H F - A s s e s s m e n t M e t h o d

- for control rooms. 2003

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Norwegian Petroleum Directorate
Developed by Human Factors Solutions - 2003

Contents

Summary

Scope

This document is a verification and validation (V & V) tool. The HF-Assessment Method can be used for systematically reviewing both the *process* of how Human Factors has been integrated into the design and operation of control rooms and for evaluating the *results* of this process.

Human Factors (HF) is a scientific discipline that applies systematic methods and knowledge about people to evaluate and improve the interaction between individuals, technology and organisations. The aim of HF is to create a working environment (that to the largest extent possible) contributes to achieving healthy, effective and safe operations. The HF-Assessment Method focuses on how the interactions can contribute towards the creation of a safe and cost-efficient work system.

The term ”control room” in this document includes all types of control room that have safety critical functions, such as central control rooms, emergency control rooms, drillers cabin, off-loaders cabin, crane cabins. The control room could be onshore or offshore. The HF-Assessment Method can be used under the development of new control rooms, modifications, upgrades or evaluation of existing control rooms.

The HF-Assessment Method is developed for the Norwegian Petroleum Directorate (NPD) and the petroleum industry.

Objective

The NPD regards the development and use of the HF-Assessment Method as an important contribution to the work of improving the overall level of health, safety and working environment in control rooms, in accordance with HSE Regulations that came into force 01.01.2002. Specifically, this tool shall aid evaluation of how control rooms:

- support the operator in carrying out the tasks necessary to maintain safe conditions during different types of operation modes and emergency situations;
- reduce the risk of human error leading to initiation, prolongation or worsening of production upsets and emergency situations;
- minimises the risk of work related illness and injury to the operator.

Use of acknowledged HF-principles and methods to in the control room will also contribute to better optimisation of production. A well designed control room will lead to fewer shutdowns, increased regularity of production and thereby improved performance for the whole production process.

Background

Most petroleum installations have one or several control rooms that function as safety critical barriers against major hazards. It is thus of vital importance that these systems are designed according to recognised principles for human-machine interface design and Human Factors. However the NPD experiences that this is seldom the case. It regards a lack of systematic integration of Human Factors into the design of control rooms as one of the root causes of health, safety and work environmental problems. Examples of these problems include: the control room operator having to deal with too many alarms simultaneously, several safety critical tasks that have to be performed simultaneously, operating stations as well as communications and display equipment that should be used simultaneously is located distant to each other, operators work load is uneven and at times relatively high, there is a lack of a total overview of events/incidents.

The NPD has noted a series of trends in the petroleum industry that also impact on the health, safety and work environment of control rooms. These include;

- increasing technological complexity in control rooms (integration of traditionally separated interfaces – process/safety),
- new functions and tasks allocated to the control room (e.g. helicopter transit, environmental monitoring, telephone exchange) without a corresponding increase in manning,
- process output is being pushed above design limits over long periods of time.

The new HSE Regulations (01.01.2002) clarify and emphasise the requirements with regard to HSE management, HSE strategy, steering, goal setting, competence and documentation of HSE (including HF) throughout the systems design process. The Regulations set requirements for risk reduction, lowest level of pollution, development of "barrier" philosophy, employee participation, HSE culture, continual surveillance and improvement of the WE and safety. The new Regulations confirm the importance of HF principles in relation to safety critical activities for a number of areas, especially control room activities, in FR §§ 19 and 20 and AR §§ 31 and 32.

It is in this context, that the NPD has decided to refine existing validation and verification tools for assessing how human factors is systematically addressed in the design, modification and operation of planned and existing control rooms. The tool presented in this document builds upon previous documents such as "Ergonomic analysis and guidelines" (NPD 1993), and "A Method for Reviewing Human Factors in Control room Design" (NPD 2000). NPD has also produced a guideline on the design of Alarm Systems (YA 711- 2001).

Basis for requirements

The method is based upon the identification and synthesis of Human Factors related requirements in the new HSE Regulations (2002), Guidance documents (YA 711), the ISO 11064 series, ISO 6385 (2002), updated NORSOK standards, results from an evaluation of "A method for Reviewing Human Factors in Control room Design" (June 2000) together with inputs from the petroleum industry and other regulatory agencies both in and outside Norway.

Intended benefits from use of this tool are:

Reduced	Improved
Costs in the development and operation of control rooms	Safety
Probability of human error	Process performance
Probability and cost of redesign/modifications	Work environment
Sickness absence / staff turnover	Communication between NPD and Industry
Risk of environmental spills	Management of emergency situations
Training costs	

About the HF-Assessment Method

The HF-Assessment Method consists of two parts:

NR.	Title	Contents
1.	Introduction	An introduction to this document and checklists
2.	Check lists 1. Documentation Checklist 2. General Checklist 3. Specific Checklist	Seven revision checklists 1 - Questions and references that cover minimum requirements to Documentation 1 - Questions and references that cover minimum requirements to all phases 5 - Questions and references that cover minimum requirements to each phase

The HF-Assessment Method exists in two languages[1], English and Norwegian, and can be downloaded from www.npd.no

Limitations

This tool is a revision tool, not a Guideline for design. Use of a design guide may be an effective way of meeting the requirements in this document. The tool does not introduce any new requirements, but specifies and emphasises important HF requirements with a basis in the NPD HSE Regulations (2002) and existing standards (international, European and industry) in this area. It should be noted that Regulations, ISO standards, NORSOK and methods used are under continual development. For example, per March 2003, ISO 11064 has three completed parts (1-3), whilst four parts (4-7) are under development. The reader should therefore check for the latest version of standards, regulations, and other documents (if applicable).

Technological trends (e.g. use of body worn control rooms, remote operation of control rooms) may elicit new requirements not directly covered in this revision tool. It should be noted that the Regulations which apply to the petroleum industry require continual improvement. Best practice changes constantly and it is expected that solutions reflect current societal and technological standards.

Requirements to the user of this revision tool

The organisation responsible for HSE is required to ensures that it has the necessary Human Factors competence (MR § 11) to comprehend and use the checklists, and to have experience with using HSE Regulations, relevant Human Factors standards (ISO 11064, ISO 6385, etc.) and relevant NORSOK standards. Therefore, no examples of methods/solutions are included in the checklists, although references are made in the guidance.

Acknowledgements

This tool has been developed by Human Factors Solutions (HFS), Norway, under contract to the NPD, in cooperation with a variety of stakeholders in the Norwegian petroleum industry. We acknowledge the many useful contributions made by the projects reference group and those that have additionally participated in developing the HF-Assessment Method.

Human Factors Solutions Jernbaneveien 4 1400 Ski Norge	Ph: + 47 64914440 Fax: + 47 64914449 Mail: company@hfs.no www.hfs.no

[1] Note. The two versions are not necessarily identical word for word, but are formulated so that the intentions and contents are the same.

Normative references

References	Full Name
Working Environment Act (WEA)	Act 4 February number 4 relating to worker protection and working environment, etc. 1977
Framework Regulations	Regulations relating to Health, Environment and Safety in the Petroleum Activities (The Framework Regulations), 2002
Management Regulations	Regulations relating to Management in the Petroleum Activities (The Management Regulations), 2002
Information Duty Regulations	Regulations relating to Material and Information in the Petroleum Activities (The Information Duty Regulations), 2002
Facility Regulations	Regulations relating to Design and Outfitting of Facilities in the Petroleum Activities (The Facilities Regulations), 2002
Activities Regulations	Regulations relating to Conduct of Activities in the Petroleum Activities (The Activities Regulations), 2002
ISO 11064 – 1 ISO 11064 – 2 ISO 11064 – 3	Ergonomic design of control rooms, Part 1: Principles for the design of control rooms, 2000 Part 2: Principles for the arrangement of control suites, 2000 Part 3: Control room layout, 1999
ISO (DIS) 6385	Ergonomic principles in the design of work systems, 2002
ISO 9241	Ergonomic requirements for office work with visual display terminals, (VDTs)
ISO (DIS) 9921	Ergonomics - Assessment of speech communication, 1996
ISO 10075- 1 ISO 10075- 2	Ergonomic principles related to mental work-load: General terms and definitions, 1991 Ergonomic principles related to mental work-load: Design principles, 1996
ISO 17776	Petroleum and natural gas industries –Offshore production installations: Guidelines on tools and techniques for hazard identification and risk assessment, 2000.
IEC 61508	Functional Safety of Electrical/ Electronic/programmable Electronic Safety Related Systems (Parts 1- 7), 1998-2000
EN 614 - 1 EN 614 - 2	Safety of machinery, Ergonomic design principles, Part 1: Terminology and general principles, 1995 Part 2: Interactions between the design of machinery and work tasks, 2000
EN 894 – 1 EN 894 – 2 EN 894 – 3	Safety of machinery, Ergonomic requirements for the design of displays and actuators – Part 1: General principles for human interaction with displays and control actuators. 1997 Part 2: Displays, 1997 Part 3: Control Actuators, 2000
NORSOK I-CR-004 NORSOK S-002 NORSOK Z-013	Control Centre, rev 1, 1996 Working environment, rev. 3, 1997 Risk and emergency preparedness analysis, rev 2, 2001

Abbreviations and Definitions

Abbreviations

For this document the following abbreviations apply:

Abbreviations	Full name
AR	The Activities Regulations
CCR	Central Control Room
EJA	Ergonomics Job Analysis
EN	European Norm
EPA	Emergency Preparedness
ESD	Emergency Shut Down (system)
F & G	Fire and Gas
FR	The Facilities Regulations
FrmR	The Framework Regulations
HED	Human error dependency
HF	Human Factors
HSE	Health, Safety and Environment
IR	The Information Duty Regulations
ISO	International Standards Organisation
MR	The Management Regulations
NORSOK	Norwegian offshore sector's industry standards.
NPD	Norwegian Petroleum Directorate
PA	Public Address system
PSD	Process Shut Down
SAS	Safety and Automation System
SIL	Safety Integrity Level
V & V	Verification and Validation
VDU	Visual Display Unit
VR	Virtual Reality
WE	Work Environment
WEA	Work Environment Act
3D	Three Dimensional

Definitions

For this document the following definitions apply:

Term	Definition
Alarm	An Alarm is a visual and/or audible indication of an abnormal condition which requires attention and/or corrective action. An alarm shall not be used to indicate status information only.
Control room	The term "control room" in this document includes all types of control room, such as central control rooms, emergency control rooms, drillers cabins, offloaders cabins and crane cabin. Control rooms can be both onshore or offshore. A control room is formally defined as "The core functional entity, and its associated physical structure, where operators are stationed to carry out centralized control, monitoring and administrative responsibilities." (Ref: ISO 11064 – 1).
Control suite	A group of functionally related rooms co-located with the control room and including it, which houses the supporting functions to the control room, such as related offices, equipment, rooms, rest-areas and training rooms (Ref: ISO 11064 – 1).

Term	Definition
Emergency control room	A control room provided to relieve the CCR and its staff from personnel traffic in a distress situation, usually located close to the CCR.
Emergency preparedness	All technical, operational and organisational measures that prevent a dangerous situation that has occurred from developing into an accidental event, or that prevent or reduce the harmful effects of accidental events that have occurred.
Function	An activity or role performed by a human or an automated system directed towards achieving a goal. A function may be decomposed into sub-functions, and is without a time sequence. A function is an activity, not the hardware that does it, nor the goal.
Function Allocation	Distribution of functions between human and machine (Ref: ISO 11064 –1).
Functional analysis	The decomposition of overall goals into functions and sub-functions. The purpose of a function analysis is to provide a basis for: function allocation to human or machine, job definition, workload assessment, the establishment of staffing, and the definition of essential information supporting the detailed design of the human-machine interface.
Human Error Assessment	The analysis of opportunities for error and error recovery, and identification of factors (performance shaping factors) which affect the likelihood of error/ recovery" (Kirwan, 1993).
Human Factors	Human Factors is a scientific discipline that applies systematic methods and knowledge about people to evaluate and improve the interaction between individuals, technology and organisations. The aim is to create a working environment (that to the largest extent possible) contributes to achieving healthy, effective and safe operations.
Human Reliability	"Reliability is the antithesis of error likelihood. Human Reliability is then defined as the probability that a person's performance will be error free for a specified duration" (Salvendy, 1997).
Human Reliability Assessment	The identification of important human errors associated with a specific task or system function, the modelling of those errors and the quantification of the probability of task failure, based on data attached to, or generated by, the model. Human Reliability assessment may be able to state how best to reduce human error impact on system performance (Kirwan, 1998).
Job analysis	An analysis of the job definition to ensure that the job can be done.
Recognized standards	Guidelines, standards, etc., that are internationally or nationally recognized within a specific professional field, and acts or regulations that are not directly applicable but that regulate corresponding or neighboring industries and professional fields.
Task	Actions or collections of actions done to carry out a function.
Task analysis	A detailed description of tasks. A systematic method for determining the tasks required in performing any particular job or function.
Validation	Confirmation by examination and provision of objective evidence that the particular requirements for a specified intended use are fulfilled (ISO 11064-1 Definitions). In design and development; validation concerns the process of examining a product to determine conformity with user needs, i.e., does it do the job or not?
Verification	Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled (ISO 8402).
Working environment	The totality of all physical, chemical, biological and psychological factors at work that may affect the employees' health and well being through acute trauma or lasting exposure. The influences from lasting exposure may be positive and negative (NORSOK S-002).

1. Introduction

1. Introduction

Before you use this document

Read the summary (p. 3 - 5) before starting to use this document.
The organisation responsible for V & V of HSE in the project is required to have Human Factors competence (MR § 11), and good working knowledge of the HSE Regulations, NORSOK, ISO 11064 series and other related Human Factors standards applicable to control rooms (see Normative references and Bibliography).

Scope

This document is a verification and validation tool. *HF-Assessment Method* can be used for systematically reviewing both the *process* of how Human Factors has been integrated into the design and operation of control rooms and for evaluating the *results* of this process.
The tool is for use by the Norwegian Petroleum Directorate (NPD) and the petroleum industry.

