Table of Contents

List of Figures

List of Tables

F Annex F Methods for WE Risk Assessment

Annex F Methods for WE Risk Assessment

F.1 Task analysis

F.1.1 General

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

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

A coarse task analysis will give valuable input to other WE analysis and will function as the starting point for a WERA.

Task analysis is a systematic review of what employees must do in order to carry out a task, physically and/or mentally. A wide array of different methods may be used to analyse and present the task details (e.g. Kirwan, 1992).

F.1.2 Method description

The choice of methods will be determined by the specific area of application, the nature of the tasks, the level of criticality and the detail needed to establish design requirements. Findings will also form the foundation for many other analyses and inform the design specifications (e.g. HMI, lay out, workplace design, illumination, organisation, noise, vibration, etc.) for optimal performance.

The task analysis should include:

- Main work task and function
- Personnel involved/Job Category
- Duration
- Frequency
- Area where the work task is performed
- Information needed
- Equipment needed
- Communication needed

A task analysis describing the main work tasks on the installation and with detailed analyses of tasks with greater degrees of interaction and potential for human error and other adverse outcome. The extent and content of the task analysis will depend on phase and also the complexity of work tasks and risks at each individual plant/project/organisation.

F.1.3 Deliverable

The results of task analysis should be documented in a table, showing area, task, job category, expected frequency, duration, and number of person involved and a detailed description of the task.

Table F.1 Table 1Coarse Task Analyses Matrix

Area	Task	Job Category	Frequency	Duration	Number of person involved	Description of task: • Info-rmation needed • Ne-cessary

						• equipment needed • Co-mmunication needed

F.2 Working Environment Risk Assessment (WERA)

F.2.1 General

The details studied in the WERA process shall increase with increased maturity of the project and as accuracy of the risk knowledge increases. A Coarse WERA can be performed in the early phase of a project, a Concept WERA when concept(s) are developed and more detailed WERAs during the FEED to the operation phase.

F.2.2 Method Description

The risk assessment shall be used to identify the most important contributors to risks for people, and select the best possible solutions from a health and working environment perspective. The main focus shall be on exposures that can lead to health problems over time (e.g. noise exposure, chemical exposure, ergonomic or psychological strain). This does not exclude sudden impacts from e.g. hazardous chemicals, fall or falling objects, but these hazards are also focus in HAZIDS or SJA.

A work shop model is recommended (as in a Hazid) when performing a WERA.

F.2.3 Planning

Planning of the WERA should include the following:

- define the context
- identify requirements
- agree on practicalities
- Identify a work shop facilitator
- establish a competent workshop team

F.2.4 The WERA Workshop

The workshop should have representatives from the risk owner (project and/or line leader), HWE professionals, technical discipline professionals relevant for the context and operators familiar with the work tasks and area to be assessed (user group).

The WERA process shall identify work tasks, health hazards, score risks and propose mitigating measures in a prioritized action list based on risk score. The main focus shall be on health risks with short, medium and long latency to consequence.

It is recommended that the work shop starts with a coarse work task assessment. Then the health hazards connected to the work task should be identified, the risk analysed and given a qualitative risk score.

Previous task analysis can be used as background information, but work task with potential risk should be discussed in the workshop-

The risk assessments shall take into consideration the following:

- The context of the work tasks
- The intrinsic hazardous properties
- Available information on health and safety
- The level of exposure
- All relevant exposure routes and types
- Duration and frequency of exposure
- Number of workers exposed
- Any threshold limit value or action levels
- The effect of preventive measures
- Where available, the conclusions from any health surveillance already undertaken

After the WERA has been performed, actions must be followed-up through the project development. The WERA shall be updated in new project phases, or a new WERA performed if there are major changes in the context. The identified risks and mitigating measures should be included in the risk register and followed up through the project. It is important that the risks and mitigating measures are prioritised!

