

Annex C Human Factors Activities

ANNEX C HFE Activities 07.09.2014 Revision Adam Balfour

DRAFT - Work in Progress

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## C 1 Introduction to HFE activities during project development

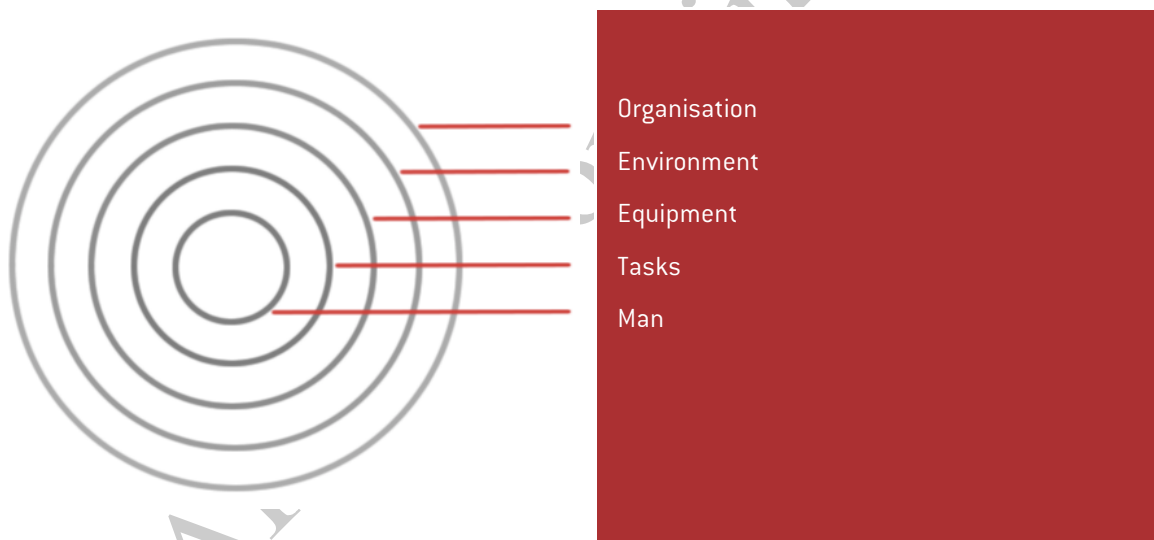
### C1.1 Introduction

The role of HFE (Human Factors/Ergonomics) is to optimise work systems design by ensuring that the work system is fully adapted to suit man's limitations, characteristics and aspirations (physical, sensory, psychological and sociological).

An optimised work system contributes to ensuring an individual's health, safety and comfort, effectiveness and performance, which in turn enables operational efficiency. A work system that is not optimised can increase the risk of fatigue, stress, errors, accidents, injury and ill health, and compromise output.

To achieve an optimal work system, Human Factors and Ergonomics principles (see ISO 11064-1, ISO 6385, EN 614-1, EN 894) should be iteratively applied throughout the design process and in a holistic manner, in order to achieve the best possible fit between people; - the work they do (tasks); - the tools they use; - their workplaces; their working environment, and the work organisation. It is the interaction between these factors that determines if the design is successfully adapted to suit the human and the work to be done.

*Figure 1: Human factors considers the interaction between Man, the Tasks to be performed, the Equipment used, the environment where work is performed and the Organisation.*



Whilst HFE is relevant for all work systems (several HFE methods are described in the General Annex A), it has special importance with regard to interactions between people and technical systems. Examples of where such interactions are found include, but are not limited to cabins (ROV, Drilling, Cranes) Panels (BOP, CAP) Communications systems, Bridges, Control rooms (onshore/offshore, helicopter control), control suites, and the interactions between these different rooms/systems (see 4.17 and 4.18).

### C 1.2 How to apply Annex C

The initial key activity for any HFE analysis or subsequent activity is the HFE screening. During the screening, the HFE risks are identified; prioritized and appropriate activities that will control these risks are chosen. The activities need to be proportionate to the characteristics of the project (minor or major project, new built or modification) and to the nature and magnitude of the risks. Criteria for identification of control activities might

for example, be whether novel technology is being used, work frequency required, known problems with similar equipment, etc. Regulatory requirements shall also be identified at this stage.

Based on the outcome of the screening, a selection from the possible activities listed in annex C can be put together and described and listed in the Human Factors Integration Plan: This document should include relevant control measures (resources, required competence, responsibilities, etc.).

## **C 2 Normative and Informative HFE References**

The following appropriate normative references SHALL be applied in the performance of HFE activities.

