CDOIF

Chemical and Downstream Oil Industries Forum

Guideline

Human Factors Review of Procedures

Foreword

In promoting and leading on key sector process safety initiatives, CDOIF has developed through its members this guideline on completing a human factors review of procedures.

The intent of this document is to provide a reference for those organisations completing a human factors review of procedures.

It is not the intention of this document to replace any existing corporate policies or processes. The intent is to provide a reference to users to help in planning and completing the human factors review.

There are no limitations on further distribution of this guideline to other organisations outside of CDOIF membership, provided that:

1. It is understood that this report represents CDOIF's view of common guidelines as applied to human factors review of procedures.
2. CDOIF accepts no responsibility in terms of the use or misuse of this document.
3. The report is distributed in a read only format, such that the name and content is not changed and that it is consistently referred to as "CDOIF Guideline – Human Factors Review of Procedures".
4. It is understood that no warranty is given in relation to the accuracy or completeness of information contained in the report except that it is believed to be substantially correct at the time of publication.

It should be understood that this document does not explore all possible options for completing human factors review, nor does it consider individual site requirements, policies or procedures – Following the guidance is not compulsory and duty holders are free to take other action.

Contents

1. EXECUTIVE SUMMARY

Several incidents in recent years have highlighted the importance of procedures - ensuring procedures are fit for purpose and take adequate account of what people are required to do as part of a potentially hazardous activity is critical in reducing risks to both people and the environment.

The final report of the Process Safety Leadership Groups (PSLG) safety and environmental standards for fuel storage sites was published in December 2009, Appendix 5 gives some guidance on the management of operations and human factors, and further detailed guidance is available from both the Health and Safety Executive (HSE) and the Energy Institute (EI) as well as other sources (Refer to section 5, other relevant publications).

However, applying Human Factors (HF) as part of the review process for procedures has in some cases been difficult for duty holders to put into practice in a resource efficient way. This has led to instances whereby systems have been created that are burdensome to implement and difficult to maintain.

As part of its role to deliver improvements in health, safety and the environment, the CDOIF Process Safety Work-stream agreed to develop high level guidance that is concise, practical and flexible to allow duty holders to carry out a review of HF as applied to procedures. The guidance is intended to be at a sufficiently high level to enable non-HF specialists to complete a review, but also sign-post to more detailed guidance where appropriate.

2. PURPOSE AND SCOPE

The purpose of this document is to provide a high level guide to help the reader understand how to review and evaluate potential HF failures that could affect both safety and environmental risks. The guidance addresses both safety critical and non-safety critical activities, and both preventative and mitigatory barriers. It is the intention of this guidance to review existing procedures, and not to determine if those existing procedures are sufficient, unless a gap is identified as part of the HF review process.

Procedures control the activities that a person carries out, however procedures are written for many different purposes, not only related to the safe operation of process plant. In the context of this guidance, the HF review of procedures relates specifically to:

- Operating Procedures (e.g. site start-up, shutdown)
- Inspection and Maintenance Procedures
- Emergency Procedures

Work processes such as Human Resource procedures are not included within the scope of this review.

Whilst this guidance is primarily written for top tier COMAH (Control of Major Accident Hazard) sites, it may also provide a useful reference for lower tier and sub COMAH sites.

The following sections provide a high level framework for assessing the HF component of procedures. Other techniques are available, and reference should also be made to the other relevant publications listed.

2.1 Competency requirements

When completing a HF review of procedures there is a need to ensure that relevant competent resources are used throughout the process. In the context of this guidance, it is likely that those with knowledge of process safety and risk assessment will be needed to help identify safety critical tasks. Similarly it is likely that those with knowledge of HF will be involved with the identification of procedures, tasks, task steps and credible human failures.

Refer to section 4.4 of this guidance for further information relating to competency requirements.

2.2 Using this guidance

Figure 1 below provides a reference to the assessment process, and the relevant sections within this guidance.

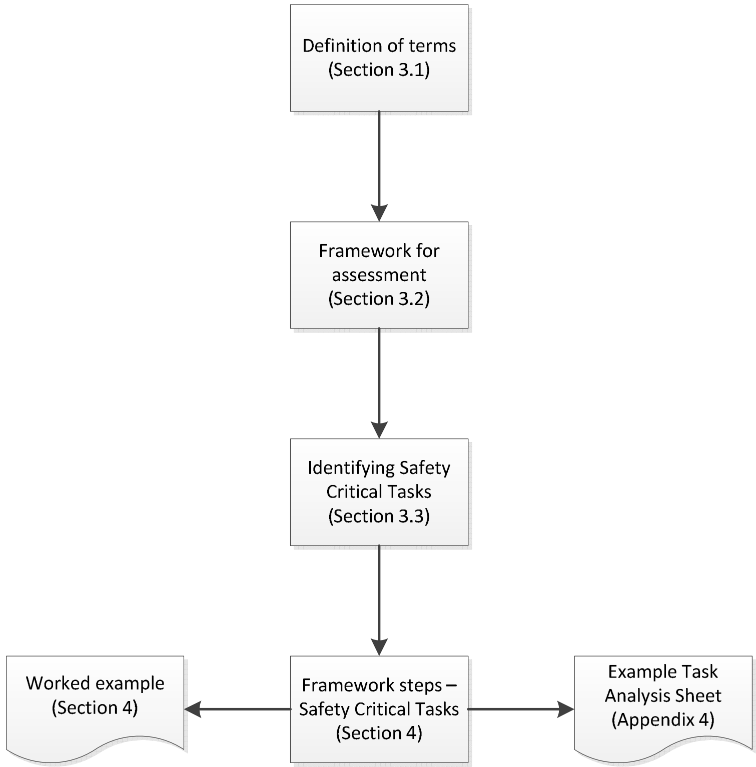


Figure 1 – Using this guidance

3. ASSESSMENT FRAMEWORK

A safety critical measure is a course of action taken (human, mechanical, electrical or otherwise) that if carried out incorrectly, may result in a major accident.

In more specific terms various measures can be defined as:

1. A *Safety Critical Activity,* a process control which can be subdivided into *Procedures* and *Tasks* (e.g. Import Control)
2. A *Safety Critical Procedure*, a defined series of steps or individual *Safety Critical Tasks* which can be further sub-divided into individual *Safety Critical Task Steps*.