Objective

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Specifically, this tool shall aid evaluation of how control rooms:

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Use of acknowledged HF-principles and methods to in the control room will also contribute to better optimisation of production. A well designed control room will lead to fewer shutdowns, increased regularity of production and thereby improved performance for the whole production process.

Document structure

This document consists of 2 main parts:
1. Introduction - An introduction to the tool
2. Check lists – Seven V & V checklists:

- One Documentation Checklist - that covers minimum requirements to Documentation.
- One General Checklist - that covers minimum requirements for all design phases.
- Five Specific Checklists - that cover minimum requirements for each specific phase of the design process, not already covered in the general checklist.

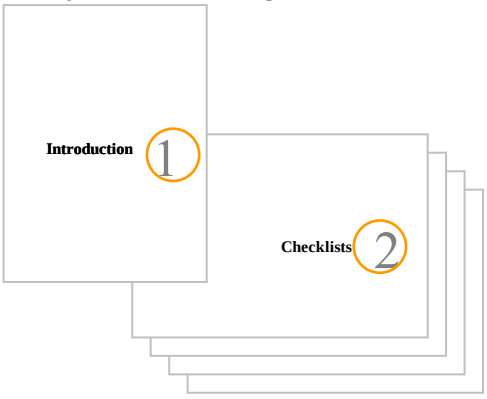

Figure 1. – The two main parts of this document

The first part, Introduction, provides a general framework (design process model) for carrying out validation and verification using the seven different checklists in Part Two. It shows when the specific checklists should be used in the design process. Part One also includes a list of normative references, definitions and abbreviations.

The second part, Checklists, consists of seven checklists for use in revisions/audits. It introduces and describes each checklist, noting purpose, intended results of use, input data, revision tools and outputs, activities to be performed. Two of the checklists, Documentation and General should always be used in V & V activities. In addition, the checklist specific to each particular phase in the design process shall also be used.

Basis for checklists

This document is a further development of NPD´s tool for reviewing HF in relation to Control rooms, developed by IFE in 2000. The tool is updated in accordance to new HSE regulations per 01.01.2003. The basis for the content of this tool is as shown in Figure 2.

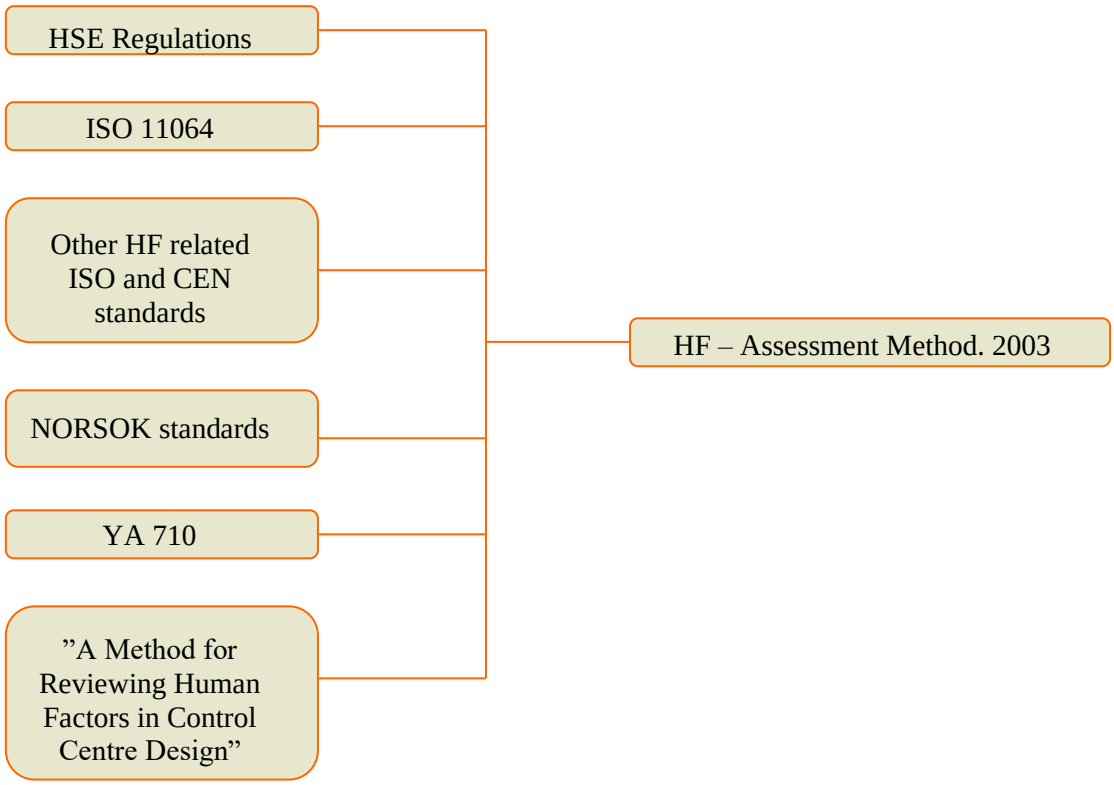

Figure 2. Basis for Technical content in this document

The structure of the HF-Assessment Method (see Figure 3) is based on an adaptation of the ISO 11064-1 model. The figure indicates the five major phases in the design process (A-E) and lists the activities to be performed in these phases (e.g. Task Analysis in Phase B). Text in ISO 11064 describes how to perform these activities. There is a specific checklist for each of the five phases. The adapted ISO model illustrates that the design process is iterative – with information being continually fed back from one phase to the previous phase(s) and forward to the next phase(s). At the Validation and Verification activities, problems and discrepancies are either resolved, or approved, before moving on to the next phase.

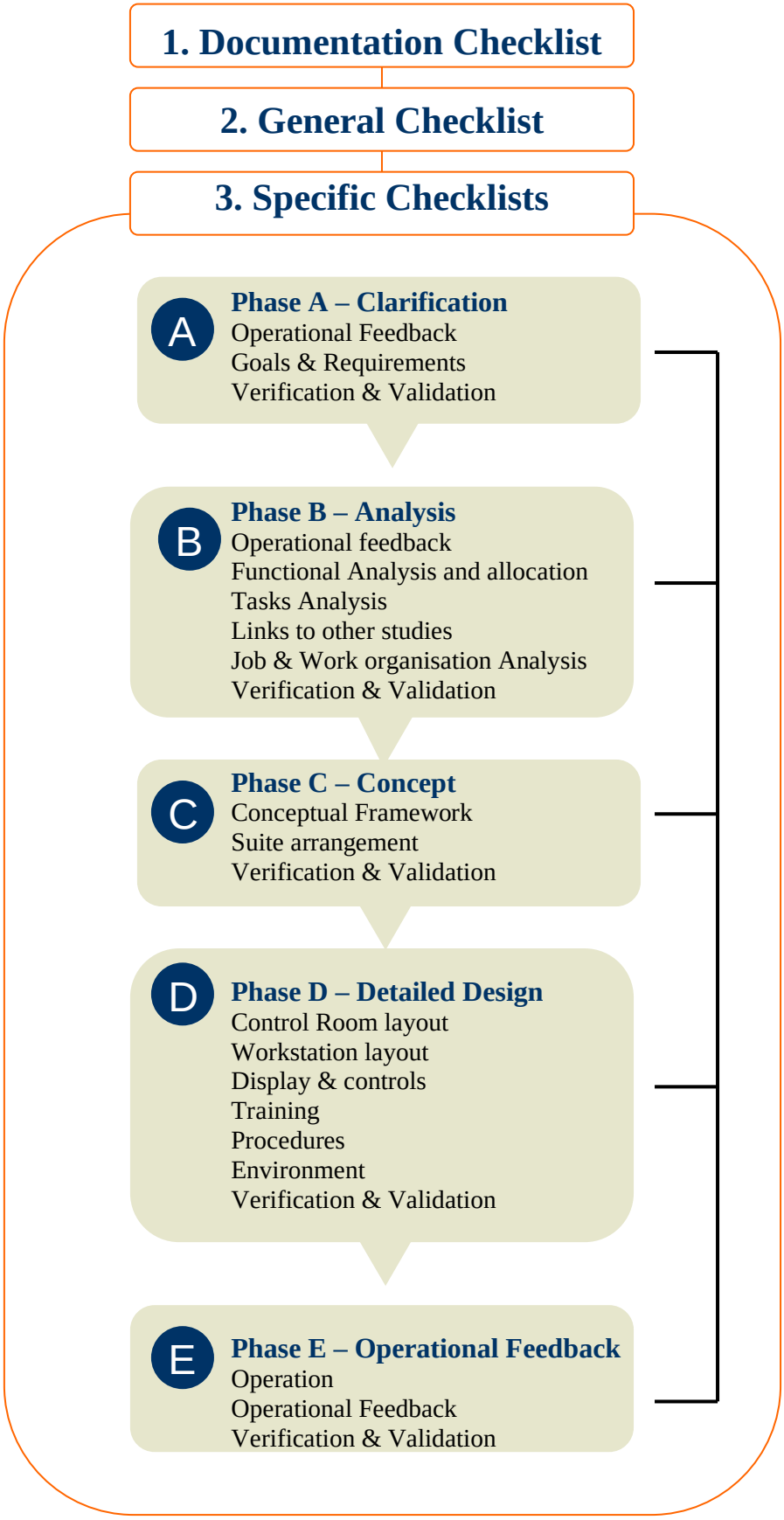

Figure 3. - Framework for use of checklists
Adapted from ISO 11064

Supplement to ISO 11064
A key difference to the ISO model is the inclusion of a general checklist that covers all phases in the design process.

In order to reflect all the basis requirements in the HSE Regulations and all HF aspects in control rooms, a number of subject areas have been added to the ISO 11064 model. These include:

- Human Factors Management, including requirements to employee participation
- Operational Experience Transfer
- Training and procedures
- Human error

Note: The chapter ”Approve Conceptual Framework” in ISO 11064 has been renamed ”Verification and Validation” in this document.

The subject area, “Human Error”, in the General Checklist, deserves comment. Regulations and industry standards have previously recognized this important subject area, but this has not been systematically followed up in practice, e.g. by analyses. This subject area has therefore considerably more guidance than any other subject area in this tool.

Description of the checklists

All the checklists (except for parts of the Documentation Checklist) have four columns (see figure 4). These four columns, reading from left to right are as follows.

Question
This column contains the V & V question and a reference to the related section in the HSE Regulations, and/or ISO and/or NORSOK and/or acknowledged ergonomic principles. In some cases, closely related ”follow-up” question(s) are asked to help throw more light on the problem. The references to the regulations and standards are provided to help relate the question asked to the appropriate regulation and standards. Note however that the requirements basis can change, and that requirements for different types of control rooms may vary and that the references might not fully include all relevant paragraphs and parts.

Guidance
The Guidance column has several functions. In some cases, it indicates where more detailed/ supplementary information can be found or how requirements in the questions column can be met. It is also used to explain/clarify terms used in the questions column. Clarification on the status of the question (Shall, should, can) may also be given in the guidance.

QUESTIONS (Verification questions)	GUIDANCE (Clarification/ reference)	ANSWERS (Objective evidence)	COMMENTS (on Quality of evidence demonstrated to auditor)

Figure 4. –Checklists format

Answers
The empty column is intended used by those being audited. Objective evidence/findings in relation to the questions asked can be noted.

Comments on Quality of evidence
The empty column is intended for the auditor to register comments/evaluation on the quality of the objective evidence provided.

Remember: There are three steps to using the checklists:

1. Complete relevant phases in Documentation Checklist
2. Complete General Checklist
3. Complete relevant Phase in Specific Checklists

2. Checklists

2.

2.1 Documentation Checklist

Introduction

This checklist covers HF documentation throughout the design process:

Purpose

The purpose of the Documentation Checklist is to give an overview of the minimum requirements for which documentation should be developed and continually updated throughout the different phases of the design process, and to which level of quality.

Intended results of use

Using the documentation checklist should result in:
- meeting HSE requirements for documentation and information;
- improved quality of experience transfer/re-use of documentation within/between projects;
- improved efficiency for parties involved in audit / V & V process;
- improved understanding of documentation (and studies) interrelationships/ hierarchy;
- a holistic overview of expected documentation to be presented for V & V activities throughout project;
- an iterative process with feed forward and feedback.

NOTE !

The term “documentation” is used in a broad sense and allows for different ways of documenting how activities have been performed (for example via database, information, documents, models, etc.) Note that documentation and its location might vary from project to project. For example, Alarm Philosophy documentation might be a standalone document, or it could be part of other documentation (Safety philosophy).

Regulatory requirements for HF documentation

Reference	Theme
FrmR §§ 17, 18, 19	General requirements to documentation
FrmR § 20	Planning
MR § 13	Criteria for updating/ overview of analysis
MR § 15	Risk/emergency preparedness analysis
IR § 1	Document requirements - control and preparation (see guidance)
MR § 3	See guidance - steering documentation
IR § 6 d	Overview of steering documentation
NORSOK S-002	Procedures and work instructions
NORSOK Z-001	Documentation for Operation (DFO)
NORSOK Z-003	Technical Information Flow requirements

Documentation Checklist

Questions covering all phases.

DOCUMENTATION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. Is necessary material and information prepared and updated to document that the project is planned and carried out in a safe and prudent manner and that established project goals are met? FrmR §§ 18, 19	Regulations (FrmR § 19) require that documentation shall confirm how the work has been organized, managed, executed, as well as the required competence for the job. Documentation shall be traceable.		
2a. Is there an updated overview of steering documentation? 2b. What are the reporting lines and are they updated? IR § 6, FrmR § 20, MR § 3	The Regulations state there shall be necessary steering documents prepared, and reporting lines established. FrmR § 20 gives an overview of relevant documentation that shall be covered.		
3a. Does the documentation meet the documentation control requirements? 3b. Are all documents available in a format that can be used? IR § 1	Regulations, IR § 1 clauses a-d, and a-c provide document control requirements.		