Table 2.1 Normative references

ISO 6385		
EEMUA 191 Alarm System Design, Rev 4, 2013		Now 4th edition – 2013
ISO 11064 – All Parts		
EN 894 – All Parts		
EN 614 Parts One & Two		
ISO 9241 - Ergonomics of human-system interaction -- Part 920: Guidance on tactile and haptic interactions.		
Etc.		

The following informative references may be useful for further understanding of the concepts and methods used in HFE.

Table 2.2 Informative references

Prevention of accidents through experience feedback.	Kjellen, U,	Taylor & Francis, London and New York, 2000
A guide to task analysis	Kirwan & Ainsworth	Taylor and Francis, 1992
Handbook of Human Factors	Salvendy, G A	4th Edition, Wiley, 2013

## **C 3 HF Activities by phase**

Note. The Human Factors Activities to be performed are determined by an iterative screening process, which will identify which activities are to be repeated and when. Activities for greenfield and brownfield may be different. The screening can also consider if activities (including from other disciplines) can be combined.

Several typical HFE activities, such as Experience Transfer, Situation Analysis, Task Analysis are described in Annex A – General.

Table 3.1 is intended to present an overview of the activities and which phases they apply to. For a more complete description of each activity, chapter C4 is referred to.

Activity / name	Deliverable	Feasibility	Concept	FEED	Detail Engineering	Construction	Commissioning	Verification in Operation
HFE Screening			X	X	X	X	X	
Situational analysis			X					
Develop HFE integration plan			X					
Apply anthropometric data				X	X			
Functional analysis and allocation			X	X	X	F	F	
Task analysis			X	X	X	X	F/V	
Job hazard analysis			X	X	X	F	V	
Safety critical task analysis				X	X	X	V	
Human reliability analysis					X			
Valve criticality analysis				X				
Skid analysis				X				
Physical workload / handling			X	X	X	F/V	V	
Psychosocial evaluation					X			
Organisation and manning analysis			X					
Mental workload			X	X	X			
Illumination				X				
Command, control and communication environments			X	X	X			
HMI			X	X	X			

## C 4 HF Activity descriptions

### 4.1 Human Factors and Ergonomics Screening

(See General Annex A for description).

#### 4.1.1 Goal

To establish which HFE analyses are needed.

#### 4.1.2 Description

Start by establishing the overall project plans and goals, and identifying which regulatory requirements and standards apply. Identify if there are any past projects that experience can be transferred from. Create a HFE feasibility report to assess the potential of the project. Define the operational and maintenance philosophy, as well as the areas that need situational or functional analysis.

- Overall Project Plans and Goals
- Regulatory requirements and standards
- Experience transfer
- HFE feasibility report
- Operational & maintenance philosophy
- Situational or Functional Analysis

#### 4.1.3 Deliverables

Create a HFE screening report defining human interaction, hazard potential, analysis methods that should be included and the level of detail required. The report should be developed in the context of regulatory requirements.

### 4.2 Situational analysis

(See General Annex A for description)

#### 4.2.1 Goal

Establish the impact of modification(s) on existing installations and operations in relation to the current regulatory requirements and related standards.

#### 4.2.2 Description

Identify current regulatory requirements and standards. Collect drawings, descriptions, equipment, lists of subject matter to be modified, in order to understand the goals & plans for modification. Evaluate the experience (positive and negative) with existing solution; this likely requires an on site survey/ evaluation of current solution for different modes of operation.

#### 4.2.3 Deliverables

Document a GAP Analysis describing impact of modification(s) in relation to the current situation. Perform analyses to describe the systems, function allocations, tasks, interfaces and operations that will be affected by the proposed modification. Analyses should be performed in relation to current regulatory requirements and standards.

### **4.3 Develop HFE Integration Plan (including steering documentation)**

(See General Annex A for description)

#### 4.3.1 Goal

Develop a plan for inclusion of HFE throughout system's lifecycle.

#### 4.3.2 Description

- Outputs / inputs from HFE Screening and HFE Integration Plan
- Regulatory requirements / best practice documentation

#### 4.3.3 Deliverables

Project relevant HFE documents which might include, but are not limited to:

- Overview of relevant HFE requirements
- HMI Philosophy / Specification
- HMI Style Guide
- Alarm Philosophy/ Requirements
- Alarm Response Manual

### **4.4 Apply Anthropometric data**

#### 4.4.1 Goal

Ensure that the design of the facility is fit for 95% of the intended user population, with regard to human body dimensions.