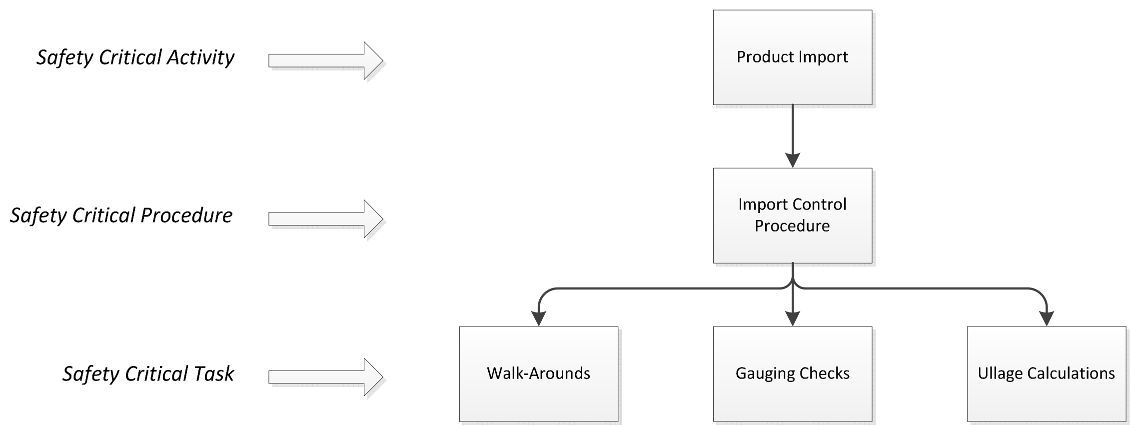


Figure 2 – Safety Critical Activities, Procedures and Tasks

The following provides a framework by which Safety Critical Activities, Procedures and Tasks can be identified and assessed.

3.1 Definition of terms

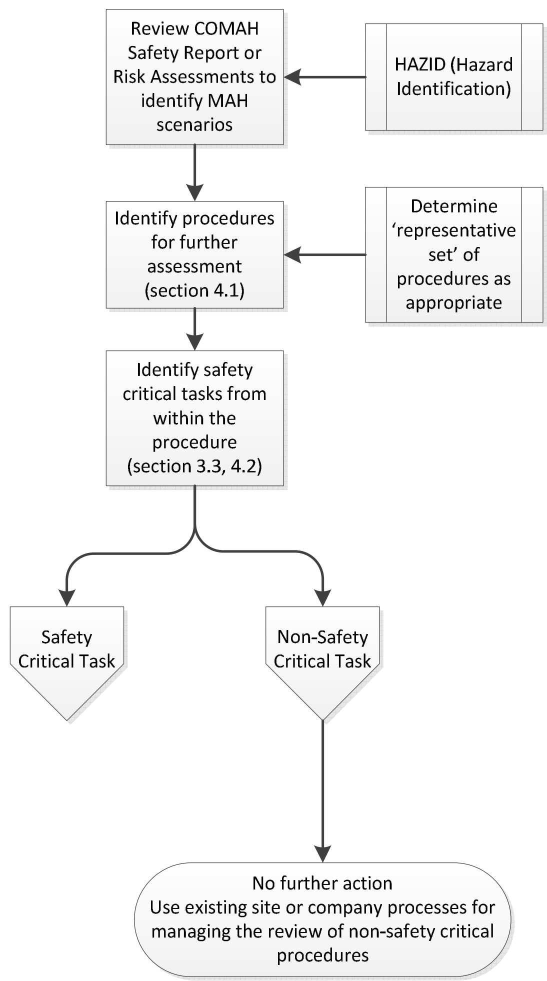
There are four key terms used in this guidance to discuss each of the elements that a procedure comprises of, these are:

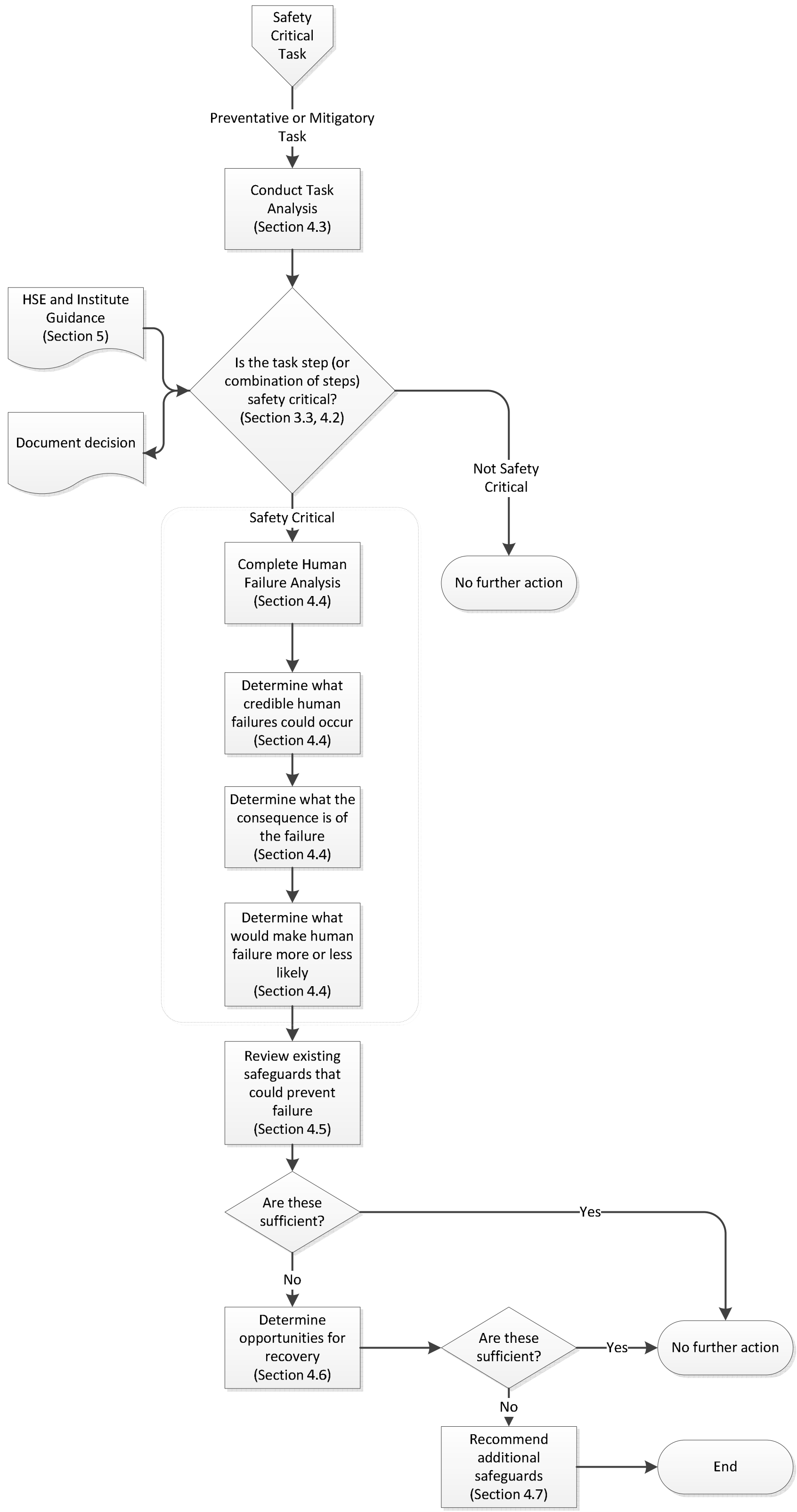
- ***Procedure*** – the overall operation that is being controlled, for example
  - Loading a road tanker with gasoline
  - Starting a Crude Distillation Unit (CDU)
  - Performing scheduled maintenance on a pump
- ***Task*** – the 'human' contribution to the ***Procedure***, for example
  - Positioning the road tanker at the loading gantry