Phase A - Clarification

PHASE A CLARIFICATION		
Documentation	Received	Comments
Experience transfer earlier projects Incident reports and analysis W.E. reports (continual improvement) Feedback from experience with previous designs and design processes		
Philosophy documentation Automation Alarm handling Safety Working environment Operations Control room design		
Planning documentation Project plan for HF (Goals for HF/requirements/ organisation) HF Management HF Philosophy HF Strategy Goal and Plan for integrating end users and employees in design process Plan/analysis for implementing and follow-up		
Contractual requirements Ref. list to other disciplines documentation/spec. List of applicable standards – (International / Company) List of regulations		To which degree are requirements to be met by entrepreneurs/suppliers explicit in the form of contract documentation, and to which degree are they implicit in the form of conclusions from analyses and evaluations performed?
V &V documentation of phase A		

Phase B – Analysis

PHASE B- ANALYSIS		
Documentation	Received	Comments
Documentation from phase A Revised/updated/closed for phase Experience transfer from Phase B – other projects		
HF plan for Phase B		
Analyses documentation Task Analysis (description – scope of work) Functional analysis and allocation Job and organisation analysis Strategy for end user and employee involvement (see Phase A)		
System specifications General design specifications Overview of standards and specifications used as requirements basis Control room / cabin design specification Programme for qualification of technology		
V & V documentation of phase B		

Phase C – Concept

PHASE C - CONCEPT		
Documentation	Received	Comments
Documentation from Phase A & B (revised/updated/closed) Experience transfer from phase C –other projects		
HF Plan for Phase C		
Detailed design specification Alarm specification Large Screen Design specification Human-System Interface style guides Computer-processing specifications (e.g. alarm-processing, information display) VDU Design specification Critical Action Panel specification Sub-supplier-specification plan/layout Functional specification (given to sub supplier)		How does the contract with the engineering contractor for the detailed design reflect the results of previous analyses and requirements documentation?
Other Documentation Scenario analysis documentation Operational procedures (normal/abnormal situations + maintenance) Standards for design Coordinating standards/design Employees involvement in decision making Description of control system incl. screen pictures / sequences for operation		
V & V documentation of Phase C		

Phase D – Detailed Design

PHASE D - DETAILED DESIGN		
Documentation	Received	Comments
Documentation from Phase A, B & C (revised/ updated/closed) Experience transfer from phase D		
HF Plan for Phase D		
Control room operational philosophy (updated) Procedures Operator training manual Operation performance measurements (Operational modes -lists of all tasks) Plan for manning (incl. Shift plan) Visual presentation of control room, (incl. layout, technical panel or workstation drawings/ elevation) Visual presentation/drawings of equipment (total equipment list)		
V&V documentation of Phase D		

Phase E – Operational Feedback

PHASE E – OPERATIONAL FEEDBACK		
Documentation	Received	Comments
Documentation from Phase A - D (revised/updated/closed) Experience transfer from similar operations		
HF plan for Phase E Systematic and continual WE and workload evaluation Operational feedback		
V & V documentation of Phase E		

2.2 General Checklist

Introduction

Purpose

The purpose of the General Checklist is to have an iterative V & V tool for reviewing general requirements that applies to all phases in the design process.
This General Checklist covers the following Human Factors topics:

It is not envisaged that all the questions will be gone through in an audit. This comprehensive checklist gives the audit team the opportunity of choosing subject areas, e.g. Operational feedback, or Management and focusing on that.
Given that there is a close interrelationship between subject areas, there are inevitably questions in different sections that overlap.

Intended result of use

Use of this checklist should give an impression of how the different factors are progressed throughout the design process. As the checklist covers general requirements, it should give a general impression of how HSE regulations are in general understood, not just in relation to control rooms. For example, poor responses in relation to Management and Documentation issues, should give cause for concern for the entire HSE programme, not just for human factors and the control room.

NOTE !

This checklist is not a normative document. It only asks questions and refers to minimum requirements.
This checklist covers a series of issues that are common throughout the design process, although the level of detail will inevitably vary throughout the design process.
Some questions are only relevant for some phases, not all phases. These are indicated in the "Answer" column with an underlined text in italics, e.g. *Only Phase C –E*.

General checklist (Applicable to entire design process)

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What Phase in the design process is this general checklist used for?	ISO 11064-1 describes five general phases.		

GOALS AND REQUIREMENTS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How are HF goals reflected in the verifiable operational goals, requirements and constraints for the (re)design of control rooms and centres? FrmR § 1, MR §§ 4, 5,	FrmR § 1, clauses a-c provide high level requirements for HSE, from which HF goals can be derived. The Regulations include require-ments for risk reduction, (FrmR § 9 and MR § 1), lowest level of pollution, (IR § 4), consideration of operational limitations and pre-requisites, ”barrier” philosophy (MR § 2), employee participation, (FrmR § 6), HSE culture, (FrmR § 11), follow up of other stakeholders (FrmR § 14), verifications (FrmR § 15), documentation (FrmR § 18), emergency preparedness (FrmR § 29), normal working hours (FrmR §§ 47, 50, 51), continual surveillance and improvement of the WE (MR §§ 17, 22 and AR § 31), well being, safety, optimal workload. See ISO 11064-1,		

GOALS AND REQUIREMENTS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
ISO 11064 -1- 6	Introduction.		
2. How do HF goals and strategies contribute to the overall project goals, strategies plans for HSE work? FrmR § 1, MR § 4, FR§ 4	Guidance to the Frame regulations § 1, state that goals are to reflect the current/ongoing societal and technological development. This requirement is of special relevance to control rooms where new technologies and work practices are under continual development. HSE related goals shall outweigh other goals (e.g. economic) if there is a conflict between goals.		
3. How is it ensured that the CCR design is based on the most robust and the simplest possible solutions? FrmR § 9, MR § 1, FR §§ 4, 9	Regulations state that failure in components, in a system, or a single mistake shall not lead to unacceptable consequences (barrier philosophy). Simple, robust solutions are required to reduce the level of risk.		
4a. What high level and detailed HF results, are attained? 4b. How will results be used? 4c. Is necessary data made available for decision making? 4d. How were the results assessed?	Results could be improvement to the work environment, a planning decision and/or output data such as a report, statistics, analysis. ISO 11064-1, and the HF-Assessment Method introduction gives an overview of required outputs for each phase. The document checklist provides an overview for each phase. It should be possible to evaluate results		

GOALS AND REQUIREMENTS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
MR § 8, ISO 11064-1-6	against objective evidence		
5a. How is data of use to HF activities collected, processed and used? 5b. What requirements are stipulated with regard to quality and validity of data in relation to the needs of those using the data? MR §§ 12, 18	The requirements in MR § 18 apply to all HSE related data. Clause A-E state what the data shall be used for.		

HUMAN FACTORS PRINCIPLES

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What are the acknowledged HF principles to be employed throughout the process of (re)designing the CCR? FrmR § 6, FR §§ 19, 20, AR §§ 31, 32, 33.	Human factors design principles are to be found in several HF standards, ISO 6385 lists general ones, ISO 11064-1 lists several specific ones for control room, EN 894 lists principles for interaction of control actuators and displays, ISO 9241-10 provides general usability principles for the design of software. ISO 13407 provides principles for involving end users in the design of interactive systems. FrmR § 6 places legal requirements on employee participation in safety and work environmental questions/ processes.		
2. Which HF related regulations, guidance to regulations, standards, (international, branch or company) or published methods form the basis for company internal human factors requirements in relation to control rooms? FR § 20, ISO 11064-1-4	The regulations list a number of standards, including: ISO 11064, ISO 9241, ISO 6385, ISO 10075, EN 614 1-2, EN 894, NORSOK S-002, YA 711.		
3. Are acknowledged HF specifications not referred to in the Regulations used to either complement or substitute those	Use of additional methods / requirements could contribute to the requirement of continual improvement. (For example use of		

HUMAN FACTORS PRINCIPLES

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
referred to in the Regulations. MR § 22, ISO 11064 –1 - 4	specifications from other industries, such as military, aerospace and nuclear.)		
4. What are the criteria for the allocation of function between people and machines? ISO 11064 -1-7.3	ISO 11064-1 Table 1, clause 7 indicates the process for determining criteria for allocating functions between operators and equipment.		
5a. How are HF requirements compiled/synthesized and communicated to those working in a project? 5b. What are the criteria for updating the HF requirements and what mechanisms ensure that updated requirements are employed in the project? FrmR §§ 5, 8, MR §§ 5, 11, 12, ISO 11064-1-4			

MANAGEMENT			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How is the management of HF activities and related HSE activities coordinated throughout the design process and across all control room related stakeholders? How does the management plan take account of coordination and division of responsibility between different stakeholders? FrmR §§ 5, 6, 13, MR §§ 3, 13. (WEA § 16)	Note: The plan should confirm organisation and resources and define the activities/analysis to be found in the different design phases. The term "stakeholders" is used to describe those parties that have a vested interest in the control room, either offshore – e.g. operators, supervisors, instrument, HSE, or onshore – e.g. HSE staff, EP staff.		
2a. What necessary information is identified, acquired, processed and communicated to relevant stakeholders to enable planning and improvement of HSE at the right time in the project? 2b. What management communication systems are established, that meet the need for acquisition, processing and communication of information? MR § 12, FrmR § 6	See section on "Analysis", questions 8 and 9 on requirements to control rooms and constraints to control rooms and "HF principles" question 5.		
3. How is consistency between HF activities in different phases of the design process and across all control	See section on "Analysis", questions 8 and 9 on requirements to control rooms and constraints to		

MANAGEMENT			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
room related stakeholders ensured? FrmR § 14	control rooms.		
4. What is the strategy for ensuring identification and improvement of human factors activities throughout the design process? MR § 22, AR § 31	The regulations state that there shall be continual improvement of HSE. This can be achieved by identifying processes, activities and products that need improvement, and by initiating improvement measures, which shall be evaluated.		
5. What resources are planned/actual for HF activities throughout the design process? FrmR § 10, MR § 11	The Regulations state that the Operator shall ensure this, but other stakeholders have an independent responsibility to provide resources for activities that are required. The term "resources" includes both competence and manning/hours.		
6a. How are end users systematically integrated into the design process with regard to work environment and safety issues? 6b. What strategies are used for involving end users?	Note: Human factors standards, such as ISO 11064, ISO 13407, ISO 6385, EN 614 and NORSOK S-002 are based on a systematic and real involvement of end users. Note: there are various strategies for involving end users and employees representatives, - e.g. employing one or two throughout a project, using different employees		

MANAGEMENT			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
6c. How is it ensured that end users can make a real contribution, through the use of tools/methods that easily communicate? FrmR § 6, WEA § 24, ISO 11064-1	or groups that rotate. It is important to give employees representatives a real opportunity to influence the design by ensuring that they (the chosen representatives) have necessary time and competence to do the work. Note: Examples of good Human factors methods/tools include: building of mock ups, task/ scenario analysis, 3D, CAD and VR.		
7a. How are conflicts between project constraints, ergonomic requirements, and operational goals documented, evaluated and resolved? 7b. Are the coordination of decisions ensured at various levels and areas, in order to avoid unintended consequences? MR § 8 & ISO 11064-1-6	Regulations require that HSE related problems are comprehensively and adequately considered. (See Analysis section Question 9, Project constraints). Criteria for making decisions to be defined prior to decision making. Criteria to be based on stipulated HSE objectives, strategies and requirements related to HSE.		
8a. How will it be ensured, that the presence of personnel other than CCR operators, does not lead to a reduction of the operators attention and performance?	Examples of this situation occurring include; under commissioning, during well/detector testing, work permitting, unauthorized personnel		

MANAGEMENT			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
8b. How will it be ensured that safety critical barriers, which involve monitoring and response, function when unauthorized personnel are in the CCR? FrmR §§ 43, 44, 45.	in the control room. Ways to maintain barriers include planned meetings / walk through of work permits where another qualified CCR operator stands in for the CCR operator who will handle the work permits during his watch.		

OPERATIONAL FEEDBACK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What operational feedback has been gained through the activity of continual improvement of HSE? MR § 22	MR § 22 requires continual improvement throughout a project and/or operations. The project must acquire experience from other similar projects performed previously. Kjéllen, 2000, provides a framework for how one can systematically acquire, analyse and make use of experience data.		
2. What types/categories of operational feedback are obtained and used in the project? MR § 22, ISO 6385, ISO 11064-1	Operational feedback should be in relation to both the *process* of designing control rooms as well as the actual *results of the process*, i.e. the control room itself. The guidance to MR § 22 and ISO 6385 Chapter 5 refers to different types of operational feedback.		
3. From which other projects/ organisations, as well as similar projects / own organisation, has operational feedback been gained? MR §§ 13, 22, ISO 11064-1	The operational feedback gained needs to be seen in context with regard to technologies, work practices, processes, etc. Guidance to MR § 22 states that both own and other organisations experience should be acquired.		
4. Has positive feedback (successes) been recorded? MR § 22, ISO 11064-1	Guidance to MR § 22 suggests recording good solutions and practice as well as problems.		

OPERATIONAL FEEDBACK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
5. Which recognized methods have been used to collect, validate and synthesize operational feedback? MR §§ 13, 17, ISO 11064, ISO 6385	Methods include: interviews, questionnaires, observation, operational logs, analysis of alarm history, analysis of accident reports.		
6a. How are different categories of operational feedback from different sources, used throughout the design process? 6b. How have conflicts (if any) between experience transfer data and project goals been resolved? MR §§ 13, 17.	Experience data should be systematically used throughout the different phases of the project when establishing the basis for decision making.		
7. How are the results from operational experience communicated to the project? MR § 22, ISO 6385, ISO 11064-1	For example, experience data should be available for contractors and suppliers that are responsible for the development of the CCR and making sure it fulfills all requirements.		

ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How will it be ensured that the analyses provide the necessary basis for decision making with regard to HF in control rooms? MR §§ 8, 13, 17.	See MR § 17, Guidance. For modifications and upgrades, it may be sufficient to revise and update previous analysis. Analysis should complement each other and include both risk and accident related analysis as well as exposure to working environment factors.		
2. How is it ensured that necessary experience and competence using structured human factors methods has been used in assessing the risk for human error? FrmR § 10, MR § 12, ISO 11064, ISO 17776.	Both ISO 17776 and OLF Guidelines note the value of experience and expert judgment in addressing risks, such as human error; need for multi disciplinary teams and need for structured human factors methods. Industry guidelines e.g. NUREG, CCPS, as well as the literature (Kirwan, Redhill, Rosness) all presume the use of fully qualified human factors experts using structured methods working in multi-disciplinary teams.		
3. What key issues do the analyses document regarding the inter-relationships between the control room and other sub-systems on the installation? ISO 11064 -1- 6	An example could be to have common information presented simultaneously (e.g. Rigs Reference picture in both CCR and drillers cabin), another that there should be two separate communication systems.		

ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
4a. Are the purposes, conditions, resources, assumptions, and delimitations of the individual analysis clear? 4b. Are relevant target group(s) of the analyses presented with a comprehensive overview of the analysis results? 4c. What is the criteria for updating of analysis? MR §§ 8, 12, 13, 17.	Target groups could be CCR operators/ supervisors, or those disciplines planning the CCR. Regulations (MR § 13) require updating / revision when alteration in the conditions, assumptions, delimitations, (individually or as a whole), affect the results of analysis, or when other new knowledge of significance to the results of the analysis exists.		
5a. How is consistency between WE and HF analyses that are either complementary to or build upon each other, ensured? 5b. How have results from complementary/ supplementary studies been used as input data/ pre conditions?	This includes, but is not limited to HF analyses (e.g. Task Analysis, Functional Analysis) and WE analyses such as noise, psycho-social analysis, ergonomic job analysis, etc. Regulations require consistency between analysis that are complementary or that build upon each other. ISO 17776, IEC 61508, NORSOK Z-013, OLF Guidelines (p. 26) all note that human error is an element of risk, and shall therefore be addressed in connection with different types of		

ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
MR §§ 8, 13, 17, ISO 17776, IEC 61508, NORSOK S-002, Z-013.	risk / emergency preparedness analysis or when identifying danger and evaluating safety systems. Such studies include HAZOP, HAZID, emergency preparedness analysis, evaluation of safety systems, risk analysis, task analysis and CRIOP analysis.		
6a. How is it ensured that all functions that may be carried out in the CCR are identified and included? 6b. Which functions are clearly identified through by requirements / guidance, with regard to choice of systems, room size, equipment, organisation and manning? 6c. What criteria are used for functional allocation? Are the criteria in conformance with the projects overall requirements with regard to the CCR operators workload?	Functions may include: process control, emergency preparedness, monitoring external environment, monitoring, alerting and notifying in connection with entry into safety zones. Telephone exchange and maritime functions are other examples of functions that can be included in the CCR. b) After all functions (formal and informal) have been identified, the consequences/ implications can be drawn out For example, if a function is “reporting of all events during the last 12 hours from all systems”, the implication is that all systems must be able to exchange data. This is in order to avoid the CCR operator having to manually print out reports from each system and then re-enter them into one report. The function “testing” has		

ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
MR §§ 8, 9, 10.	space related implications. c) Criteria for functional allocation may be determined by regulations (e.g. requirements to back-up SAS), they could be based on acknowledged ergonomics principals (e.g. Fitts list), the project/ companies philosophy for operations/ manning/ safety or a combination of these.		
7. How is it ensured that the analyses build upon relevant input data? MR §§ 8, 17, AR § 31, ISO 11064, NORSOK S-002.	Types of data could include: empirical data for individual/ group work load and exposure to WE factors, data on employees perception of physical and psychosocial work environment, work related disease and accidents and results from other analyses. MR § 17 Guidance states that both ISO 11064-1, and NORSOK S-002 should be used.		
8a. What requirements for the control room are documented as a result of analyses performed? 8b. Are these requirements concrete or abstract? ISO 11064-1-6	(Guidance: See ISO 11064-1 Annex B for a minimum list of requirements).		

ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
9. What new constraints to the CCR and its operation are identified as a result of analyses performed? ISO 11064-1-6	New constraints could be changes in technology, work practices, lack of presupposed systems integration, additional equipment in the CCR and layout changes.		
10a. Which criteria shall ensure that new technology meets acknowledged HF requirements? 10b. Has qualification or testing demonstrated that HF requirements can be met by using the new technology? FR § 8, MR § 7	The term “new technology” includes new products, methods, analysis tools, or use of known products / methods /tools in a new manner. The criteria should be representative of the relevant operational conditions, and proven for the solutions intended.		
11. Are HF requirements for the control room identified for temporary conditions such as commissioning, decommissioning, refloating, transit? MR §§ 2, 5, 11	For example need for extra desks under completion, personnel, new tasks such as navigation and positioning during transit.		

ADAPTION OF WORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. Which input data is used when adapting work to suit the individual?	NORSOK states that manning, work sequences, frequency of operation, inspection and maintenance tasks, necessary		

ADAPTION OF WORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
MR § 18, FR §§ 19, 20, AR § 31, NORSOK S-002.	equipment for performance of the tasks, personnel selection and earlier experience from similar tasks shall be acquired.		
2a. Which psycho-social factors are taken into account to ensure an acceptable Work Environment? 2b. Has there been a systematic evaluation / walk through of tasks with the aim of identifying peaks in work load? 2c. How has work been organized to handle periods with high mental load? AR §§ 31, 33, NORSOK S-002.	Regulations place emphasis on the interaction between work performance, the individuals perception of control over own work and social support in the WE. Additional factors are listed in AR § 33 Guidance clauses A-H.	*(Phase B-E)*	
3a. How is it ensured that CCR operators will not be subjected to adverse physical strain, poor working positions, repetitive movements, unacceptable work intensity? 3b. How can workspaces and equipment located at workspaces be quickly and easily adapted to suit the individual?	The Regulations, WEA No. 528, NORSOK S-002, ISO 11064 1-3 all state that screen workplaces and equipment at the workplace (screens, keyboards, work surfaces) shall be adjustable to the individual. NORSOK S-002 Annex B provides ranges for height adjustability of working surfaces. All mentally demanding work situations introduce a risk of muscular-skeletal harm, ref	*(Phase B-E)*	

ADAPTION OF WORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
AR §§ 31, 32, WEA §§ 1-13, FR § 19 WEA No. 528. NORSOK S-002, ISO 6385-3.6.6	NORSOK S-002, analysis requirements. The analysis should cover: evaluations of layout, clearances for performance of tasks, location of work functions (displays, control, etc).		
4a. Have HF aspects for all operational modes been gone through? 4b. What are the consequences with regards to manning, workload, system integration, requirements, procedures and training? AR §§ 30, 44, 49, 55-62,	The regulations require that all operational modes are to be gone through including: maintenance (AR § 44), monitoring of the external environment (AR § 49) - use and discharge of monitoring /control of oil and chemical to sea. (AR §§ 55-62) - ensuring necessary transfer of information to oncoming personnel (AR § 30), registration of hazards, accidents. (MR § 19), safe procedures, training and systems, reporting of near misses. (IR §§ 11, 12), process safety systems/gas release system (FR §§ 33, 34).	*(Phase B-E)*	
5. Under normal conditions, do the operators have an acceptable overview which enables them to make sure that the work can be carried out safely, and that the possibility of mistakes is limited? FR § 19, AR § 31, NORSOK S-002.	The term ”under normal conditions” implies that CCR operators are performing normal operations, from their normal (seated) workplace and with a good working posture.	*(Phase B-E)*	

ADAPTION OF WORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
6a. Under normal conditions, is there a good overview of the status of safety functions (F & G, ESD, PSD)? FR §§ 7, 31, 32, NORSOK I-CR-004.	NORSOK I-CR-004 states that ESD functions shall be physically and functionally different from the program functions.	*(Phase C-E)*	

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. What is the overall goal and strategy to reduce the probability of human error in the control center? 1b. How is the goal and strategy for the limitation of human error integrated into the safety management system throughout the entire design process?	Note: the key intention of the HMS Regulations is to reduce the overall level of risk. Human interaction with technical systems is an important part of the safety barrier. The UK HSE (HSG 48) provides an introduction and guidance to management on the establishment of goals / strategy for handling human error. Kirwan (1994) notes the impact that managing human error (or rather lack of it) has had on major incidents. NUREG 0711, Chapter 7 provides a framework/strategy for HRA in Human Factors Engineering. CCPS- Chapter 8, provides a worked example of implementing an error management system in a process plant. ISO 17776 states that safety management systems must apply to the entire system life cycle. Chapter 5 provides a high level approach to management of risk, which could be applied specifically to human error. Alternatively, an overall strategy for risk management could include human error.		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1c. What are management policies to resolve Human Error Dependency (HED)? FrmR §§ 9, 20, MR §§ 1, 2, 4, 15, 17, AR §§ 30-33, ISO 11064, ISO 17776, NORSOK S-002, Z-013	Human Error Dependency (HED) can defeat multiple independent safety barriers. UK HSE OTR 2001/053 provide a framework for considering dependency in a given context, and how dependency may be controlled. Reducing HED is based on avoiding dependencies on equipment, organisations, procedures, personnel. Note: MR § 1 states that when more than one safety barrier exists, therE shall be sufficient independence between barriers.		
2. What are the safety system performance requirements with regard to the human operator being able to: 2a. detect abnormal situations? 2b. prevent abnormal conditions from developing into situations of hazard and accident? 2c. limit harm in event of incidents and accidents? FR § 7, MR § 2, IEC 61508, NORSOK S-002	MR § 2 require performance requirements be determined for individual safety barriers. The control room operator is one such barrier. Performance requirements (metrics) for the human operator could be in relation to time taken to identify abnormal situations, number of actions (keystrokes/ commands), time taken to make decisions, time taken to react, time taken to resolve abnormal situa-tions, training in “recovery” / fault finding techniques. Kirwan (1994), discusses how to determine criteria and performance requirements.		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
3a. What is the rationale for choosing the approach/philosophy for identifying human error? 3b. Are the conditions that governed the choice of approach, relevant for when the study/analysis was performed / during audit? MR §§ 13, 17, AR § 31, ISO 11064-1	According to HSE Regulations (MR § 13), the choice of analysis methods shall be based on a rationale. Recognized models, methods, procedures shall be used. Conditions for analysis/study to be stated and appropriate. The Human Error Assessment Approach is qualitative, the Human Reliability Approach is quantitative. UK HSE CRR 373/2001 and OLF Guidelines promote a tabular approach using (SIL) tables of known risks in relation to consequences. ISO 17776, NUREG 0711, Chapter 7, CCPS Guidelines, Chapter 2, and Kirwan (1994) provide advice on different approaches for risk assessment (See Chapter 3, figure 1.).		
4. How have Root Causes of human error been identified and resolved?	The UK HSE (HSG 48), Reason (1990) and Redmill (1997) lists several root causes of human error and provide frameworks for handling such. OLF Guidelines provide examples of root causes of human error in relation to alarm handling, p. 40, and in relation to overrides, p 50.		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
ManF §§ 15, 17, ISO 11064-1	CCPS Guidelines, Chapter 6 provide advice on how to determine root causes of human error.		
5a. What information on human error has been acquired from experience transfer (including from own and other organisations)? 5b. Which human error data has been obtained from other sources? MR §§ 13, 17, 22, ISO 6385, ISO 11064-1	HSE Regulations require experience transfer from within own organisation and external. CCPS Guidelines, Chapters 1 and 7, provide a list of case studies which could contribute to experience transfer. Chapter 6 provides advice on how to acquire data. Kjéllen, 2000, provides a framework for how to acquire, analyse and make use of experience data. ISO 17776 (Annexes) provides a high level list of known risk related aspects to be considered in various offshore activities. Kirwan (1994), Annex II, provides examples of human error data and with advice on eliciting such. OLF Guidelines provide several examples, including the possibility of an operator forgetting to reset an override (See Chapter 10.4.2). The UK HSE (HSG 48) provides examples of human error.		
6. Which Human reliability assessment techniques and criteria	Regulations state that analysis methods chosen should be		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
have been considered as the most suitable for the project? MR § 13, FR § 20, ISO 6385, ISO 11064-1, ISO 17776, NORSOK S-002, NORSOK Z-013	dependent upon the goal of the study. NUREG / CR 6350 provides a method (ATHEANA) for human error Analysis. Rosness (94) provides an overview of task analytical and human reliability assessment techniques. NUREG 0711 Chapter 7, notes several methods/techniques that could be employed (function, task and scenario analysis, walkthroughs, simulators) and suitable conditions for such. Redmill (1997) provides a review of known methods and techniques used for Human Reliability Assessment. Kirwan, (1988), lists five classes of technique and criteria for evaluating their applicability to a given situation. Kirwan (1994) and Swain (1989) note advantages/ disadvantages with these techniques. ISO 17776 Annex B lists several methods that could be employed to generate input data. CCPS Guidelines, Chapters 4, 5 and 6 provides an overview of methods and techniques that could be employed.		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
7. What assessment (methods and criteria) has been performed / requirements made - to ensure that the plant, systems and equipment have a design that is as simple as possible, so that the possibility of human errors or mistakes is limited? FrmR § 9, MR § 17, FR § 9, AF § 31	A simple, well laid out process plant will make it easier for operators to maintain an overview. Systems that are easy to use (consistent in use) and intuitive can reduce the possibility of human error. The same applies to equipment.		
8a. Which factors have been identified, that can contribute to the possibility of human error occurring under "normal" operating conditions? 8b. How will these situations of risk be resolved? 8c. Have "informal" unofficial tasks as well as official tasks been included in the assessment? FrmR § 9, MR § 9, AR § 31	Examples identified in Kirwan (1994) and Reason (1990) include: lack of overview of process plant / safety systems, too many alarms simultaneously, overloading of operators memory, poor grouping of input/output devices, poor environment, poor communications procedures, interaction of above. Redmill (1997) includes Human Computer Interaction (interface design, training, support) and Socio-technical systems (including procedural violations) as known factors. Unofficial/informal tasks could include acting as telephone exchange, social corner, visitors etc.		

