INCORPORATION OF HUMAN FACTORS IN THE DESIGN PROCESS

This guide was prepared by:

Gitahi Kariuki
Katharina Löwe

Institute for Plant and Process Technology, Process Safety and Plant Technology
Technische Universität Berlin
Germany

Tel (+49) 30 314 26949
Fax (+49) 30 26907

E-mail: mailto:prism@tu-berlin.de
http://www.ast.tu-berlin.de

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1. Scope

Basically, all tasks could be analysed using this method but it focuses mainly on the tasks ranked as critical. That means those that could have adverse effects to the overall plant safety, reliability of a unit or the environment.

2. Task Identification /Description

First, the tasks need to be screened to identify those that need to be pursued. The tasks that have at least one of the following characteristics should be analysed:

2.1 Tasks are to be performed in abnormal environmental conditions requiring PPE or other temporary measures due to ambient temperatures (hot or cold); air quality; lighting; noise or vibration.

2.2 Tasks are in small (restricting movement) or confined spaces and requires operator to perform it for a periods of time.

2.3 Tasks involve manual materials handling or repetitive motion or working in an unusual body position.

2.4 Tasks to be performed are complex (especially if required during night shift) e.g. those having a high number of sequential steps or with a high information processing load, e.g. operator would have to consider many process readings, alarms, etc. and then decide on the right action.

2.5 If tasks were not performed correctly, they would have significant safety, health, environmental or production consequences.

2.6 Tasks involve process or work on equipment that is new (operator or maintainer has little or no experience) or for which past experience is that incidents occur more frequently or process, that has undergone modifications.

3. Ranking of Tasks according to criticality

Tasks are then grouped according to the consequences they would have if not correctly performed. One approach could be as presented on Table T1. The definition of consequences categories could be modified to fit different type of process industries as well as their sizes.

The highest risk is represented in the darker cells and therefore the analysis should start with the tasks that fall under this category. The clear cells indicate very little risk and this means that tasks appearing in these regions shall be analysed only when time and resources allow. Ranking of the tasks according to their criticality is a process that requires a good knowledge of the facility. It therefore requires pooling of knowledge of all design team members.

Conse-quence Category	Potential Consequences				Probability of Occurrence				
	Health/ Safety	Public Disrup-tion	Financial Impact	Environ-mental Impact	A Possibili-ty of repeated incidents	B Possibility of isolated incidents	C Possibility of occurring sometime	D Not likely to occur	E Practically impossible
I	Fatalities	Large Community	>€5M	Major cleanup. Potential long term effects					
II	Serious Injury	Small Community	€500K to €5M	Cleanup for several weeks					
III	Medical Treatment	Minor (few individuals)	€100K to €500K	Cleanup for several days					
IV	Minor impact	Minimal to none	< €100K	Confined to site. Minor effects					

Table T1: Example of Consequences Classification

4. Analysis of the tasks

The analysis begins by describing the task. This could be done on a Task Description Worksheet similar to the one on Table T2. This is only a guideline and therefore different analyses sheets could be used for unique types of installations. Among the factors to be identified are a). Operating environment e.g. high vibration, noise, poor lighting; b). The time the task is performed to consider lighting and fatigue; c). Location, either inside or outside because weather may play a role; d). Protective clothing to be worn by the operator because they may restrict movement, limit the grip strength or prevent good sight; e). Communication required and the system to be used and f). Visual requirements.

The Task Analysis Worksheet on Table T3 shall be used to record each significant task step and analyse them aspects in more details. It consists of four columns.

Task Description Worksheet				
Page _ of _	**Prepared by**:		**Date**:	
Job Name:				
Number of people involved in performing task:	**Operating Environment**: *Extreme temperatures, high noise, poor lighting, confined spaces etc*	**Location of Task:** *Indoor or Outdoor*	**Protective Equipment Required:** *Description of.*	**Time Task is Performed**: *Day only, 24-hour shift?*
Frequency of task: *Continually, hourly, daily, monthly etc.*	**Vision Requirements:** *Need to view controls and/or displays.*	**Communication:** *Verbal, radio, written, none*	**Related Knowledge:** *Knowledge required to carry out the task e.g. Understand steam pressure principles.*	
Review Aids: *Diagrams used e.g. P&ID, or sketches*				

Table T2: Task Description Worksheet Example

4.1 Task Step

This states the task step and in the sequence, each step has to be performed: As a rule of thumb task statement should contain action verb and an object, e.g. close inlet-valve.

4.2 Possible error and consequences

Each task is evaluated to identify potential errors associated with it. This information can help designers to make changes to reduce the probability of design-induced errors. For this purpose, two types of errors shall be considered. First is error of commission describes the situation where the operator performs a task incorrectly and second is error of omission which describes when the operator omits a step of the task or the whole task. Error of commission could be further subdivided as follows

a. Selection error
   - Operator selects wrong control
   - Issues a wrong command or information
b. Error of Sequence
c. Time error:
   - Too early or too late
d. Qualitative error:
   - Too little or too much

Consequences of each error should be evaluated and stated.

Task Analysis Worksheet			
Page _ of _	**Prepared by**:		**Date**:
Job Name:			
Task Step	**Possible Error and Consequences**	**Ergonomic / Human Factors concern**	**Possible Mitigation**
Example: *Open the drain valve*		*Drain valve located at inconvenient position.*	*Frequently operated valves to be designed according to valve anthropometrics data on PRISM GUIDELINES*

Table T3: Task Analysis Worksheet Example

4.3 Human Factors Issues

The next columns involve identifying all HF/ergonomics related issues. They could be obtained through brainstorming. Some of the issues are:

Physical Activities
- Manual Materials Handling
- Musculoskeletal
- Access, walkways, platforms
- Routes: Exit, Entrance, stairs

Receiving information
- Lighting

- Noise interference
- Display design

Processing Information

- Too much information
- Short-term Memory and Long-term Memory

These issues vary from one process to the next and therefore should be developed to suit each unique industry.

4.4 Mitigation and error reduction

Annex II provides a guideline of addressing various HF issues. This is a general guideline for the whole process industry. For critical tasks, tailored solution to the design of HMI should be adopted.

After task analyses is completed a final report should be written and proper documentations done for because the results shall be used in preparation of procedures and as a training guide.

5. References

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