- Start-up fired heater
- Performing mechanical isolation

- ***Task Steps*** – the 'human' contribution to the ***Task***, for example
  - Applying the parking brake on a road tanker
  - Commission pilots to fired heater
  - Close outlet valve from the pump
- ***Credible Human Failure*** – Failure of an action by the 'human' such that the ***Task Step*** is not completed correctly, for example
  - Product left on board in tanker compartment prior to loading activity, leading to a probe hit or potential overfill
  - Omitted to commission pilot on fired heater
  - Outlet valve on the wrong pump closed

3.2 Framework for assessment




Safety Critical Task
Preventative or Mitigatory Task
Conduct Task Analysis (Section 4.3)
HSE and Institute Guidance (Section 5)
Is the task step (or combination of steps) safety critical? (Section 3.3, 4.2)
Document decision
Not Safety Critical
No further action
Safety Critical
Complete Human Failure Analysis (Section 4.4)
Determine what credible human failures could occur (Section 4.4)
Determine what the consequence is of the failure (Section 4.4)
Determine what would make human failure more or less likely (Section 4.4)
Review existing safeguards that could prevent failure (Section 4.5)
Are these sufficient?
Yes
No
Determine opportunities for recovery (Section 4.6)
Are these sufficient?
Yes
No further action
No
Recommend additional safeguards (Section 4.7)
End

3.3 Safety critical task definition and selection

A Safety Critical Task is any task where human failure could potentially *initiate*, *prevent*, *escalate* or fail to *mitigate* a major accident with consequences that are greater than the specified threshold for the site or company.

For example:

Initiate – a valve is left open which leads to a loss of containment

Prevent – An individual fails to respond to an alarm

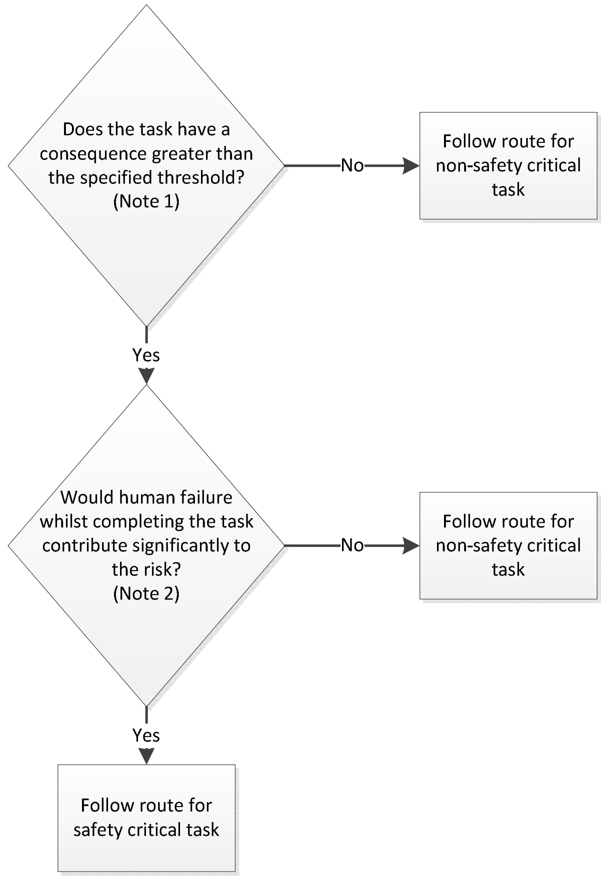
Escalate – Drenching system failed to operate due to poor maintenance

Mitigate – An individual fails to activate the emergency plan for the site or process unit

When determining the failures that could occur, the following are all of relevance:

- Inaction, the task was not completed
- Action (either a physical or mental action), the task was not completed correctly
- Time, the task was completed at the wrong time, or for the wrong duration

The following flowchart can be used as a simple tool to help in determining whether or not a task is safety critical:



Note 1: The specified threshold will be site/corporate based, and should be linked to the Major Accident definition with the COMAH safety regulations

Note 2: Does the task involve breaking of containment which could lead to a Major Accident Hazard (MAH)? For example taking samples, hot-work on pipes, preparing equipment for maintenance, water draws or filter changes.

Alternatively, does the task directly involve the management of safety critical equipment? For example, proof test of a Safety Instrumented System (SIS) or maintenance of a Pressure Relief Valve (PRV).

4. ASSESSMENT FRAMEWORK STEPS – SAFETY CRITICAL TASKS

The following provides an overview of the process to be followed when completing each of the assessment framework steps for safety critical tasks.

Note that a worked example for each step is included at the end of each section. The complete worked example is provided in Appendix 5.