HUMAN ERROR			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
9a. What safety critical situations are identified, where human error may have severe consequences (large potential loss)? 9b. How will these situations of risk be resolved? FrmR § 9, MR § 17, AR § 27, NORSOK S-002, Z-013.	Example of safety critical situation: Forgetting to un-inhibit gas detectors after detector testing. Shuttle tanker operations.		
10. When the CCR operator is attempting to handle a critical incident, how have the solutions that s/he is to use been assessed in relation to human error? MR §§ 2, 11, AR § 31	Solutions to safety critical incidents could be training, procedures, shutdown, checklists etc. OLF Guidelines promote periodic diagnostic training. See also Guidance to MR § 11.		

COMMUNICATION SYSTEMS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Have communication requirements for all situations (normal and abnormal, internal on installation and external to installation) been examined and appropriate solutions reached? 1b. Have procedures, tasks, training, functions, etc, been evaluated with regards to communication? FR §§ 17, 18, IR §§ 11, 12, NORSOK I-CR-004	Regulations place a number of requirements on communications, including both ability to be informed of events and to inform (PA) of events/incidents, both internally on installation and externally. There are requirements for immediate and continuous communications in certain circumstances. See Guidance to FR § 17 and § 18 for details.		
2a. Have requirements for monitors to be used for a variety of monitoring tasks (normal and abnormal) been established? 2b. Do the monitors meet the requirements and are they suitably placed for intended use? FR § 20, AR § 31, NORSOK I-CR-004	Regulations require a number of monitoring tasks to be performed from the control room that could be performed using monitors either alone or in conjunction with other (communication) technologies.		
3. Is criteria for speech intelligibility met internally for both communication between operators in	ISO 9921 “Ergonomics of speech assessment” specifies the requirements for the performance		

COMMUNICATION SYSTEMS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
the control room and when communicating externally? ISO DIS 9921	of speech communication for verbal alert and danger signals, information messages and speech communication. It includes methods to predict and assess communication.		
4a. Is the same language used for control systems, procedures, training and communications? 4b. If not, are there safety critical reasons for using several languages? FrmR § 16.	The Regulations state that Norwegian shall be used to the maximum extent possible without compromising safety. NB! Consistency is a general HF design principle, with special relevance for safety.		

ALARMS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. In the events of incidents, deviations or failures in systems of significance to safety, do the correct alarms stand out clearly in relation to other information provided? 1b. Are the alarms given in such a way that they can be perceived and acted on immediately / in the time required for safe operation of equipment, plants and processes? MR § 2, FR § 20, AR § 31	Guidance for the design of alarm systems is given in NPD Publication: YA 711 Alarm System Design.		

OTHERS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. How is cooperation between platforms ensured in the event of an ESD? 1b. What are the implications for the CCR with regard to space, equipment, systems and manning? AR § 69	If a control room runs two or more platforms, which are either full or part time manned, it will be necessary to establish a plan for cooperation in the event of incidents. b) The implications can be that the control room must be dimensioned, equipped and manned in order to handle incidents on two or more platforms simultaneously.	*(Phase B-E)*	
2a. In the event of hazards that might develop into incidents, who constitutes the preparedness team for the operators? 2b. How is it ensured that the operators during accidents can get a total overview of the situation, as well as an overview of communication means accessible to combat the situation? 2c. How are the operators given an overview of where personnel on the installation are situated? 2d. What criteria are set to determine whether the situation is normalized?	See Guidance for AR § 68.		

OTHERS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
AR § 68.			
1. How have environmental factors been assessed against their impact on task performance? AR § 31, FR § 22, NORSOK S-002, ISO 11064 –6	Speech Interference Levels shall be evaluated to document that acoustics/noise does not obstruct communication of significance to safety (see ISO 9921). Lighting/reflections/contrasts/color on screens shall be assessed up against task requirements of continued screen usage and where good vision is required in order to perform the task safely.		
2. How is the work environment designed to take account of an individuals differences, including work capacity and age? FR § 19, AR § 31	Note: Humans sensory capabilities such as vision, hearing deteriorate with age. (FR § 19 and MR § 18).		

OTHERS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
LOCATION 1. Is the proposed CCR ”safe by location”, i.e. distant to known major sources of incidents, so that it is operative until the facility is evacuated? FR § 6c		*(Phase A-C)*	
2. Does the location of the control room take account of the need for interworking with other rooms and functions? AR § 68, NORSOK C-001, NORSOK I-CR-004, ISO 11064-2 Annex A	See NORSOK C-001 and NORSOK I-CR-004 for requirements for relative location of functions and rooms such as emergency preparedness room, work permitting, toilets, etc. See ISO 11064-2 Annex A.		
3. How does the transport route to the control room facilitate effective and safe personnel transport? FR § 12, NORSOK S-002	See NORSOK S-002.		
4. Does the location of the control room facilitate a quick and effective escape way? FR § 6e, 12, NORSOK I-CR-004	Regulations state that their shall be two escape ways from the control room with at least one escape way from the control room directly to the life boats.		
MATERIALS 1. How do specifications for materials in the CCR contribute to	General requirements to materials include: glare free, easy to clean, easy to maintain, suitable for use,	*(Phase C-E)*	

OTHERS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
ensuring employees health and creating a good working environment? FR § 11, NORSOK S-002	comfortable to walk on, noise absorbing, anti-static properties and suitable choice of color.		

V & V			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. What is the overall verification process, with regard to scope, goals, plan, methods, criteria, resources, competence, independence of the verification, documentation and feedback/traceability to the project? 1b. How is V & V integrated into the project? FrmR § 15, MR § 21, ISO 11064-1, ISO WD 11064 – 7. 4.2.11.3, ISO 6385-4	ISO 11064-1 states that V & V shall be an integral part of the design process, is iterative and should feed back into the design process. V & V should contribute to identify technical, operational, or organisational weaknesses, failures, and shortcomings.		
2. Which validation criteria are derived? MR § 7, ISO 11064-1, ISO WD 11064-7- 4.2.1.1.7.	The degree to which goals have been met shall be evaluated. ISO 11064 states that a specific document describing the criteria and methods used shall be developed.		
3a. Which stakeholders (operations, different project disciplines, concern auditors, etc) have taken part in the different parts of the V & V? (see ISO 11064-7-4.2.11.2) 3b. How is the output from the analyses verified and validated both individually and collectively?	ISO 11064 –1 states that Task analysis shall include all operational modes of the control system. NORSOK S-002 states that the analysis shall cover normal operation, including start up and shut down, emergency operations and maintenance and revision. The analysis shall cover personnel and system safety aspects, including		

V & V			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
3c. How are deviations identified and handled? 3d. What are the outcomes of validating and verifying the proposed jobs against ergonomic principles and error tolerances? 3e. What typical and critical scenarios are used in the assessment? MR § 20, NORSOK S-002, ISO 11064-1-7.6, ISO 11064 – 7 WD	controlling process disturbances in a safe manner.		
4a. Do verification(s) confirm that the HSE requirements are met? 4b. Does the available documentation (both process and requirements related) provide an acceptable overview over planned and completed work processes? FrmR § 15, MR § 10, ISO 11064 – 7 WD	The term “requirements” includes both results (products) and work processes (analyses).		
5. Have inconsistencies between different requirements been identified and resolved? MR § 20, ISO 11064 – 7 WD	It is relatively normal to find inconsistencies between different stakeholders in a project and between different levels of detail.		

V & V			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
6a. Does the V & V focus on key human factors requirements? 6b. Which V&V tools (static and dynamic) have been used to evaluate the control room design? MR § 21, ISO 11064-1, ISO WD 11064 – 7	ISO 11064-1 states that the V & V process shall focus on operational safety, human error reduction, ergonomic design, environmental factors and job satisfaction. The CRIOP method contains both a static checklist and a method for dynamic evaluations (scenario analysis). NUREG 0700 contains a checklist. Modeling techniques that facilitate a dynamic evaluation include building of physical mock ups, system prototypes, 3D and CAD models and VR solutions.		
7a. Does the approach followed, the methods used and experience transfer data give a total overview of important risk elements, including human error? 7b. How is it ensured that all safety critical systems are evaluated? MF § 15, IEC 61508.	For guidance se MF § 15 clauses a-f. The analysis work should be dimensioned in relation to the level of risk and size of operation. Kirwan, 1994, Annex 3, provides a validation of techniques used for human reliability analysis.		

2.3 Specific Checklists

Introduction

Purpose

The Specific Checklists shall provide a revision tool that asks relevant questions and provides references related to specific requirements for each phase in the design process.

The Specific Checklists consists of 5 checklists related to the 5 phases in ISO 11064:

Intended results of use

Using the specific checklists should result in a better overview of activities missing in each phase, related to normative regulations and standards.

Note !

The results gained from use of the specific checklists should be seen in relation to the results gained from the documentation checklist and the general checklist.

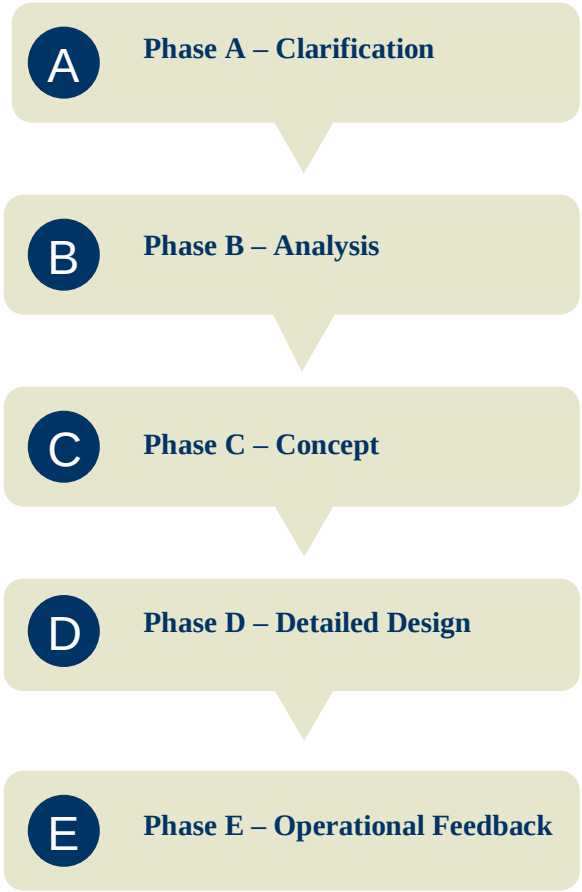

Fig - 5 phases in ISO 11064-1 related to 5 Specific Checklists.

Phase A - Clarification Checklist

Introduction

Flow chart – HF activities in Phase A

This phase covers the organisational and management aspects of the project. Fig 6. gives a general overview of minimum required inputs, activities and outputs as well as the tools necessary to verify and validate HF activities in this phase. (For more information on the design process see ISO 11064-1.)

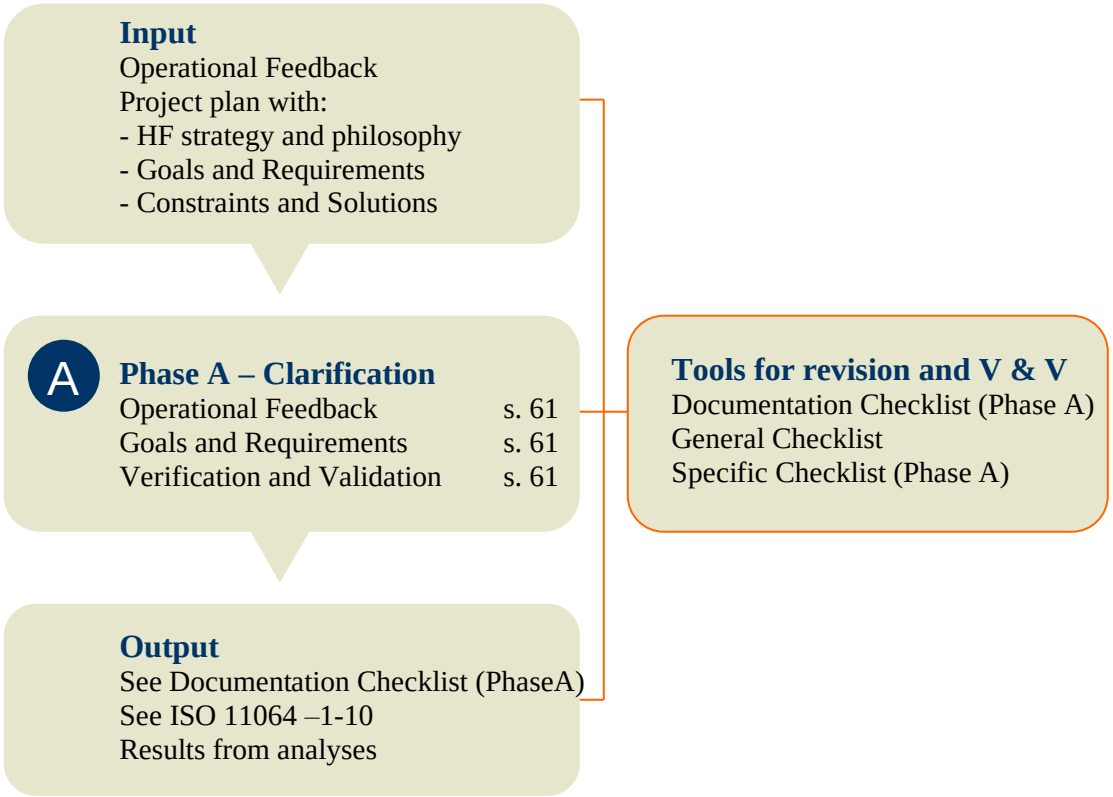

Figure 6. – HF activities in Phase A

Phase A – Clarification Checklist

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which shortcomings/ weaknesses were identified as a result of using the Documentation and General Checklists? 1b. To what degree is the project aware of these shortcomings/ weaknesses and how have they been handled?			
2. How do the frame agreements made with equipment suppliers meet the HSE regulations with regard to HF?	E.g. Frame agreement on Control Systems.		