F.2.5 Example Activity chart

Fig. F.1

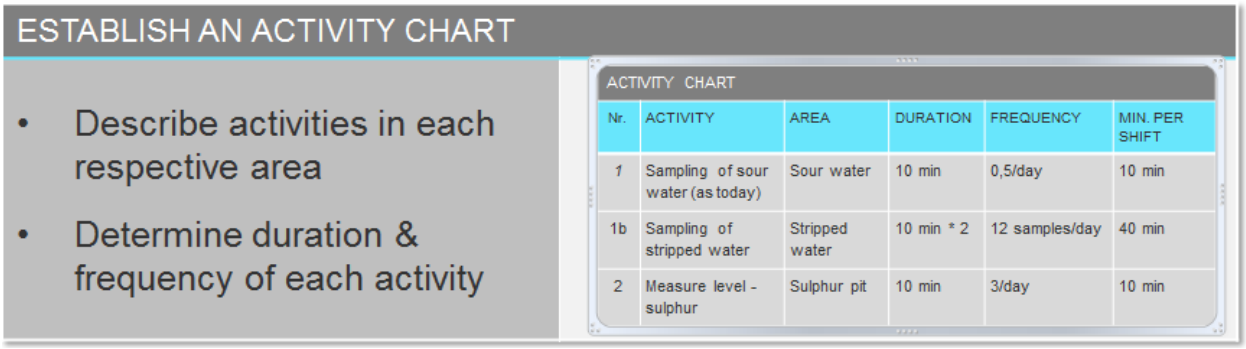

Fig. F.1 Table 2 WERA activity chart.

F.2.6 Risk Score Table

Table 3: WERA risk score

Fig. F.2

SCORE	COLOUR	DESCRIPTION	DETAILS
1		Risk is low and acceptable	Good working conditions
2		Risk is controlled	Working conditions OK, but can be improved (ALARP)
3		Risk is unacceptable	Control measures to improve Working conditions shall be applied.
4		Risk is high and unacceptable	Control measures to improve working conditions shall be applied. Immediate action.
5		Risk is unknown	Control measures shall be applied immediately. Detailed risk assessment must be started.

Fig. F.2 Picture from 15092014 Annex F Methods for WE Risk Assessment til xaitporter Nja.docx

F.2.7 Example Risk Matrix

Fig. F.3

No.	Activity	Area	Identified WE hazards	Noise	Vibration	Ergonomics	Climate	Light	Radiation	Chemical	Biological	Organisational
1	Inspection rounds and monitoring	Sulphur block/amine regeneration and sulphur water stripper	H_2S, Amines (DEA), Sulphur (pellets), dust, ammonia Heat/hot, rotating equipment, noise									
2	Sulphur Handling (pelleting, storage and loading, automatically on train)	Sulphur block/amine regeneration and sulphur water stripper	H_2S, Amines (DEA), Sulphur (pellets), dust, ammonia Heat/hot, rotating equipment, noise									

Fig. F.3 Table 4 WERA Risk Matrix

F.2.8 Example Action plan

Fig. F.4

PRIORITY LIST – MEASURES Example							
Priority	Activity	Work environment factor	Risk number	Suggested measures	Responsible Statoil/ Contractor	Follow up measures	deadline
1	Sulphur block	Chemical exp, H2S Amine (DEA) Sulphur dust	4	Personal H2S monitor with alarm Make H2S areas restricted area (fence, entrance permit etc.) Wind socks showing wind direction. Fixed gas detection PPE, escape mask Procedures and training Fume hood? Respirator (dust filter mask)	Statoil (design fix gas detection)		
2	Sulphur block	Noise	4 (5)	Noise specification to vendors and low noise design.	Statoil		
3	Delayed coker and gas recovery unit	Chemical exp, H2S Green coke PAH	4	Personal H2S monitor with alarm Make H2S areas restricted area (fence, entrance permit etc.) Wind socks showing wind direction.	Statoil		