4.1 Identify procedures for further assessment

Procedures which are in place to ensure the safe operation of process plant may take many different forms, including:

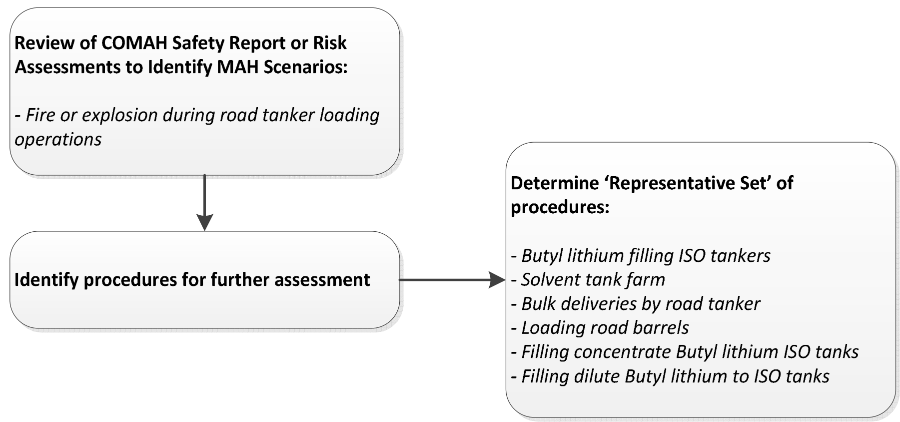
- Operating tasks
- Routine tasks
- Emergency tasks
- Maintenance tasks
- Inspection tasks
- Job/task cards (for example routine tasks, work instructions)

Procedures can be reviewed to determine if any of the ***tasks*** that they include have the potential to be safety critical. The following methodology can be used to determine which ***procedures*** should be reviewed:

1. Identify the MAH you have on the site
2. Identify the activities that relate to the MAH (for example Product Import)
3. Identify the ***procedures*** which relate to those activities
4. Identify those that apply to prevention and mitigation
5. Identify those ***procedures*** which are common/and can be used as a representative set[1]
6. Prioritise those that have the highest risk (for example using a colour code), and complete a detailed assessment of the highest priorities first

[1]For example, there are ten similar or common start-up procedures. A detailed assessment of one of these can be completed, and the findings applied to all others, providing the Performance Influencing Factor's (PIFs) are also similar or the same (Refer to section 4.4) – i.e. the same procedure may be used across multiple sites and as the environments are different, so to may be the PIFs.

Example - Identify procedures for further assessment



4.2 Identify safety critical tasks from within the procedure

Prior to identifying safety critical tasks, it is assumed that procedures have been reviewed to ensure that they are an accurate representation of the task(s) to be carried out.

Once relevant ***procedures*** have been identified (i.e. those that contribute toward the safe operation of the process plant, and have some level of human interaction), it is necessary to determine if there are any ***tasks*** within those procedures that could be safety critical. Reference can be made to section 3.3 for one methodology that can be used to identify safety critical ***tasks***. This methodology asks two questions:

1. Does failure to complete the task have an unmitigated consequence greater than the specified threshold?

    Can human failure whilst performing the task lead directly to the MAH or hazards?

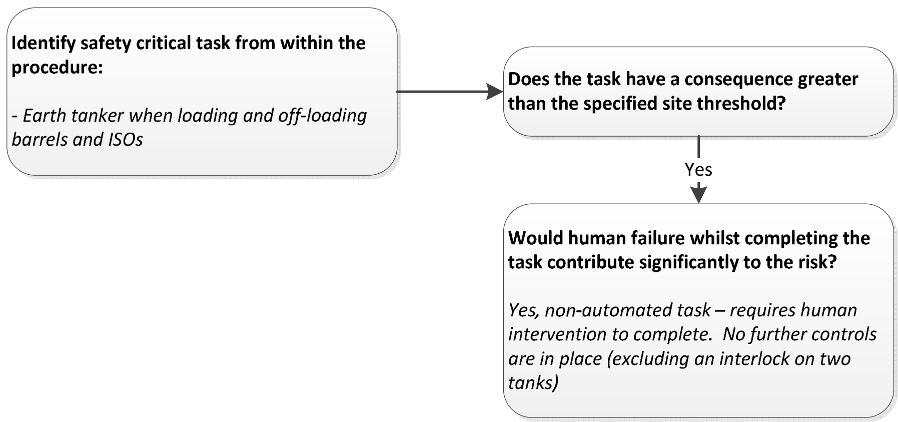
And

2. Would human failure whilst completing the task contribute significantly to the risk?

    Does a risk assessment for this scenario require a high degree of certainty that personnel will execute this task flawlessly? This is likely to include those tasks which are identified as the "Last Line of Defence" i.e. those activities where no additional safeguard is in place to prevent one of the consequences above from occurring. If an equipment safeguard is in place (for example, a Pressure Safety Valve, a contained blow down system or an instrumented interlock system) then the task typically would not be a "last line of defence".

If the answer to these two questions is *yes*, then the task is safety critical. However it is worthwhile examining further to see if the ***task*** can be removed from the ***procedure*** or the ***procedure*** can be changed to make the ***task*** non-safety critical.

Example - Identify safety critical tasks from within the procedure



4.3 Conduct task analysis

Following the identification of the ***procedures*** (or representative procedure), and the safety critical ***tasks*** within those ***procedures***, it is necessary to identify the ***task steps*** that are safety critical as not all steps within a task will be safety critical, and therefore not subject to further investigation.

Examples of human interactions (***task steps***) with a ***task*** that may require further analysis include:

- Those which have the potential to initiate an event sequence (for example incorrect valve operation causing a loss of containment)
- Those required to stop an event sequence (for example activation of an Emergency Shut Down [ESD] system)
- Those required to initiate an evacuation procedure for the area or the site
- Actions that may escalate an incident (for example inadequate maintenance of a fire control system)

The purpose of this analysis is to identify which of the ***task steps***, if carried out incorrectly, in the wrong order or are omitted could result directly to the MAH or hazards identified in section 4.1.

Existing published guidance[1] agrees that as a minimum, an operator responsible for carrying out the ***task*** should be involved to identify the correct sequence of ***task steps***, and the consequences if a ***task step*** is incorrectly executed. The preferred method of conducting this analysis is to carry out a 'walk through, talk through' with the operator.