OPERATIONAL FEEDBACK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How is experience transfer data used for the development of the project management system? FrmR § 13	See also General Checklist and Phase E		

GOALS & REQUIREMENTS

V & V

1. See General Checklist.			

Phase B - Analysis Checklist

Introduction

Once the goals and requirements have been specified in Phase A, more detailed analyses are needed to determine more specific requirements. Fig 7. gives a general overview of minimum required inputs, activities and outputs as well as the tools necessary to verify and validate HF activities in phase B. (For more information on the design process see ISO 11064-1.)
NB: Analyses must be related to chosen concept.

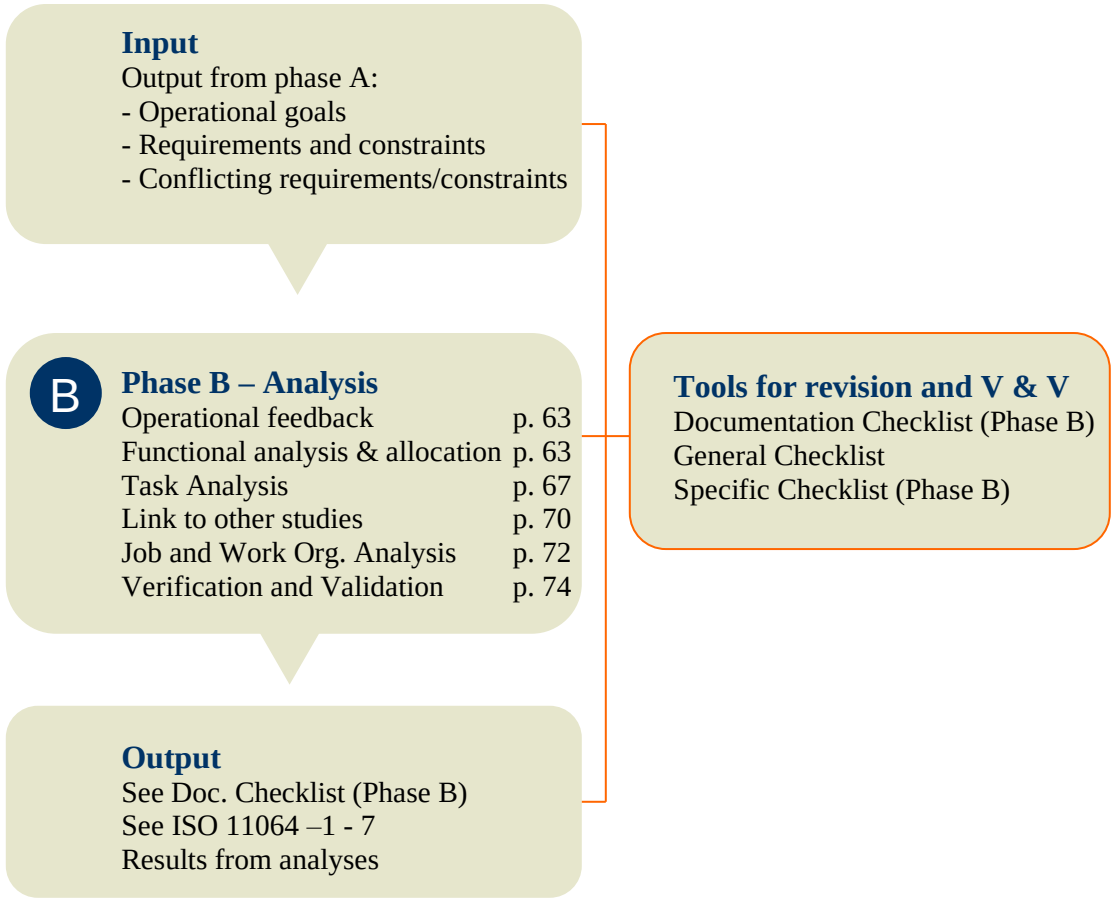

Figure 7. – HF activities in Phase B

Phase B - Analysis Checklist

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which shortcomings/ weaknesses were identified as a result of using the Documentation and General Checklists for phase A? 1b. To what degree is the project aware of these shortcomings/ weaknesses and how have they been handled?	Shortcomings could be lack of: - experience transfer - philosophies - document hierarchy Shortcomings could be handled by: - establishment of experience transfer system for company - establishment of company philosophies for CCR		
2. What are the outputs from the General Checklist?			

OPERATIONAL FEEDBACK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. See General Checklist and Phase E.			

FUNCTIONAL ALLOCATION AND ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What is the scope/objectives of the function- and task analysis? MR §§ 1, 2, 8, 13, 17, FR §§ 9, 20, AR § 31	The scope/objectives of the analysis should reflect the overall HSE requirements for the control room and the overall requirement to reduce the level of risk and “barrier” philosophy.		

FUNCTIONAL ALLOCATION AND ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
2. Which parts of the control room / control system and which modes of operation has the analysis examined? MR §§ 11, 13, 17, FR § 20, AR § 31, ISO 11064-1, NORSOK S-002	Guidance to Regulations requires that analysis (MR § 13) give the necessary information for making decisions regarding HSE. Regulations (MR § 11) for manning require an overview of all tasks including work peaks/ tops including disturbances and abnormal situations. NORSOK states that functional analysis shall include all operational modes of the control system, including start up shut down maintenance, incidents, abnormal situations and normal operations.		
3a. What methods/procedures are used? 3b. What performance requirements are documented as a result of the functional analyses performed to achieve the objectives defined in phase A? 3c. What functions are allocated to humans, machines, or dynamic (interaction between the two)? MR § 13, FR § 20, AR § 31, ISO 11064 1 - 7.2-7.3	Guidance to Regulations (FR § 20) state that function and task analysis should be performed according to ISO 11064. See step 7.3 or Annex B in ISO 11064. It is best to use a method that keeps the functions relatively abstract, i.e., not too detailed or finely decomposed. They should not be described, at this stage, in terms of human or machine performance, to avoid pre-empting later decisions.		
4a. What considerations (e.g.	See ISO 11064-1, figure 1, -Basic		

FUNCTIONAL ALLOCATION AND ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
mandatory requirements) and criteria (e.g. human variability/ performance) are used for functional allocation? 4b. What procedures for allocation of functions are followed? 4c. Is there a preliminary consideration of functional areas for the CCR? 4d. How are the results of the functional analysis (planned) used? 4e. What links/sequences of functions are identified? 4f. What conclusions, requirements and results have been obtained? 4g. To what extent is the functional allocation in accordance with given criteria/ limitations (human, technological, organisational) and the projects operational and	procedures for the allocation of functions/tasks to human and/or machines. See the HSE Regulations for requirements to allocation, e.g. for safety systems. Fitts List contains an overview over the functions that people and systems are most suited to handle. For example, that functional areas are needed for emergency preparedness, handling of work permits, safety systems, rest recreational area, office functions, etc. Conclusions/results could be that certain functions shall not be performed in the CCR, e.g. telephone exchange. Is there a good correlation, or are additional iterations needed? The manning philosophy can indicate a minimum of manning, which in turn requires a high degree of automation		

FUNCTIONAL ALLOCATION AND ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
manning philosophy for the CCR? FR § 20, AR §§ 31, 33, ISO 11064 -1- 7.0-7.3	(i.e. technical systems do nearly everything).		
5. Are possible consequences of adding functions in the future assessed? FR § 20, AF § 31, ISO 11064-1-7.5, ISO 11064 –3 - 4.2.1.3	The consequences could be that more space is needed, e.g. for system modifications, testing or for special situations where more personnel are required, such as offloading.		

TASK ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. Does the scope of the analysis cover all modes of operation? MR §§ 8, 11, 13, 17, FR § 20, AR §§ 31, 32, ISO DIS 6385 - 3.6.2, NORSOK S-002.	ISO 11064 –1 states that Task analysis shall include all operational modes of the control system. NORSOK S-002 states that the analysis shall cover normal operations, including start up and shut down, emergency operations and maintenance and revision. The analysis shall cover personnel and system safety aspects, including controlling process disturbances in a safe manner.		
2a. How is it ensured that the task analysis covers all tasks where human errors may cause accidents with severe consequences to personnel, environment or property? 2b. How will the results of the analysis be used to reduce the probability of human error? MR § 17, FR § 20, AR §§ 30, 31, NORSOK S-002.	Tasks may be administration, work permitting, monitoring environment, telephone exchange, alarm handling, communications (internal/external), position keeping, testing, verification of instrumentations reliability, monitoring/controlling process, power supply, ballasting. The Regulations allocate a number of tasks, e.g. participation in emergency preparedness training every shift (AR § 21), transfer of information between operators under shift change (AR § 30).		
3. Does the task analysis include all the monitoring tasks and the total responsibility operators for	The manning level and the competence of the operators present in control room should allow for this.		

TASK ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
monitoring ongoing work? MR §§ 11, 17, FR § 20, AR §§ 29, 31	The analysis should allow for operators getting hold of and processing necessary information.		
4. Are the task elements systematically broken down to a level that provides concrete input to the design? FR § 20, AR § 31, ISO 11064 -1-7.4	The level of detail should provide requirements with regard to space, equipment, procedures, training, manning and workload.		
5. On what relevant prior experience is the task description based? FR § 20, AR § 31, ISO 11064-1-7.4	Situational analysis (ISO 11064-1) should help to determine degree of relevance. See "Ergonomics in Process Control" IIUA, page 6, for example of Situation Analysis. Evaluations of similar, continual WE surveys of existing installations, literature reviews, and use of experienced CCR operators are all sources that can contribute.		
6. What opportunities for innovation/invention/ improvement (technical/ organisational) have resulted from evaluating the task description? How are these possibilities exploited in relation to ergonomic requirements/ goals?	Whilst the first step in Task Analysis, Task description, maps out how existing tasks are performed, the second step, Analysis, should include changing the task, exploiting the use of new technologies / working practices in order to improve system performance / reduce workload/ possibility for human error.		

TASK ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
FR § 20, AR § 31, ISO 11064 -1 -7.4			
7a. What simultaneous tasks are identified? 7b. What measures ensure that handling of simultaneous tasks will not lead to an unacceptable increase in risk? MR §§ 11, 17, FR § 20, AR §§ 26, 31, 33.	The manning analysis should show the total number of staff and changes in manning (shifts, different modes). Measures to handle simultaneous tasks could be procedures, training, manning, and/or technical improvements.		
8a. Does the task analysis confirm that operators are able to continually monitor and control significant HSE aspects without disturbance? 8b. How is it ensured that the operators are not given tasks that can weaken performance of the monitoring? FR § 20, AR §§ 29, 31	The manning level and the competence of the operators present in control room should allow for this. There should be a minimum of 2 operators to perform monitoring and controlling for permanently manned installations, and when operating equipment for dynamic positioning, (Class 2-3) drilling and well activities.		
9a. What links between tasks are identified? 9b. What are the resulting requirements?	Link analysis is useful for identifying which entities (rooms, equipment) should be placed together. It is also useful for identifying which links should be developed in software (i.e.		

TASK ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
FR § 20, AR § 31, ISO 11064-2	going directly from one screen picture to another).		
10. Does the analysis include identification of tasks outside the scope of normal control room operations? MR § 1, FR § 20, AR § 31	It is important to get a common understanding amongst all stakeholders of what the operator should not do – e.g. act as switchboard operator, otherwise such tasks may be allocated over time.		

LINKS TO OTHER STUDIES

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Do other analyses identify situations where human error in relation to the control room may have severe consequences? 1b. If so, how is the resolution of these issues coordinated? FR § 20, AR §§ 31, 64, NORSOK S-002	Related studies include: Human Error Analysis, Risk Analysis, Emergency Preparedness Analysis, Safe Job Analysis, Ergonomic Job Analysis, Noise, Lighting, etc.		
2. Is it ensured that critical activities are carried out within the operational limits assumed in the design and in the risk analyses? MR § 13, AR § 25	Example: inhibition of alarms during detector testing.		

LINKS TO OTHER STUDIES

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
3a. What hazards and accidents in the control room could adversely effect the functionality in an emergency situation? 3b. How is this resolved? AR § 64, MR § 15.	For details see MR § 15 Guidance, a-b.		
4a. What is the role of the operators in relation to emergency preparedness? 4b. How does this role differ before and after the emergency response team has arrived in the control room? 4c. Does a difference in roles have implications for the control room with regard to layout, equipment, manning, planning and work load? MR § 17, AR §§ 31, 33, 64.	Note: Control room operators are the EP Team until the other members of the EP team arrive and take over. The CCR operators should therefore have responsibility for specific tasks. EP manuals/procedures do not always reflect this.		

JOB AND WORK ORG. ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. What is the manning plan for the CCR for all operational modes (day/night/maintenance/ emergencies)? 1b. How is it demonstrated that the manning plan meets the conditions and requirements resulting from the task analysis? MR § 3, 11, AR §§ 31, 33.	Manning levels, job and work design and subsequent evaluation of work load are an iterative process. Manning plans / job descriptions are a precondition to fulfilling requirements in AR §§ 31 and 33.		
2. What is the proposed assignment of tasks and jobs to each individual in the CCR for all operational modes? AR §§ 31, 33, ISO 10075 1-3			
3a. How has the workload, including mental workload, for each individual been documented as acceptable? 3b. What ergonomic principles and methods have been used? AR §§ 31, 33, WEA § 12, ISO 10075-2, ISO 13407, EN 614-2, NORSOK S-002.	See Guidance to AR § 33, EN 614-2, ISO 10075 and ISO/TR 16982. AR § 31 requires that levels of mental load that are damaging to an individuals health be avoided. Guidance for AR § 33 lists several psycho-sociological factors (a-h) to be taken into account that relate to workload. See also mental workload assessment in EN 614-2. NORSOK S-002 requires a Psycho-social analysis.		