#### 4.4.2 Description

If anthropometric data is not available from a similar context, then it needs to be developed. Developing and applying correct anthropometric data is especially important if the facility is being designed outside Western Europe. Anthropometric calculations are carried out to determine correct dimension specifications (height, reach, width, etc.) of equipment design, lay out, position of controls and handles, etc. For the Norwegian Continental Shelf, anthropometric data for the Norwegian population (20 – 67 yrs) are applicable. The available data have been used to determine the Norwegian specifications that are mentioned in Chapter 6. The design criteria for human envelopes are given in ISO15534-1 but for other functional specifications the Company shall define and document the design criteria based on acknowledged anthropometric design methods.

The design shall be fit for the range from the 5<sup>th</sup> percentile female to the 95<sup>th</sup> percentile male of the Norwegian working population. For safety critical items (e.g. manhole sizes, height of emergency controls) the design range from the 1<sup>st</sup> percentile female up to the 99<sup>th</sup> percentile male shall be used.

#### 4.4.3 Deliverables

An overview of the chosen anthropometric design criteria for all relevant items and the resulting dimension specifications that is not already present in Chapter 6 of this standard. The anthropometric data that have been used for the overview shall be referred to.

## **4.5 Functional analysis and allocation**

### **4.5.1 Goal**

To appropriately allocate system functions between humans and technology, and location - onshore - offshore, and provide a starting point for all subsequent human factors and ergonomics analyses during the project.

### **4.5.2 Description**

The system and system goals are described and system functions are identified and allocated between human and technology (ref. ISO 11064-1 and/or EN 614-2 for description). This analysis and allocation applies to the entire installation, all workplaces, its systems and onshore or remote support. Depending on the complexity of the system a break down into sub systems can be made. The functional analysis shall consider all modes of operation (i.e. normal, emergency, testing, integrated operations, maintenance, cleaning, decommissioning) and especially the transition between modes. The functional analysis shall be performed as early as possible (latest in Select phase) and is the basis for all other human factors and ergonomics activities. It will need to be continuously reviewed in every following project phase and updated if/ as required throughout the project. Other Working Environment disciplines should be actively involved in this activity, as the result of an allocation of function might result in the human being allocated work in an area of the installation where s/he will be adversely exposed to working environment factors.

The analysis should examine:

- System boundaries
- System goals
- Automation philosophy
- Operational & maintenance philosophy
- Installation description

### **4.5.3 Deliverables**

A report, which contains a description of:

- The system and system goals
- System functions and allocation between human and technology
- Location of functions (onshore/offshore)

## **4.6 Task analysis**

(See General Annex A for description)

### **4.6.1 Goals**

Ensure solutions are optimised in relation to end users capabilities and limitations.

### **4.6.2 Description**

The tasks that need to be performed should be defined, so that they can be used to ensure that the systems installed properly support that task and that the layout places things frequently used together close to each other.

Documents related to this information may need to be reviewed for this process:

- Functional Analysis and Allocation
- Experience transfer
- Operations & maintenance manuals



- Procedures
- Operational Philosophies
- Installation drawings

#### 4.6.3 Deliverables

Create a task analysis report (hierarchical and tabular) providing an overview of tasks that are performed. The report should identify tasks requiring more detailed analyses (e.g. safety critical tasks, mental workload, physical workload, etc.).

### 4.7 Job Hazard Analysis

(See General Annex A for description).

#### 4.7.1 Goal

Identify potential job hazards in relation to tasks to be performed, tools/equipment to be used, and environments to be worked in. Finally, propose mitigation to address these hazards.

#### 4.7.2 Description

Job hazards are analysed to identify potential hazards in the work environment before they cause accidents. The hazards identified should be modified for a safer environment wherever possible, or the user should be warned in some way of the hazard if modification is not possible.

These documents may need to be reviewed for this process:

- Layout drawings
- List / description of tools/equipment
- Task analysis
- Experience transfer

#### 4.7.3 Deliverables

A report detailing focus areas, risk assessments and design solutions.

### 4.8 Safety Critical Task Analysis

#### 4.8.1 Goal

To identify tasks that are safety critical and understand which human actions or inactions might make a failure more likely or serious. Determine if additional risk reducing measures are required in order to ensure that risks are ALARP.

#### 4.8.2 Description

Tasks are analysed to identify safety critical tasks associated with major accident hazards. The analysis shall be used to identify potential human failures, the probability of failures and their related consequences. The range of factors that influence performance will be considered for both active failures and introduction of latent conditions. Necessary safety measures shall be implemented if risk of human error is considered to be unacceptable. Safety measures may be technical as well as operational. The analysis may have wide-ranging impact such as upon plant and equipment design, task design, procedure and training, etc. The analysis should be performed in the FEED phase, or when sufficient details regarding human system interaction are known.