If it is not practical to complete a 'live walk through, talk through', for example the ***task*** is carried out on an infrequent basis; one of the techniques listed below could be used:

- Field simulated walk through/talk through
- Desk top review/talk through

[1]Existing published guidance includes (refer also to section 5):

- HSE Core Topic 3: Identifying Human Failures, http://www.hse.gov.uk/humanfactors/topics/core3.pdf
- HSE Understanding the task, http://www.hse.gov.uk/humanfactors/resources/understanding-the-task.pdf
- HSG48, Reducing Error and Influencing Behaviour, http://www.hse.gov.uk/pubns/books/hsg48.htm
- Energy Institute, Guidance on human factors safety critical task analysis

Example – Conduct task analysis

Identify safety critical task step:

- Earth tanker when loading and off-loading barrels and ISOs

4.4 Complete human failure analysis and determine what credible human failures could occur

Once safety critical ***task steps*** have been identified, it is necessary to complete a human failure analysis (HFA) to determine how failures could occur; in essence an HFA is a Hazard and Operability study (HAZOP) for a human[1].

The following process can be adopted:

1. Determine what failure could occur, using a defined set of keywords (an example is provided in appendix 1)
2. Determine the type of failure that could occur (an detailed example of failure types is provided in appendix 2);
    - a slip error

   - a lapse error
   - a mistake
   - a violation

3. Determine the consequences of those failures; refer to section 4.1 above, where the MAH for the site (and thus consequences) are identified.

4. Identify factors which could make these failures more or less likely (commonly referred to as 'Performance Influencing Factors [PIF] or Performance Shaping Factors [PSF]).

   - PIFs are the characteristics of the job, the individual and the organisation that influence human performance. Optimising PIFs may reduce the likelihood of all types of human failure. A list of common PIF's can be found in the HSE publication 'Performance Influencing Factors', http://www.hse.gov.uk/humanfactors/topics/pifs.pdf (also included in Appendix 3 for reference).

[1] A record of the analysis results should be kept as part of the analysis process

To ensure the effectiveness of the HFA, the team assembled to complete the analysis should include as a minimum:

- HFA leader, competent[2] in the use of the *qualitative* or *quantitative* assessment techniques (see below)
- The person or persons who carries out the task (for example the operator, maintenance technician)

[2] The duty holder should define and be able to demonstrate the necessary competency requirements for this person.

When completing the HFA, either a *Qualitative* or *Quantitative* approach can be taken. In general a qualitative approach should be taken; where a more detailed analysis is required a quantitative approach may be considered.

<u>Qualitative</u>

From the information collected as part of the process above, a qualitative approach can be taken to analyse this data and identify potential. An example methodology for completing this analysis is included in appendix 4, however many different approaches are available.

<u>Quantitative</u>

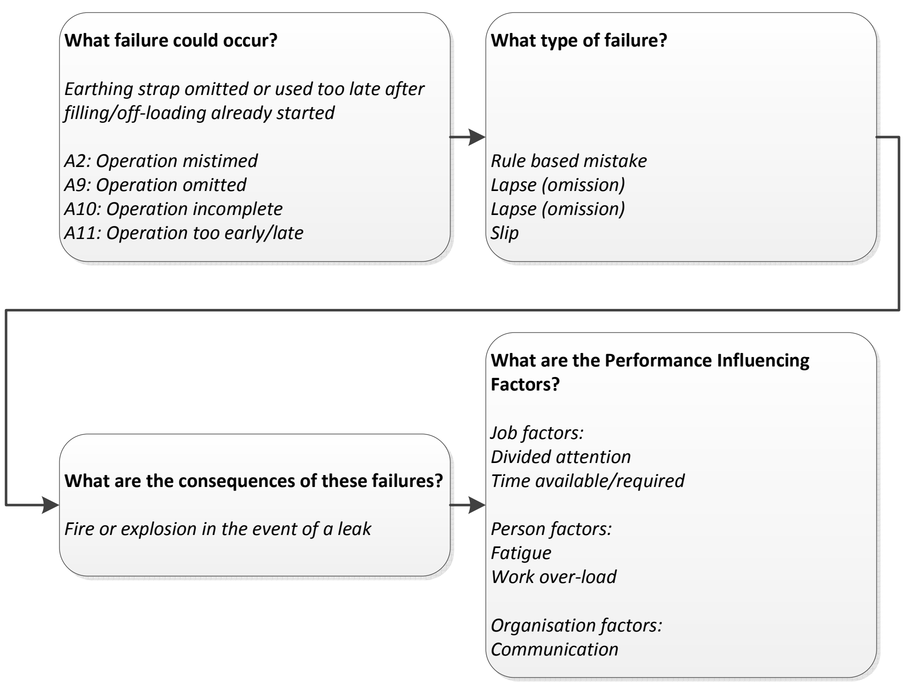
Where further detailed analysis is required, site operators may wish to use a validated Quantitative Human Reliability Assessment (QHRA) [3] to quantify the probability of human failure. The following tools are commonly used:

- Human Error Analysis and Reduction Technique (HEART)
- Technique for Human Error Rate Prediction (THERP)

Use of these techniques can provide Human Error Probabilities (HEPs) which can be used to inform quantitative risk assessment, Layers of Protection Analysis (LOPA), Safety Integrity Level (SIL) determinations and As Low as Reasonably Practicable (ALARP) demonstrations. These tools can be helpful in evaluating the benefit of taking additional measures to reduce human error, but should only be applied by a suitably competent person.

[3] Further information on QHRA can be found in the Energy Institute publication 'Guidance on quantified human reliability analysis (QHRA)', http://www.energyinst.org/technical/human-and-organisational-factors/qhra

Example – Complete human failure analysis and determine what failures could occur



4.5 Review existing safe-guards that could prevent the human failure

In sections 4.4 and 4.5 the failures, type of failure, and the factors which influence that failure (PIF) have been identified. The next step is to determine what existing controls and safe-guards are already in place which may address each of the PIFs.

Following this analysis, those PIFs that do not have existing controls, weak controls that could be improved or safeguards will be identified.

Example – Review existing safeguards that could prevent the human failure

Measures to prevent the failure from occurring:

-Detailed procedures with Safety Critical task highlighted
- MAH scenario signage at earth point
- Earthing strap permanently fixed to plant
- Multiple and well positioned earth straps in place to avoid violation apathy

Measures to address PIFs:

Divided attention; Time available/required; Work overload;
May be distracted by other deliveries/ activities. Planning system includes dispatch cover for offloading/loading activities. Shift pattern allows for holiday/sickness cover.