JOB AND WORK ORG. ANALYSIS

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
4. What is the basis for making the assignments (e.g. job assignment criteria checklist)? MR § 4, ISO 11064-1, ISO 10075 –2, NORSOK S-002	ISO 11064 has a minimum list of criteria. NORSOK S-002 requires a systematic method be used for evaluating job demands. Input data, such as experience transfer data, previous analysis (function, task) can contribute as a systematic basis.		
5a. What information needs to be shared between operators working in teams? 5b. How does layout/systems/ procedures support this? AR § 31, ISO 11064-3 - 4.2.2.2			
6a. What topics does the scope of the work organisation plan cover? 6b. What plans/criteria exist for updating the Work organisation? AR § 31, ISO 11064 –1 -7.5	Job rotation within and between CCR / process plant, responsibilities in teams, effects of shift work, availability are typical topics. AR § 31 requires that the minimum necessary work be done at night.		
7. How will results from the analysis of Job and Work organisation be incorporated into training, procedures and functional specifications for the design of the control room?	The development of requirements specifications should plan to use the results from analyses.		

JOB AND WORK ORG. ANALYSIS			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
MR § 13, ISO 11064-1-7.5			

V & V			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. See General Checklist.			

Phase C - Concept Checklist

Introduction

Once the requirements have been specified in phase B, a conceptual framework may be developed.
Fig 8. gives a general overview of minimum required inputs, activities and outputs as well as the tools necessary to verify and validate HF activities in this phase.
(For more information see ISO 11064-1.)

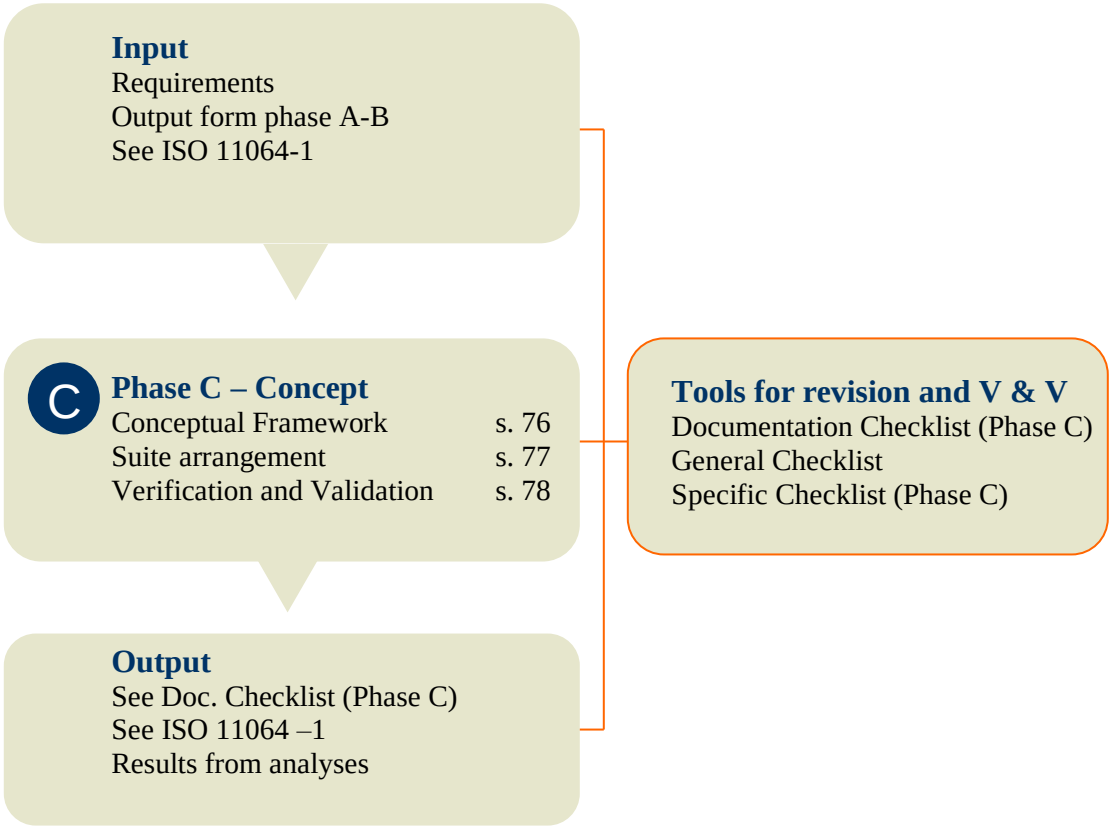

Figure 8. - HF activities for Phase C

Phase C – Concept Checklist

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which shortcomings / weaknesses were identified as a result of using the Documentation and General Checklists and the specific checklists from Phases A and B? 1b. To what degree is the project aware of these shortcomings/ weaknesses and how have they been handled?			
2. What are the outputs from the general checklist?			

CONCEPTUAL FRAMEWORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. How have HF requirements from the concept design been used in preliminary specifications? 1b. Which HF criteria are the basis for choosing the control room concept? 1c. Which are the design constraints with regards to HF / WE?	There are overall requirements on prudent activities (FrmR § 8), those that reduce the possibility of risk (FrmR § 9) and use of the best possible solution. There are requirements for design solutions that are as robust and simple as possible so that the possibility of mistakes is reduced/limited (FR § 9). The scope could include physical layout, systems, room location, work system design,		

CONCEPTUAL FRAMEWORK

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1d. In relation to the overall goals and requirements, what are the compromises that accompany the chosen concept? FrmR §§ 8, 9, MR §§ 4, 5, FR § 9, ISO 11064 -1 - 8.1- 8.2	communications, manning levels. ISO 11064-1 and 2 list aspects for conceptual design. The HF criteria should have been developed earlier in the design process (HF principles) and recorded in the CCR Design Philosophy.		

SUITE ARRANGEMENT

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which other related rooms are considered when determining the control rooms functionality? 1b. Do the area specifications for these related rooms facilitate support functionality /cooperation? 1c. Does the analysis consider requirements for communication between these related rooms? FR §§ 4, 12, 19, 20, 60, ISO 11064-1-9.2, ISO 11064-2, NORSOK I-CR-004, NORSOK C-001.	See NORSOK C-001 and NORSOK I-CR-004 for requirements for relative location of functions and rooms such as emergency preparedness room, work permitting, toilets, as well as functions that the control room cooperates closely with. See ISO 11064-2 Annex A.		
2a. How are the main safety	The CRIOP method is referred to in		

SUITE ARRANGEMENT

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
functions of the CCR systems maintained during incidents? 2b. What role will the CCR and its operators play in preventing different types of incidents / accidents escalating? FR §§ 6, 20, NORSOK S-002	NORSOK S-002. NORSOK I-002 includes requirements to safety systems.		

V & V

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. See General Checklist			

Phase D - Detailed Design Checklist

Introduction

In this document the term “detailed design” includes detailed design, fabrication, preparation for operation and commissioning. This phase is an iterative process that begins with identifying clear and detailed design requirements for systems, and ends with a working control centre (commissioning).
Fig 9. gives a general overview of minimum required inputs, activities and outputs as well as the tools necessary to verify and validate HF activities in this phase.
(For more information on the design process phase D see ISO 11064-1.)

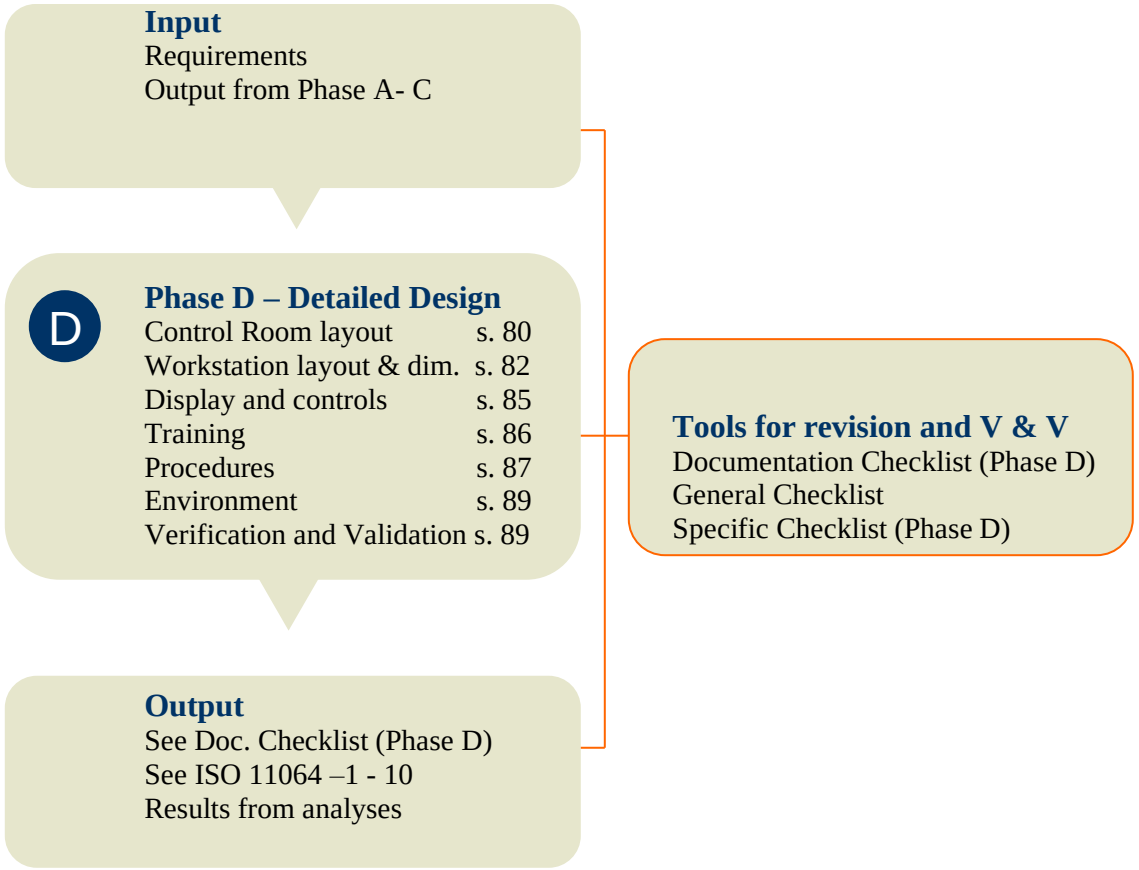

Figure 9. Flow chart– HF activities in Phase D

Phase D – Detailed design Checklist

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which shortcomings / weaknesses were identified as a result of using the Documentation and General Checklists and the specific checklists from Phases A, B and C? 1b. To what degree is the project aware of these shortcomings/ weaknesses and how have they been handled?			
2. What are the outputs from the general checklist?			

CONTROL ROOM LAYOUT

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How are requirements from the concept phase implemented in the detailed design phase? FrmR §§ 8, 9, FR § 9, ISO 11064 – 1	It is normal, within different disciplines, to further develop high level requirements into detailed specifications. The need to document this link should be considered.		
2a. How do the control room specifications contribute to ensuring a smooth transition between all activities in/around	See ISO 11064-1 Annex B and ISO 11064 – 3, NORSOK I-CR-004.		

CONTROL ROOM LAYOUT

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
the control room? 2b. What documented project activities have been performed in determining the layout out of the control room? 2c. Which human factors aspects have been taken into account? MR § 13, ISO 11064-1-9.3, ISO 11064–3			
3. Where are survival suits for the control room to be stored and how much space is needed? AR § 39, FR § 44			
4a. What are the roles, procedures, equipment in the control room that will be used in an emergency situation? 4b. What effect does this have on the control room design? AR § 67	See AR § 67 Guidance for details.		
5. Is the CCTV system readable and operable from the normal seated place of work?			

CONTROL ROOM LAYOUT

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
NORSOK I-CR-004-5.2.3			
6. Is adequate space provided for material/documentation that must be archived/used in the control room? FrmR § 17	Evaluations of this must include both archiving space and space to use documents in different operational modes.		
7. Does the room layout/manning allow for the control room / emergency preparedness room to be able to maintain continuous contact with the supervisory and emergency preparedness instances where this is required? IR §§ 11, 12, AR §§ 68, 71	Regulations (IR § 12), stipulate several situations (a-d) where immediate contact must be established and thereafter continually maintained. Note. The EP team will not arrive immediately.		

WORKSTATION LAYOUT AND DIMENSION

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which parameters (height, angles, distance to operators) are adjustable on workstations and the equipment mounted on them? 1b. Can adjustments be made quickly and easily? 1c. What is the range of the adjustments?	Regulations state that adjustments shall be quick and easy and also specify which parameters shall be adjustable and the ranges. See WEA No. 528, ISO 11064-1 Annex B and ISO/DIS 11064 – 4, NORSOK I-CR-004 - 5.2.2, NORSOK S-002, Annexes. The range of adjustments must take account of variations in individual size and individual need		

WORKSTATION LAYOUT AND DIMENSION

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
AR § 32, FR § 19, WEA § 9 No 1, 528, NORSOK I-CR-004 - 5.2.2, ISO 11064-1-9.4, ISO/DIS 11064-4.	for variation.		
2. Which recognized requirements/guideline(s) are used for control suite arrangement? MR § 1, FR §§ 19, 20, NORSOK I-CR-004, NORSOK C-001, ISO 11064 –1 - 9.2, ISO 11064 –2	Regulations have requirements for the design, location and arrangement of controls and displays. Other requirements area good overview so that work can be carried out safely, arrangements that do not subject employees to adverse physical or mental strain. Arrangements shall not negatively impact safety. Guidance to FR states that ISO 11064 should be used. ISO 11064- 2 for specific requirements and guidelines for control suite layout		
3. What human factors principles and procedures were used to detail the workstation design and layout? ISO CD 11064-4	ISO CD 11064-4 provides a procedure for workstation design.		
4. How is it confirmed that there are a sufficient number of operator stations for both normal and abnormal situations? NORSOK I-CR-004 -5.2.2			

WORKSTATION LAYOUT AND DIMENSION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
5. Does one seated operator have an overview of all operational systems, and is the operator able to take first action in an emergency situation? NORSOK I-CR-004 -5.2.2	NORSOK I-CR-004 -5.2.2, states that one operator shall have an overview of all operational equipment, including process control, F & G, ESD, and Telecom equipment from a seated position.		