There are several methods available (see e.g. Stanton, Salmon, Walker, Baber & Jenkins – Human Factors – A Practical Guide for Engineering and Design) and Energy Institute’s “Guidance on safety critical task analysis”.

These documents may need to be reviewed for this process:

- Functional Analysis
- Task Analysis
- HAZOP /HAZID
- SIL assessment
- LOPA Analysis

#### 4.8.3 Deliverables

A report describing safety critical tasks, the potential for human failure and safety measures that could be implemented reduce the probability for human error and its consequences.

### 4.9 Human Reliability Analysis

#### 4.9.1 Goal

The goal of a Human Reliability Analysis (HRA) is to support the assessment and reduction of risk associated with human error in safety critical systems. The results and findings of a HRA is used to reduce potential of human error and increase human reliability by improving human factors, such as procedures, human-machine-interface, training, workload, system configuration (e.g. automation) etc. Additionally, the results should be used to enhance the opportunity for recovery in the event of a failure / error.

#### 4.9.2 Description

Human Reliability Analysis should be applied to tasks where human error may contribute to the initiation or escalation of hazardous events, in order to enhance the system's capacity for recovery from failures and to reduce adverse consequences. Quantitative HRA may be included in SIL assessments and QRA/PRA where quantification of human reliability important to determine the total reliability of a system. A HRA should be performed when an identification of SCTs has been performed.

The choice of method should be based on the goal of the analysis with both qualitative and quantitative methods available. Techniques vary in their complexity, but aim to look beyond immediate 'active' failures to latent conditions (where the consequence of a human action are experienced later on). These accommodate factors that shape performance, such as individual capacity, the environment in which the job is undertaken, and the way that work is organised. For guidance, see Energy Institutes «*Guidance on quantified human reliability analysis*».

These documents may need to be reviewed for this process:

- System descriptions
- Task procedures
- P&IDs
- QRA/PRA
- HAZOP
- FMECA

#### 4.9.3 Deliverables

A report assessing human reliability and its effect on overall system safety. It shall also include risk reduction measures if risk is found to be unacceptable. An HRA may also integrated in a QRA/PRA or SIL analysis.

#### 4.10 Valve Criticality Analysis

##### 4.10.1 Goal

To ensure that all valve configurations are designed for the performance of safe and efficient operations and maintenance.

##### 4.10.2 Description

All valves will be listed in a valve inventory. Based upon risk criteria (such as criticality, frequency of operation or maintenance) a criticality rating will also be applied. For each criticality rating, specific design requirements will apply, such as access, forces for operation, and if it is to be locked, closed or open. The analysis may also inform valve selection or design, such as in the use of gears, the use of quarter turn ball valves instead of globe valves, or the employment of actuators instead of a manual operation. It is first undertaken during FEED and during detailed design, as changes occur.

For more information regarding valve criticality, see “*Human factors engineering in projects*” (OGP report no. 454, 2011).

Documentation related to this information may need to be reviewed for this process:

- P&IDs
- HAZOP / HAZID
- Process Safety Analyses
- Frequency of use

##### 4.10.3 Deliverables

A report detailing the valve risk criteria and specified design requirements.

#### 4.11 Skid Analysis

(Relocated to Annex B Procurement Packages)

##### 4.11.1 Goal

Ensure add-on units and packages are compatible with the existing facility (especially interfaces).

##### 4.11.2 Description

- Safety Critical Task Analysis
- Experience transfer

##### 4.11.3 Deliverables

A report of skid criticality, WE implications and HF design requirements.

#### 4.12 Physical workload / handling

##### 4.12.1 Goal

To ensure a safe and efficient physical workload and material handling environment. To generate design requirements that ensure an acceptable level of worker physical workload. This includes, but is not limited to, design requirements for efficient handling, transport and storage of products and tools, access for maintenance and energetic load, e.g. due to climbing stairs.

#### 4.12.2 Description

The task analyses will identify activities where physical interaction is required. Whilst a certain amount of physical activity and movement is desirable, poorly designed tasks can exceed an individual's energetic capacity or create risk factors for musculoskeletal injuries. These activities will be subject to analysis of the physical load characteristics (such a lifting/carrying, pushing/pulling, static postures/motions, repetitive motions, vibrations/shocks and energetic load). **The analyses to take account of workplace design factors such as layout, access and clearance for task performance, location of work functions (displays, control actuators, manually operated equipment), viewing conditions, lifting and transportation aids.** Specific assessment methods might be indicated to quantify the load and / or the health risk. The results shall be assessed holistically and not as separate tasks. The handling and workload philosophy will be established at Concept and integrated during FEED and engineering /detailed design phases.

