stage of projects is recommended.

Secondly, if an organisation is encountering recurring failures/issues such as those that result in HCRs, then it is essential that the incident investigations that are conducted go beyond analysis of the front line failures and take due consideration of HF and organisational root causes. It is important to involve HF experts in this process and to use a suitable framework for root cause investigation, in order to ensure that all contributory factors can be identified.

Lastly, the study has shown that there is no simple answer to the question of 'what causes HCRs to occur?' There are a multitude of factors that play a part in making an organisation more or less susceptible to these sorts of failings, and to tackle these factors means looking at and addressing a number of aspects of the organisation's processes and systems. LR Scandpower's framework for Organisational Integrity (as presented in Figure 2) provides one way of systematically looking at an organisation in order to begin to address such issues, and a similar multi-level approach is recommended to look at and deal with similar issues within the industry.

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