DISPLAY AND CONTROL

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. Which acknowledged ergonomic principles is the Human Systems Interface designed upon? MR § 5, ISO 11064 –1, EN 894, NORSOK I-CR-004, NORSOK S-002.	Regulations and NORSOK state that the design of the Interface shall be based on acknowledged ergonomic principles. Examples include consistency of user interfaces across systems, logically structured displays, total plant overviews.		
2a. How will the Interface design support the tasks in the CCR? 2b. What criteria have been used to select input devices? 2c. How have critical screen/display design issues, such as density, quality of information, timeliness, been resolved? FR § 20, EN 894 1-3, ISO 11064 –1 9.5, NORSOK I-CR-004 - 5.2.3	See ISO 11064-1 Annex B and ISO/WD 11064 – 5 Input and output devices should be designed, located and grouped to allow simple and quick reception of necessary information and implementation of necessary actions. Information presented shall be correct and easily understandable. NORSOK I-CR-004 -5.2.3 requires consistency of the user interface across systems. Provision of overview over entire plant is also required. Another requirement is that displays are logically structured and readable from a seated workplace.	.	
3. How is screen equipment designed so that the probability of mistakes when using them is	The term screen equipment includes equipment for monitoring, controlling and running machinery, plants or		

DISPLAY AND CONTROL

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
reduced? MR § 17, FR § 20, (ISO 11064, NORSOK S-002).	production processes.		

TRAINING

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. How has it been ensured that the personnel at all times have the competence necessary to be able to carry out the activities safely and in accordance with the legislation relating to HSE? MR § 11, AR §§ 19, 20	See Annex A to this document.		
2. How are personnel trained so they have the necessary practice and capability of handling process disturbances and serious incidents, including emergency situations at all times? AR §§ 21, 66.	NB Guidance states that simulator training shall be used for operators who have monitoring and or control functions.		
3. What type of training is provided regarding person - person communication? AR §§ 68, 71	Person - person communication could be face to face, or via handover / shift reports / notes or radio/telephone/PA.		
4. How will it be ensured that	Information on risks shall be		

TRAINING			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
employees understand information on risks in connection with the work being carried out? AR §§ 33, 41	implemented in practice, it shall be presented, and read so that the employees understand the significance of the information about risks.		
5a. What HSE training or understanding of risk in relation to total work load is given to employees? 5b. Are requirements established for HSE training to include assessing changes in tasks and associated risks, and how to manage them? AR § 20			
6. What systematic methods have been used to develop and evaluate training? AR §§ 19, 20, 21.	Annex A to this document includes a series of training related requirements from NPD Publication (2000) " A method for reviewing HF in control rooms".		

PROCEDURES			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What systematic methods have been used to develop and assess procedures? MR §§ 3, 13	Annex B to this document includes a series of requirements from NPD Publication (2000) " A method for reviewing HF in control rooms".		
2. Is a list of all control room tasks available that covers all operational modes? MR § 13, AR § 26	NORSOK O-DP-001 -7.2.1 gives a list of applicable operational modes and requires that operating, start-up and commissioning instructions are developed in parallel with system design.		
3a. What simultaneous tasks have been identified? 3b. What measures (procedures) ensure that this will not lead to an unacceptable increase in risk? MR § 11, AR § 26	This could be helicopter landing or offloading simultaneously with process control. The manning analysis should show the total number of staff including changes in manning in relation to shifts / operational modes. Measures could be procedures, training, manning or technical.		
4. What is the criteria for when procedures are to used as a means of preventing faults and situations of hazard and accident? AR § 22			
5. What procedures are there for reporting and follow up of near misses and unsatisfactory	Experience shows that reports of near misses are seldom made where the control room is the main cause		

PROCEDURES			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
conditions related to control room design, instrumentation and operational practice within the control room? MR § 22	or part of the causal chain.		
6. How is accessibility to procedures ensured? AR § 22			
7. How is it ensured that procedures are used as intended? AR § 22			
8. How is it ensured that procedures that overlap are consistent with each other? AR § 22			
9. How is it ensured that rests can be taken as per Regulations (FrmR § 50)? FrmR §§ 47, 48, 50, AR § 31.			

ENVIRONMENT V & V			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. See General Checklist.			

Phase E - Operational Feedback Checklist

Introduction

Fig 10. gives a general overview of minimum required inputs, activities and outputs as well as the tools necessary to verify and validate HF activities in this phase.
(For more information see ISO 11064-1.)

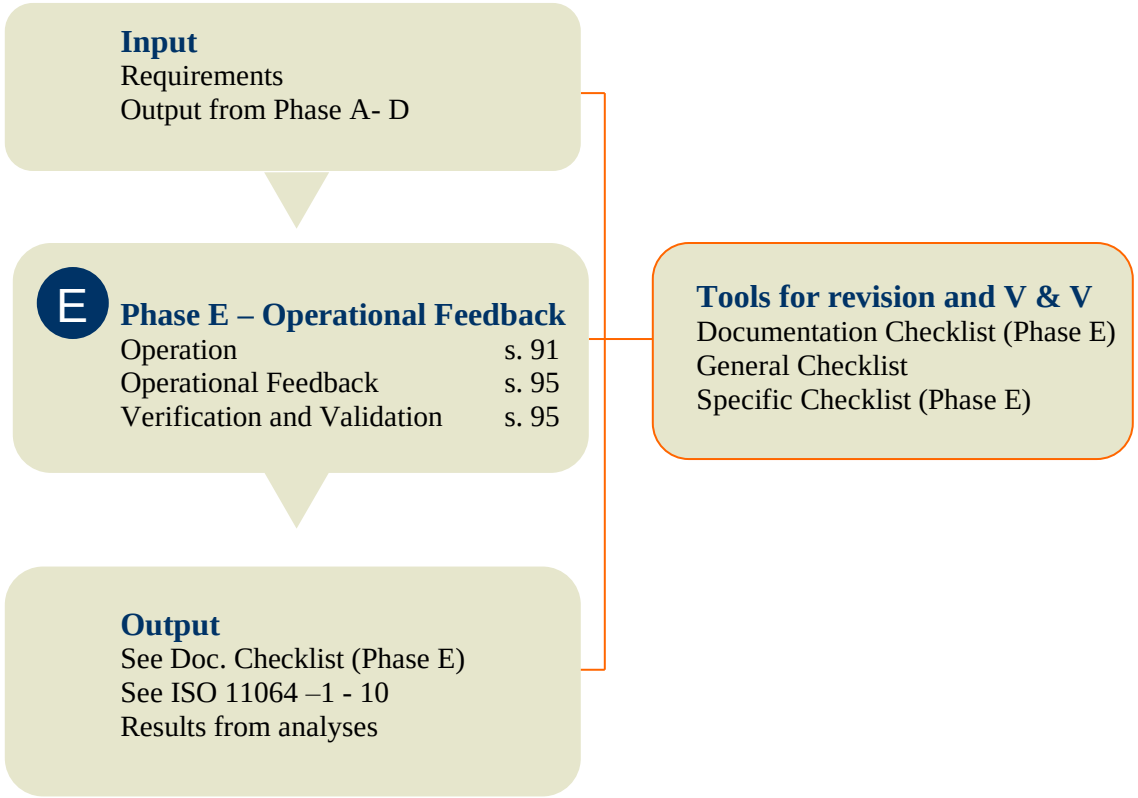

Figure 10. Flow chart – HF activities in Phase E

Phase E –Operational feedback Checklist

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1a. Which shortcomings / weaknesses were identified as a result of using the Documentation and General Checklists and the specific checklists from Phases A, B, C and D? 1b. To what degree is the project aware of these shortcomings/ weaknesses and how have they been handled? Alternatively: 1c. What is the experience from operations?	The context for Question 1c is that the installation has been in operation for many years, and there is no available information from "previous phases". Where documentation is missing, going through the general checklist is especially important.		
2. What are the outputs from the general checklist?			

OPERATION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. What are the possible consequences identified when changing ways of working? MR § 11 last section	Regulations state that a consequence analysis shall be performed.		

OPERATION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
2. Does hazard/accident registration consider human error as one of the causes? MR § 19	(See MR § 19 Guidance clause D).		
3a. What management / steering systems / resources / documentations and operational organisation are established, made available and communicated during start up and under operation? 3b. What system has been established for ensuring necessary transfer of information to oncoming personnel? 3c. How are operational personnel made acquainted with documentation? 3d. How do systems for employee participation function? AR §§ 18, 30			

OPERATION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
4a. How much time is allocated for employees to read and comprehend information on risks in connection with the work carried out? 4b. What type of information is available, how is it presented and implemented in practice so that the employees understand the significance of the information on risks? AR § 41			
5a. Has the control room operators perception of risk in relation to human error been measured? 5b. What measures are taken to ensure that employees perception and companies perception are the same? 5c. Which techniques have been used to measure operators perception of risk? AR § 31	The consequences of employees risk perception not reflecting company perception could be that the real risk is actually higher than the perceived risk, due to rule violations (employees do not follow procedures). Redmill (1997) and Kirwan (1998) devote a chapter to rule violation/ organisational issues.		

OPERATION			
QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
6a. What indicators monitor changes and trends in the risk relating to major incidents? 6b. How are CCR operators made aware of these changes and given a total overview of a changing risk picture? 6c. How have questions a and b been assessed with regard to human error? MR §§ 7, 12, AR § 19	Factors to consider include ensuring that all key pieces of information are present, that the information is collated, that the pieces of information are consistent, comprehensible and unambiguous. A total overview could be given by various means, including for example, use of Large Screen Displays. c). This refers to the possibility of the operator himself making a mistake when either identifying, comprehending or acting upon a changing picture of risk.		
7. How is both the individual and combined effect of all work environmental factors on an individual working a 12 hour day for 14 days measured objectively and subjectively? FR §§ 20, 21, 22, 24, NORSOK S-002, NORSOK C-001-6.5, NORSOK I-CR-004-5.1.2, ISO 9241-6, ISO WD 1064-6.	There are a number of regulations that require an evaluation of all the work environmental factors (noise, temperature, lighting, air quality, vibration, etc) in relation to their associated acceptance criteria.		

OPERATION

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
8. Is there a plan for updating he task analyses and other analyses when the requirements for work changes? MR § 13, FR §§ 19, 20.	For example, when the control room is modified or relocated.		

OPERATIONAL FEEDBACK

V & V

QUESTIONS	GUIDANCE	ANSWERS	COMMENTS
1. See General Checklist.			

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Annex A - Training

(Adapted from: ”A method for reviewing HF in CCR design”, NPD 2000).

1	Has the CRIOP part 1 checklist been used to evaluate training?	
2	Was a systematic method used and documented that identified all control room tasks across all operating conditions?	
3	Was a systematic method used to decide in which of these tasks operators needed training?	
4	Are tasks for initial training and those for refresher training identified separately?	
5	Is the analysis of the chosen tasks adequate to develop learning objectives and are the results presented in a consistent format?	
6	Is there refresher training for difficult, critical, or infrequently performed tasks?	
7	Are exemptions from training and task performance based on objective criteria?	
8	Is feedback formally collected from operators and used to identify potential improvements to operator training?	
9	Are operators asked for feedback about jobs/tasks that they did not feel adequately trained to perform and is it used to identify potential improvements to operator training?	
10	Is information collected from supervisors about the performance of operators, in order to identify tasks that they were not adequately trained to perform. Is it used to identify potential improvements to operator training?	
11	Is information or feedback collected from operators and supervisors about task performance that declines over time, and is it used to identify potential improvements to operator training?	
12	Are external factors and changes evaluated to identify their impact on CCR jobs and related training programmes?	
13	Do changes in requirements for job performance result in changes in training and training materials?	

Annex B - Procedures

(Adapted from: “A method for reviewing HF in CCR design”, NPD 2000).

1	Is a list of all CCR tasks available that covers all operational modes?	
2	Was a systematic method used to decide which of these tasks need procedures to support the operator?	
3	Was appropriate information and expertise used in developing the CCR procedures?	
4	How has employee participation been ensured in the development of procedure?	
5	Is a list of documentation that was used to develop the procedures available?	
6	Was relevant input from end users included in the development of the procedures?	
7	Are procedures included in a system for tracking management documentation?	
8	Do the procedures conform to the standards for format and writing style that are laid down in the Operating Company’s writer's guide?	
9	Do the procedures routinely give information about why the tasks should be done in the way described?	
10	Has an appropriate method been used to identify and assess consequences of error made carrying out the procedure? As a result, have warnings, cautions, error prevention and error recovery strategies been included at these points?	
11	Have inspections or controls been included at appropriate points to verify the task is being performed correctly?	
12	Have procedures been verified to ensure that their technical content is accurate?	
13	Did the walk-through ensure that procedurally oriented tasks can be carried out without the need for additional information?	
14	Have steps been taken to ensure that the requirements of procedures do not conflict with other safety requirements or other procedures?	
15	Are procedures easily accessible for CCR operators?	
16	Are procedures routinely checked against operating practice to ensure compliance?	
17	Is there a system for ensuring that training will be updated when procedures are further developed or revised?	
18	Are operators trained in the actual use of a procedure?	

Address

Norwegian Petroleum Directorate
Office address: Professor Olav Hanssensvei 10
Postal address: Pb. 600
4003 Stavanger
NORWAY
Ph: + 47 51876000
Fax: + 47 51551571

Internet

www.npd.no

Norwegian Petroleum Directorate
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