The manual handling component of this activity shall be integrated with the overall material handling study.

These documents may need to be reviewed for this process:

- Material Handling Philosophy
- Operations and Maintenance Philosophy
- Description tools/equipment for material handling
- Task Analysis
- Layout drawings/2D/3D models

#### 4.12.3 Deliverables

A report showing the workload and handling assessment and specification for work environment and organisational changes that will successfully avoid or reduce adverse physical workload.

### 4.13 Psychosocial Evaluation

#### 4.13.1 Goals

Ensure health, safety, and welfare under work and leisure conditions.

#### 4.13.2 Description

As input to detailed engineering, the company shall perform a systematic analysis of the preconditions for a safe, efficient and health-promoting interaction between the worker and the environment. The purpose is to analyse organisation, manning, and workplace design in order to identify potential problem areas related to psychosocial WE in particular.

For various positions on the installation, the analysis should, as a minimum, include an evaluation of the psychological job demands and the preconditions for social interaction/support and control at work. The analysis should also consider the preconditions for restitution during the time off at the installation.

These documents may need to be reviewed for this process:

- Job descriptions
- Drawings
- Manning plans

Reference is made to the psychosocial analysis method, DRA, in G.2.

#### 4.13.3 Deliverables

A report that evaluates psychosocial risk for personnel and proposes risk-reducing measures.

#### **4.14 Organisation and manning analysis**

(See General Annex A for description).

##### **4.14.1 Goal**

To ensure efficient and competent manning for all modes of operation.

##### **4.14.2 Description**

- Operation, maintenance and manning philosophies
- Handing / workload analyses
- Task analyses
- Drawings/GA's

##### **4.14.3 Deliverables**

A report on organisation and manning.

#### **4.15 Mental workload and situational awareness**

##### **4.15.1 Goal**

To ensure an appropriate mental workload for the individual user and an even distribution of mental workload across teams and shifts in any operational mode. To ensure situational awareness in all modes of operation.

##### **4.15.2 Description**

Mental workload shall be evaluated in systems where the mental workload of the operators can have consequences for operation and safety. This includes safety critical control and monitoring tasks in control rooms, drilling cabins, support centres and similar. Mental workload is a product of the task, the persons involved, the technology used, the working environment and the organisation. Adverse health effects, performance decrement and increased potential for human error are associated with both overload and underload. An analysis of the mental workload shall establish the total workload for each job position, and the team as a whole. The level of detail shall be determined by the importance of mental workload for safe and reliable operations, taking into account the task duration, intensity, frequency and fluctuation of demands during a work shift. Mental workload shall be considered at Concept, FEED and detailed engineering phases.

These documents may need to be reviewed for this process:

- Functional Analysis
- Task Analysis
- Organisation and Manning Philosophy
- HMI and communication design
- Operational Philosophy

##### **4.15.3 Deliverables**

A report defining the results of the mental workload analysis, high risk activities and remedial measures to be put in place.

#### **4.16 Illumination (Include in Chapter 6 Requirements & HF for control rooms)**

##### **4.16.1 Goal**

To provide lighting that ensures an individual's safety, health, wellbeing and that is appropriate for performance of tasks in a range of locations.

#### 4.16.2 Description

The lighting environment shall fulfil task and user needs and applies to all areas, including the Central Control Room, offices, workshops, process areas and living quarters. The lighting quality shall provide high visual comfort, good modelling and correct light intensity. A high colour representation shall also be provided for CCR, offices and living quarters.

The range of human factors analyses informs task and user needs. Assessment of visual element shall identify the size, colour, reflectance, luminance, and movement range of the objects to be viewed; the complexity, criticality and duration of the interaction; and influence upon the visual field from other sources (such as shadow, glare, colour contrast and self-illuminated equipment). Lighting principals shall be established at FEED stage and later integrated into the detailed design. Lighting requirements for some specific areas or operations are defined elsewhere, such as for Control Rooms (ISO 11064-6), emergency lighting (NORSOK S-001), and maintenance of indoor electric systems (CIE 97:2005).