Fig. F.4 Table 5 WERA Action plan

F.3 Chemical Health Risk Assessment

F.3.1 Method description

F.3.2 Identify chemicals

Opprett en liste med alle farlige kjemikalier grupper/ kjemikalier som er i bruk eller er planlagt brukt under drift og ved vedlikehold.Create a list of all hazardous chemicals groups / chemicals that are in use or planned for use during operation and maintenance. Et typisk eksempel på grupper av kjemikalier offshore er gitt i Tabell G1 For hver kjemikalie gruppe/kjemikalie, bestemme og dokumentere potensiell helserisiko ved eksponering, dvs. kjemikalies giftighet og alvorligheten av konsekvensene. A typical example of groups of chemicals are given in Table 6. For each chemical group / chemical, determine and document the potential health risks from exposure, ie the toxicity and the severity of the consequences. Det vises til sikkerhetsdatablad (SDS) og regelverket for klassifisering, merking osv. av farlige kjemikalier. Refer to the safety data sheet (SDS) and the rules for classification, labelling etc., of dangerous chemicals. Kjemikalier/kjemikaliegrupper kan kategoriseres på basis av iboende egenskaper uttrykt ved risikosetninger. Chemicals / chemical groups can be categorized on the basis of intrinsic properties expressed by phrases. Et typisk eksempel på kategorisering er gitt i tabell G.2. A typical example of categorization is given in Table 7.

F.3.3 Identify activities

For hver kjemikaliegruppe/kjemikalie som er klassifisert som farlig, angi alle tilhørende aktiviteter der det er potensiale for vesentlig eksponering ved inhalering og/eller hudkontakt.

List all activities where there is potential for significant exposure through inhalation and / or skin contact for each group of chemical that are classified as hazardous. Inkluder aktiviteter under håndtering/ transport, lagring, bruk, vedlikehold og avfallshåndtering. Include activities during handling / transport, storage, use, maintenance and disposal.

F.3.4 Assess exposure level

For hver aktivitet og kjemikalie/kjemikaliegruppe, vurder og kategoriser graden av eksponering via inhalering og/eller hudkontakt.

Assess and categorize the degree of exposure via inhalation and / or skin contact for each activity and chemical / chemical group. For langtidseksponering ved inhalering skal omfang, hyppighet og varighet av eksponeringen tas med i vurderingen.If there is long-term exposure by inhalation, the concentration level, the frequency of and the duration of exposure should be taken into consideration.

For å estimere graden av eksponering kan følgende retningslinjer gis:

F.3.5 Guide to estimate the level of exposure:

Chemical exposure ruled out (estimated <10% of reference value). No further assessment.

Når kjemisk eksponering ikke kan utelukkes (anslås til å være over 10 % av referanseverdien) med den valgte tekniske løsningen, skal det foretas numeriske/semi-kvantitative beregninger der det tas hensyn til:Chemical exposure cannot be ruled out (estimated > 10% of reference value). Perform a numerical / semi quantitative calculation including:

- område for bruk (hvilke område er bruken begrenset til)Physical properties of the substance
- Area of use typiske arbeidsoppgaver
- Typical work tasks
- fysiske egenskap til stoffet/kjemikalien (væske, fast stoff, pulver, damp etc)Frequency of the task frekvens på oppgaven
- mengde i bruk (hvilken mengde som er relevant for oppgaven eller mengde som er relevant i eksponeringssammenheng)Amount of chemical in use, relevant for exposure
- antall personer (avklar hvor mange personer som er involvert i oppgaven eller vil kunne bli eksponert ved)Number of persons that may be exposed

- redegjør for bruk og håndteringDescribe the use and handling
- definer eksponeringsveier(hud eller åndedrett)Defining the routes of exposure (skin or respiratory)
- avstand til kilden,Estimate distance to the exposure source,
- beskrivelse av tekniske barrierer (hvilke type ventilasjon er lagt inn i designet, fysiske områdeskiller, vaskestasjoner, drenering/spill trau)Describe the technical barriers (ventilation, space separation, washing stations, drainage/ drip tray)

Tabell G.3 viser eksempel på hvordan man kan strukturere informasjonen som man trenger for å gjennomføre risikoestimeringen.

Table 8. shows an example of how to structure the information that you need to conduct risk assessment. Dette kan også være en fin måte å dokumenter at det er gjennomført en kjemisk risikovurdering.This is a good example on how to document a chemical risk assessment.

Målinger fra lignende situasjoner kan benyttes som en del av dokumentasjonen.Measurements from similar work situations can be used as part of the documentation.