Communication:
Planning system alerts technicians to activities for the week ahead with additional daily despatches to account for changes/additional deliveries. Offloading check sheet and handover log completed to communicate to oncoming shift.

4.6 Determine opportunities for recovery

Not all human failures will lead to an undesirable consequence. There may be opportunities for recovery before reaching the consequence. It is important to take recovery from errors into account in the assessment. A recovery process generally follows three stages:

1. Detection of the error
2. Diagnosis of what went wrong and how
3. Correction of the problem.

Example – Determine opportunities for recovery

Potential to recover (from the failure before the consequence occurs):

- Tank has interlock system ensuring earthing continuity
- Off-loading checklist including earth confirmation
- Operation completed with ADR qualified driver present

4.7 Recommend additional safeguards for preventing failure or improving recovery

Section 4.5 and 4.6 identified those PIF's for failure types that already have appropriate controls and safe-guards in place or have opportunities for recovery. For the remaining PIF's, consider what additional safeguards or recovery steps can reasonably[1] be implemented to mitigate the effect of the PIF, this may include:

Technical

- Removing human interaction by automating the process, e.g. introduce automatic loading shutdown in the event of a meter overrun to remove driver monitoring and manual intervention.
- Consider use of new signage or improving existing signs/ labels**,** e.g. improving valve labelling to ensure operator doesn't open incorrect valve by mistake.

Procedural

- Ensure safety critical steps are clearly identified and highlighted to those who carry out the tasks.
- For those tasks identified as safety critical, consider the use of job aids with detailed information of risks, minimum controls and potential human failures. E.g. breaking containment job aid, critical safety system maintenance.

Behavioural

- Introduce robust processes to maintain competency and compliance to procedures, e.g. competency checks for safety critical tasks.
- Introduce independents check at critical tasks, e.g. second permit to work authority verifies permit before issuing.

If the risk of the PIF for the task step cannot be mitigated, reference should be made to the risk assessment for the MAH to see where additional risk reduction measures can be introduced[1].

[1] Any further risk reduction measures should be subject to the ALARP principle.

Example – Recommended additional safeguards

Measures to reduce the consequence/failure:

Consider expansion of earthing continuity protection system to all offloading points

Change laboratory offloading procedure to include independent check/confirmation of earthing in place

Task currently completed by self-managing team. Frequency of supervision checks/ presence in area to be increased including checks of safety critical tasks

5. REFERENCE DOCUMENTS

Further information relating Human Factors analysis can be found in the following publications

1. Process Safety Leadership Group, final report – Safety and Environmental Standards for Fuel Storage Sites
2. HSE, Core Topic 3: Identifying Human Failures
3. HSE, Understanding the task
4. HSE, Performance Influencing Factors
5. HSG48, Reducing Error and Influencing Behaviour
6. Energy Institute, Guidance on human factors safety critical task analysis
7. Energy Institute, Guidance on quantified human reliability analysis (QHRA)

Abbreviations

Abbreviation	Description
ALARP	As Low as Reasonably Practicable
CDOIF	Chemical and Downstream Oil Industry Forum
CDU	Crude Distillation Unit
COMAH	Control of Major Accident Hazards
EI	Energy Institute
ESD	Emergency Shut Down
HAZID	Hazard Identification study
HAZOP	Hazard and Operability study
HEART	Human Error Analysis and Reduction Technique
HF	Human Factors
HFA	Human Failure Analysis
HSE	Health and Safety Executive
LOPA	Layer of Protection Analysis
MAH	Major Accident Hazard
PIF	Performance Influencing Factor
PPE	Personal Protective Equipment
PRV	Pressure Relief Valve
PSF	Performance Shaping Factors
PSLG	Process Safety Leadership Group
QHRA	Quantitative Human Reliability Assessment
SIL	Safety Integrity Level
SIS	Safety Instrumented System
THERP	Technique for Human Error Rate Prediction
UK	United Kingdom
UKPIA	United Kingdom Petroleum Industry Association

Acknowledgements

This document was created as part of the Chemical and Downstream Oil Industries Forum Process Safety work stream.

CDOIF wish to record their appreciation to the working group members who were responsible for creating this guideline:

Name	Organisation
David Smith (Chair)	Murco Petroleum Ltd
Barrie Salmon	Tank Storage Association
Chris Simes	Valero UK Ltd
Doug Leech	Chemical Business Association
James Greenhalgh	Valero UK Ltd
Karen Inchley	Essar Oil (UK) Ltd
Linda Dixon	Valero UK Ltd
Morven Ozanne	FMC Chemicals Ltd, representing the Chemical Industries Association
Nigel Collison	BP
Paul Kenny	Esso Petroleum Company Ltd
Peter Davidson	United Kingdom Petroleum Industry Association
Peter Hill	Total Lindsey Oil Refinery Ltd
Peter Jefferies	Phillips 66
Pippa Brockington	Health and Safety Executive
Stuart Duncan	PetroIneos Manufacturing Scotland Ltd
Vitor Monteiro	BP Oil UK Ltd

Revision History

Rev.	Section	Description	Date	Changed By
0.0	All	First Issue	05-Jul-2013	Peter Davidson
0.1	All	Updated following working group comments	10-Jul-2013	Peter Davidson
0.2	All	Final comments from working group incorporated	01-Aug-2013	Peter Davidson
0.3	All	Stakeholder comments incorporated	20-Sep-2013	Peter Davidson