These documents may need to be reviewed for this process:

- Task analysis
- Drawings / 3D models
- O&M Philosophy

#### 4.16.3 Deliverables

A plan detailing the analysis, recommended qualities and locations of lighting and maintenance requirements. Additionally it should detail the follow up activities throughout design, commissioning, and operations.

### **4.17 Command, Control and Communication environments**

#### 4.17.1 Goal

Provide a command, control and communication environment that will reduce the probability of error or mistakes being made, enhance operational efficiency and maintain the safety, health and well-being of personnel operating in the control environment. Additionally, enhance usability and performance of the environment.

#### 4.17.2 Description

Command, control, communication and monitoring functions may be co-located in one environment (typically referred to as a central control room) or distributed between several locations ("local control rooms" - land and offshore) or the control environment may consist of just one function (e.g. lifting) in a cabin or at a panel. Regardless of the number and configuration of the functions that are being monitored and controlled, the HFE goals stated above, the HFE principles and HFE design process (which is scalable) shall apply. Actual designs will differ - but these will be informed by the HFE principles, analyses and design process.

The HFE principles, requirements and design process stipulated in ISO 11064 Part One shall be applied in the design of command, control and communication environments such as cabins (cranes, various driller control cabins, off loaders cabin, heliguard, etc.) and control rooms (e.g. ROV control, BOP control, the Central Control Room, Emergency Control Room, Emergency Preparedness Centre, Communications and collaboration centre /environment, etc.). This entails establishing a control environment group that includes formal HF expertise, designers/architects, equipment /system suppliers and end users and end users representatives ("Vernombud/safety delegate"). Tools for ensuring a common understanding between the groups members should be used, e.g. physical scale models, 3 D models or sketches. The models/ sketches to become more detailed as the design progresses.

During concept definition and optimisation/FEED, the human factors activity shall include a functional analysis and allocation describing functions to be performed, defining system performance requirements, and allocating manual and/or automatic functions, a task analysis defining tasks based on allocated functions, and defining

requirements (time, cognitive demands, etc.) for operator tasks, including information needed and the interface devices necessary to handle these tasks. Models (physical and/or 3D), prototypes, sketches of different conceptual alternatives shall be developed.

During engineering, a job and work organisation analysis shall be performed to provide input regarding job design and organisation of operator work, including requirements to communications, operating procedures, operator training and information and control.

The analyses shall be updated and elaborated in an iterative process to ensure that further development of requirements is in compliance with the main objectives and philosophies. A full-scale mock up shall be considered during detailed design.

For mobile offshore units, ISO 11064 (all parts) should be applied in design of the wheelhouse/bridge and the machine control room.

For control cabins, such as crane cabins, EN 894 and EN 614 shall apply.

For the design of control suites, ISO 11064-2 shall be applied.

For the conceptual design of control room layouts, ISO 11064-3 shall be applied.

For the detailed design of control room layouts and dimensions, ISO 11064-4 shall be applied. Dimensions given in relation to equipment and systems should be assessed and where necessary, modified in relation to dimensions of current systems and equipment. For example, the depth of a control desk should not need to accommodate the depth of a CRT display, but the depth of an LCD/ LED display.

For control rooms and control suites, the environmental requirements given in ISO 11064-6 shall be applied.

Documents related to the information below may need to be reviewed for this process:

- Experience data
- Stakeholder analyses
- Initial GA drawings of LQ
- Interrelationship with other rooms
- Overall goals
- Functional Analysis
- Manning / operation philosophy
- HF analyses such as Functional
- Task, SCTA, Job and work Organisation
- Vendor information (furniture, equipment, technology)

#### 4.17.3 Validation and Verification

In accordance with ISO 11064-1 and ISO 11064-7, a procedure for unambiguously verifying and validating command, control and communications environments (cabins and rooms) iteratively throughout the design process, shall be established. The validation activities shall assess the ability of the control environment to handle all modes of operation. Validation activities shall assess work place design, work environment, the interfaces of control and communication systems, procedures, work organisation and training. The assessment shall examine the aforementioned factors individually and collectively. Validation of the factors individually can be performed using prototypes, scale models, CAD systems, checklists, performing calculations (e.g. of sight lines, environmental factors) or measurements. Collective or dynamic validations could be performed using scenario analyses, walkthroughs of safety critical tasks, simulations, usability testing, etc. The validation exercises should also assess the interactions with other related rooms (e.g. all the drilling related control environments together; the CCR and the Emergency preparedness room together, etc.). Weak points in the

control environment's ability to handle the different modes of operation should be identified and mitigated. The validation and verification activities should be documented.

#### 4.17.4 Deliverables

- HF Plan for development and validation & verification of Control Environment
- HF Analyses including Function Analysis and Allocation, Task Analyses, Link Analyses, Communication Analysis, Job and Workload Analyses (including assessment of mental workload and situational awareness)
- Control Room Design Specification
- Technology Assessments (e.g. projectors, LSD, CAP, etc.)
- Documentation of Validation and Verification activities performed in different phases of design process according to plan
- Concept Designs (models, drawings, sketches) of alternative room layouts and equipment location
- Mock-Up of control room
- Equipment designs
- Criteria for assessing alternative concepts & documentation of concept assessments
- Detailed designs of room and equipment, furniture, room elements
- Control Environment Development Plan including team, resources, mandate. Initial location of rooms, physical spaces needed / available. Initial high-level concepts.
- Control Room overviewing systems, equipment and furniture concepts, layout, drawings, models and specifications. Technology Assessment.

### 4.18 Human Machine Interface

#### 4.18.1 Goals

Ensure Optimal HMI in order to achieve user acceptance, effectiveness, efficiency, reduced load on operator.

Provide Human Machine Interfaces (HMI) that:

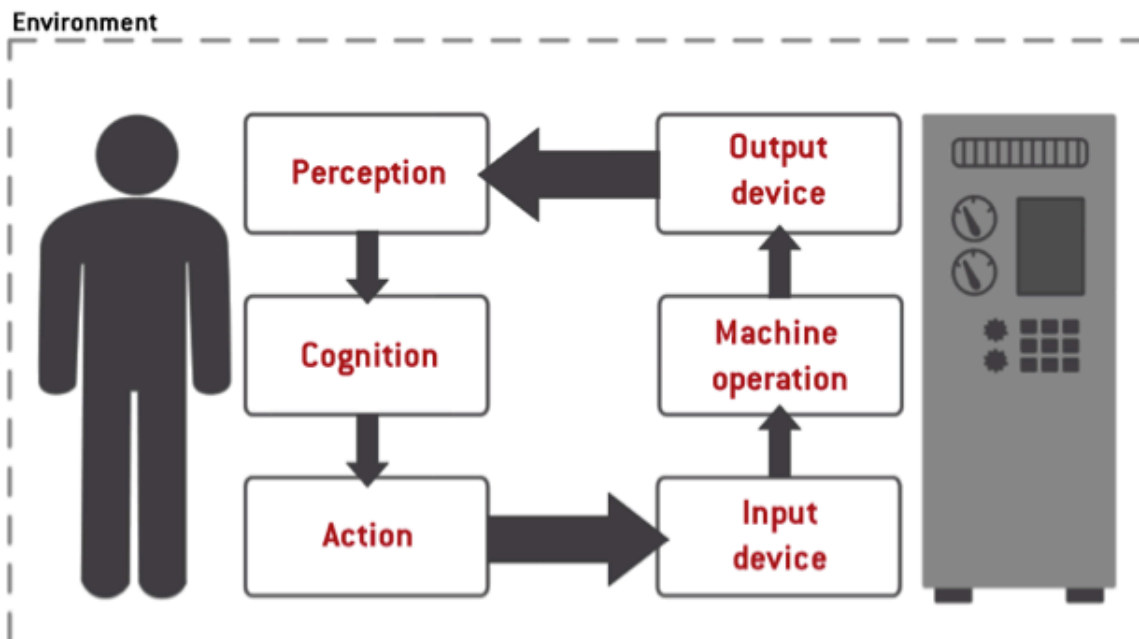
- Reduce the probability of human error or mistakes occurring
- Support correct and efficient recovery if errors / mistakes occur
- Ensure the health, safety and wellbeing of users
- Enhance operational efficiency
- Are usable - i.e. easy to use, efficient in operation and accepted by end users
- Are adapted to the human operators perceptual and cognitive capacities and limitations
- Are adapted to all modes of operation
- Are consistent both with regards to their interaction and information elements
- Support a motivating working environment
- Avoid RSI
- Improve operators situational awareness

#### 4.18.2 Description

The term "HMI" includes all controls and displays: software, physical, digital and analogue that the operator uses to control or monitor a function. The term "HMI" covers interfaces on individual control panels (e.g. BOP), those found in cabins (e.g. driller's cabins) and control and monitoring environments. Alarm presentation, management and operator response are included in the term "HMI".

The elements of Human Machine Interaction are illustrated in Figure 4.1.