Appendix 1 – Example key words for Human Failure Analysis

Action Errors

A1 Operation too long / short

A2 Operation mistimed

A3 Operation in wrong direction

A4 Operation too little / too much

A5 Operation too fast / too slow

A6 Misalign

A7 Right operation on wrong object

A8 Wrong operation on right object

A9 Operation omitted

A10 Operation incomplete

A11 Operation too early / late

Checking Errors

C1 Check omitted

C2 Check incomplete

C3 Right check on wrong object

C4 Wrong check on right object

C5 Check too early / late

Information Retrieval Errors

R1 Information not obtained

R2 Wrong information obtained

R3 Information retrieval incomplete

R4 Information incorrectly interpreted

Information Communication Errors

I1 Information not communicated

I2 Wrong information communicated

I3 Information communication incomplete

I4 Information communication unclear

Selection Errors

S1 Selection omitted

S2 Wrong selection made

Planning Errors

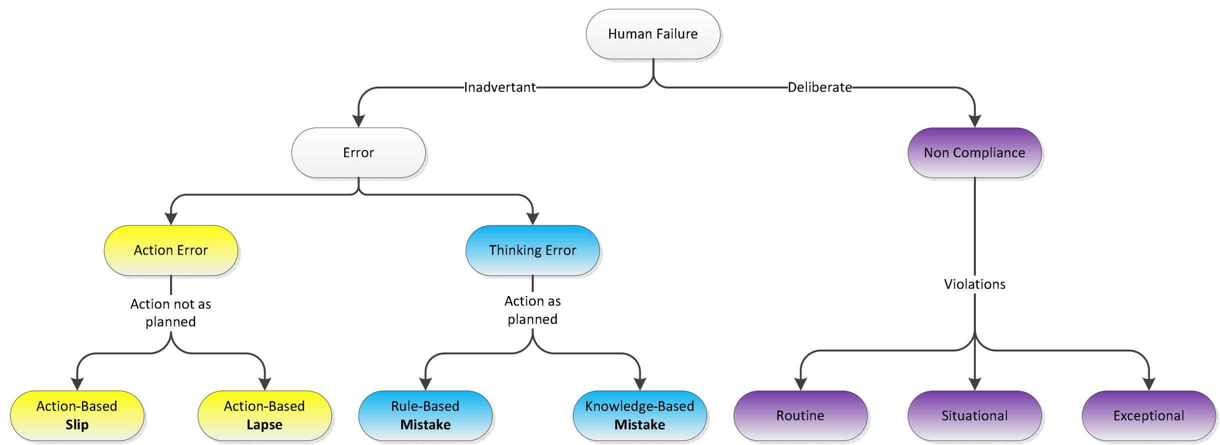
P1 Plan omitted

P2 Plan incorrect

Violations

V1 Deliberate actions

Appendix 2 – Example human failure types



	Characteristics	Failure Type	Examples	Typical Control Measures
Skill-based errors	Associated with familiar tasks that require little conscious attention. These 'skill-based' errors occur if attention is diverted, even momentarily. Resulting action is not intended: 'not doing what you meant to do'. Common during maintenance and repair activities.	**Slip** (Commission)	A simple, frequently-performed physical action goes wrong: • put on indicators instead of operating windscreen wash/wipe function • move a switch up rather than down (wrong action on right object) • take reading from wrong instrument (right action on wrong object) • transpose digits during data input into a process control interface	• human-centred design (consistency e.g. up always means off; intuitive layout of controls and instrumentation; level of automation etc.) • checklists and reminders; procedures with 'place markers' (tick off each step) • independent cross-check of critical tasks (PTW) • removal of distractions and interruptions • sufficient time available to complete task • warnings and alarms to help detect errors often made by experienced, highly-trained, well-motivated staff: <u>additional training not valid</u>
		Lapse (Omission)	Short-term memory lapse; omit to perform a required action: • forget to indicate at a road junction • medical implement left in patient after surgery • miss crucial step, or lose place, in a safety-critical procedure • drive road tanker away, after bulk delivery, with hose still connected	
Rule based errors	Decision-making failures; errors of judgement (involve mental processes linked to planning; info. gathering; communication etc.) Action is carried out,	Rule-Based **Mistake**	If behaviour is based on remembered rules and procedures, mistake occurs due to mis-application of a good rule or application of a bad rule: • misjudge overtaking manoeuvre in unfamiliar, under-powered car • assume £20 fuel will last a week but fail to account for rising prices • ignore alarm in real emergency, following history of spurious alarms	• plan for all relevant 'what ifs' (procedures for upset, abnormal and emergency scenarios) • regular drills/exercises for upsets/emergencies • clear overview / mental model (clear displays; system feedback; effective shift handover etc.)

	Characteristics	Failure Type	Examples	Typical Control Measures
Knowledge based errors	as planned, using conscious thought processes, but wrong course of action is taken: ‘*do the wrong thing believing it to be right’*	Knowledge-Based **Mistake**	Individual has no rules or routines available to handle an unusual situation: resorts to first principles and experience to solve problem: • rely on out-of-date map to plan unfamiliar route • misdiagnose process upset and take inappropriate corrective action (due to lack of experience or insufficient / incorrect information etc.)	• diagnostic tools and decision-making aids (flow-charts; schematics; job-aids etc.) • competence (knowledge and understanding of system; training in decision-making techniques) • organisational learning (capture and share experience of unusual events)
Violations	Deliberate deviations from rules, procedures, regulations etc. Also known as ‘non-conformance’. Knowingly take short cuts, or fail to follow procedures, to save time or effort. Usually well-meaning, but misguided (often exacerbated by unwitting encouragement from management for ‘getting the job done’).	**Routine**	Non-compliance becomes the ‘norm’; general consensus that rules no longer apply; characterised by a lack of meaningful enforcement: • high proportion of motorists drive at 80mph on the motorway • PTWs routinely authorised without physical, on-plant checks	• improve risk perception; promote understanding and raise awareness of ‘whys’ & consequences (e.g. warnings embedded within procedures) • increase likelihood of getting caught • effective supervision • reward compliance and investigate reasons for non-compliance; • eliminate reasons to cut corners (poor job design; inconvenient requirements; unnecessary rules; unrealistic workload and targets; unrealistic procedures; adverse environmental factors) • improve attitudes / organisational culture (active workforce involvement; encourage reporting of violations; make non-compliance ‘socially’ unacceptable e.g. drink-driving).
		Situational	Non-compliance dictated by situation-specific factors (time pressure; workload; unsuitable tools & equipment; weather); non-compliance may be the only solution to an impossible task: • van driver has no option but to speed to complete day’s deliveries	
		Exceptional	Person attempts to solve problem in highly unusual circumstances (often if something has gone wrong); takes a calculated risk in breaking rules: • after a puncture, speed excessively to ensure not late for meeting • delay ESD during emergency to prevent loss of production	
		Optimising	A person seeks to improve their experience or perception of a monotonous task by changing the way they carry it out: • Operatives compete to see how quickly they can carry out a task over-riding safety measures to increase speed	