Information from the system is provided through the visual, acoustic or haptic channels, or a combination of these. The information should be adapted to the channels for perception and presented in a manner that supports the cognitive processes of the human operator. Human control can be performed by voice, physical movement or by touch, using various parts of the human body, feet, knees, hands, fingers etc. The mandated EN 894 series (four parts) describes the processes for determining the choice of input and output devices and location of these. EN 894 (all parts) shall be followed.

For displays and controls that come under the Machinery Directive, EN 614 Parts 1 and 2 and EN 894 (all 4 parts) shall apply. Visual danger signals shall be according to EN 842. EN 891 shall be applied to systems for auditory and visual danger and information signals.

The principles and design processes described in ISO 11064-5 shall be applied to the design and evaluation of Human Machine Interfaces. This entails establishing an HMI team, that as a minimum consists of formal expertise in Human Factors, interaction design, systems design, instrumentation, telecommunications, end users and end users' representatives.

Tools for ensuring a common understanding between the groups members should be used, e.g. prototypes, sketches and wireframes. The wireframes/ sketches to become more detailed as the design progresses.

During concept definition and optimisation/FEED, the activity shall include writing an HMI philosophy, a functional analysis and allocation describing functions to be performed, defining system performance (usability) requirements, allocating manual and/or automatic functions, a task analysis defining tasks based on allocated functions, and defining requirements (time, cognitive demands, etc.) for operator tasks, including information needed and the interface devices necessary to handle these tasks. Examples (sketches, prototypes, wireframes), of different conceptual alternatives shall be developed and evaluated.

The analyses shall be updated and elaborated in an iterative process to ensure that further development of requirements is in compliance with the main objectives and philosophies. An interactive model should be provided during detailed design.

The analyses and iterative design should be based on:

- Overall system goals
- Functional analysis / allocation

- Company / general Style Guide
- Experience data
- Philosophies
- Specifications

#### 4.18.3 Validation and Verification

In accordance with ISO 11064-1, ISO 11064-5 and ISO 11064-7, a procedure for unambiguously verifying and validating the HMI iteratively throughout the design process, shall be established. The validation activities shall assess the ability of the HMI to handle all modes of operation. Validation activities shall assess the interfaces of control and communication systems, including alarms. Validation can be performed using tools such as prototypes, interactive models, checklists, or usability evaluations. Methods for validation include usability analysis, scenario analyses, walkthroughs of safety critical tasks, simulations, etc. The validation exercises should also assess the interactions with other related HMI systems. (e.g. all the drilling related control systems together). Weak points in the control system's ability to handle the different modes of operation should be identified and mitigated. The validation and verification activities shall be documented.

Alarm presentation and documentation of operator responses shall be in accordance with EEMUA 191 Rev 4, 2013.

Tactile interfaces shall follow the principles and processes described in ISO 9241 - Ergonomics of human-system interaction -- Part 920: Guidance on tactile and haptic interactions.

#### 4.18.4 Deliverables

- Plan for HMI development and Validation and Verification, including system boundaries, & goals
- HMI Philosophy & Specification
- HMI report detailing concepts, specifications, symbols & usability testing
- HMI-IAT & HMI- FAT
- Alarm Philosophy & Specification
- Alarm Response Manual
- HF Analyses, including Functional Analysis, Functional Allocation, Task Analysis, Job/Workload Analysis
- Concept & Detailed Designs
- Development of User Documentation
- Training

## **ANNEX C1. Guidelines for Skid Analysis**

(Relocated to Annex B Procurement Packages OR S005)

## **ANNEX C2: Guidelines for Valve Criticality Analysis**

Content of this analysis proposed relocated to Chapter 6, Requirements. Therefore Guideline proposed removed. Please see OGP Guideline 454 as a useful information source.

## **ANNEX C3: Task analysis**

**Proposed relocated to new Methods Annex.**

In a task analysis, functions allocated to operators are broken down into units of work, which are described and systemised to ensure necessary resources to support successful work performance.

Both the requirements to the employees' capabilities (skills, knowledge, etc.) and to the working environment (controls, displays, procedures, etc.) are considered.

There are many variations of task analysis. A simple method adapted for industrial use lists the sequence of tasks by purpose, action, needed information input, and problems related to controls, displays and working posture. Results are used in order to identify the requirements for a good design as input to the redesign of the workplace.

(Add examples of TA – Hierarchical, Tabular, etc)

See ISO 6385, ISO 11064-1, 614-1, EN 614-2 and EN 894.

Salvendy, G. (Ed.): Handbook of Human Factors. Wiley, 2013

Kirwan, B., Ainsworth, L.K.: A guide to task analysis. Taylor and Francis, 1992.