Appendix 3 – Example Performance Influencing Factors

Job factors
Clarity of signs, signals, instructions and other information
System/equipment interface (labelling, alarms, error avoidance/ tolerance)
Difficulty/complexity of task
Routine or unusual
Divided attention
Procedures inadequate or inappropriate
Preparation for task (e.g. permits, risk assessments, checking)
Time available/required
Tools appropriate for task
Communication, with colleagues, supervision, contractor, other
Working environment (noise, heat, space, lighting, ventilation)

Person factors
Physical capability and condition
Fatigue (acute from temporary situation, or chronic)
Stress/morale
Work overload/underload
Competence to deal with circumstances
Motivation vs. other priorities

Organisation factors
Work pressures e.g. production vs. safety
Level and nature of supervision / leadership
Communication
Manning levels
Peer pressure
Clarity of roles and responsibilities
Consequences of failure to follow rules/procedures
Effectiveness of organisational learning (learning from experiences)
Organisational or safety culture, e.g. everyone breaks the rules

Appendix 4 – Example qualitative task analysis sheet

Table 1 Instructions

Task Step Description	Likely Human Failure	Is it a Slip, Lapse, Mistake or Violation	Potential Consequence	Performance Influencing Factors (PIF's)	Potential to Recover From Human Failure	Measures to Prevent Failure	Measures to Reduce the Consequence
Task steps taken from procedures. Walk through with shift controller	This column records the types of human error that are considered possible for this task step. Note there may be more than one type of error. Use the error codes to determine the error type. Use the error codes listed on the error code tab below for a list of all error types and their coding	Use the human failure sheet to assess the human failure type. This may be a mistake or a violation. It is important to determine this as it will have a direct impact on the solution.	This column records the consequences that may occur as a result of the human failure described in the previous columns. Use the risk matrix to determine the level of risk	This column records any factors which may have an influence on the operator's ability to undertake the task. This may include fatigue, weather conditions, distractions, workload etc. Use the PIF's detailed on the PIF tab below for a comprehensive list of PIF's.	Not all human failures will lead to an undesirable consequence. There may be opportunities for recovery before reaching the consequence detailed in the next column. It is important to take recovery from errors into account in the assessment. A recovery process generally follows three stages:- **detection** of the error, **diagnosis** of what went wrong and how, **correction** of the problem	List practical suggestions on how to prevent the error from occurring in this column. This may include changes to procedures, training, engineering modifications	This column details suggestions as to how the consequences of an incident may be reduced or the recovery potential increased should a failure occur

Review the task criticality / frequency and complexity, using table 3	If procedural support is not available in the recommended format then this issue must be addressed

Note: For Human Failure types refer to Appendix 2. For Performance Influencing factors refer to Appendix 3.

Table 2 Task Sheet

Task Observed ______________________

Date ________

Observed by:- ______________________

	Human Factors Analysis of Current Situation						**Additional Measures to Deal With Human Factor Issues**		
Step number	Task Step Description	Likely Human Failure	Is This a slip, lapse, mistake, or violation	Potential consequence	Performance Influencing Factors (PIF's)	Potential to Recover From Human Failure	Measures to Prevent Failure	Measures to Reduce the Consequence	Comments

Table 3 Procedural Support

Task Criticality		**Low**			**Medium**			**High**		
Task Familiarity		**Freq**	**Infreq**	**Rare**	**Freq**	**Infreq**	**Rare**	**Freq**	**Infreq**	**Rare**
Task Complexity	**Low**									
	Medium									
	High									

No Written Instructions Required

Job Aid Required i.e. Checklist

Step By Step Instructions Required

CDOIF **Chemical and Downstream Oil Industries Forum**	*CDOIF is a collaborative venture formed to agree strategic areas for joint industry / trade union / regulator action aimed at delivering health, safety and environmental improvements with cross-sector benefits.*

Appendix 5 – Worked example

<table>
<tr><th></th><th colspan="6">Human Factors Analysis of Current Situation</th><th colspan="3">Additional Measures to Deal With Human Factor Issues</th></tr>
<tr><th>Step number</th><th>Task Step Description</th><th>Likely Human Failure</th><th>Is This a slip, lapse, mistake, or violation</th><th>Potential consequence</th><th>Performance Influencing Factors (PIF's)</th><th>Potential to Recover From Human Failure</th><th>Measures to Prevent Failure</th><th>Measures to Reduce the Consequence</th><th>Comments</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Earth tanker when loading and offloading barrels and ISO's</td><td>Earthing strap omitted or used too late after filling offloading already begun

A2: Operation mistimed
A9: Operation omitted
A10: Operation incomplete
A11: Operation too early / late</td><td>Rule based mistake
Lapse (omission)
Lapse (omission)
Slip</td><td rowspan="3">Fire / explosion in the event of leak</td><td>Job Factors:
Divided attention
Time available / required

Person Factors:
Fatigue
Work over load

Organisation Factors:
Communication</td><td rowspan="3">Tank has interlock system to ensure earthing continuity

Offloading check list including earth confirmation

Operation completed with ADR driver present</td><td rowspan="3">Detailed procedures with SCT highlighted

MAH scenario signage at earth point

Earthing strap permanently fixed to plant end

Multiple and well positioned earth straps in place to avoid violation due to apathy</td><td rowspan="3">Consider expansion of earthing continuity protection system to all offloading points (capital project)

Change laboratory offloading procedure to include independent check / confirmation of earthing in place (review assessment including C1: Check omitted)

Task currently completed by self-managing team. Frequency of supervision checks / presence in area to be increased including checks of SCT (again, review assessment including C1: Check omitted)</td><td rowspan="3">N/A</td></tr>
<tr><td>Earthing accidently attached to non-conducting material

A6: Misalign
A7: Right operation on wrong object</td><td>Slip (commission)
Slip (commission)</td><td>Job Factors:
Clarity of instructions
Divided attention
Tools for task
Environment

Person Factors:
Fatigue</td></tr>
<tr><td>Failure to earth

V1 : Deliberate actions</td><td>Violation (routine, situational)</td><td>Job Factors:
Difficulty / Complexity of task
Time available / required

Person Factors:
Stress
Motivation vs. other priorities

Organisation Factors:
Work pressures
Clarity of R&R</td></tr>
</table>