If there is a potential for exposure to highly hazardous chemicals Om nødvendig skal mer avanserte, dataassisterte modeller (f.eks,spredningsmodeller eller or there is other complex challenges such as exhaust dispersion more advanced models (e.g., dispersion or beregningsmodeller for dynamiske strømninger) eller simuleringer benyttes, særlig når eksponering overfor svært farlige kjemikalier, eller komplekse problemer, vurderes, eksempelvis eksosspredning.Computational fluid dynamics simulations) should be used.

F.3.6 Exposure categories

For kategorisering av eksponering kan normene for arbeidsrelatert eksponering brukes somThe degree of exposure shall be assessed against recognized Occupational Exposure Limits.

Typical examples of exposure categories indicated in Table 9.

F.3.7 Dermal exposure

For dermal exposure is the size of the affected area and the concentration degree of chemical / chemical group important factors. Typiske eksempler på eksponeringskategorier angis i tabell G.4.

F.3.8 Classify the risk

Estimer helse- og sikkerhetsrisikoen som høy, middels eller lav ved å kombinerehelserisikokategori og eksponeringskategori.Classify the health and safety risks as high, medium or low, by combining the health risk category and the exposure category as shown in En typisk matrise for risikoestimerings er vist i tabell G.5. Table 10.

For eventuelle aktiviteter med potensiale for eksponering for akutt giftige/etsende kjemikaliersom kan gi alvorlige ulykkesskader/sykdommer, bør det også utføres en JHA, se 4.4.3.JHA (Job Hazard Analysis – see chapt. 4. should be performed when activities have potential for exposure to acute toxic or corrosive chemicals that can cause serious accident injuries / illnesses. Ref!

Prioritize risk mitigation measures to be implemented in the design.

Table F.2 Table 6 Examples: Chemicals in use offshore

Chemical groups	Typical chemical	Typical Health hazard	Typical area /room of use
Drilling fluids (water based mud, oil based mud and brine chemicals)	Worst case: Oil based mud Dry mud additives (sacks and big sacks)	Carcinogen Dust exposure (quarts?) Health Category 1-4	Mud treatment room (Shaker room), drill floor, pump room, mixing room, mud tank room
Cement	Various types of cement and cement additives.	Some serious health hazardous: Health Category 5	Cement room Cement mixing station

Lube oil/ grease/ hydraulic oil	Normally a high range of products	Normally less serious Health Category 2 (but normally high exposure)	All machinery, pumps with moving parts.
Paints/ coatings/ solvents	Various types of paint depending on surface. Epoxy flooring, Epoxy paint Polyurethane paint/ flooring Other paint Spray cans Solvents /thinners Smoke from warm work on covered surfaces	Skin exposure Inhalation Health category 1-4 Often long term exposure. Increases with age of installation.	All rig
Diesel	Testing, filter change, aeration of tanks Exhaust	Possibly carcinogen Health category 4	Fuel for engines, life boats
Jet fuel		Health category 3	Helideck
Detergents (LQ, galley, laundry)	Degreasing for oven Detergents for washing machine General detergents	Health category 1-4	LQ
Detergents (machinery parts)	Solvents Corrosive chemicals	Health category 3	Mechanical workshop
Detergents (outdoor cleaning chemicals)		Health category 1-2	Open deck areas Drill floor derrick
BOP fluids	”Pelagic 50”	Health category 2	BOP control system BOP maintenance on deck
Water treatment chemicals	Sodium Hypochlorite	Toxic Corrosive Often manual handling Health category 4	Water treatment room Chlorination station
Maintenance chemicals	Glue Joint fillers Fillers Various types based on epoxy and polyurethane/ isocyanate.	Health category 1-4	All rig
Laboratory chemicals	Solvents Indicators Acids Buffers Calibration solutions	Health category 1-5 Small amounts	Laboratory
Welding gases	Acetylene Oxygen Argon	Health category 1-2	Workshop
Welding fumes	Depending on material Metals Polyurethane/ Icocyanates Fume	Health category 4,	Workshop
Fire extinguishing		Health category 2	LQ

substances			Deck areas Helideck
Anti-freeze solution	Glycol/MEG	Health category 3 (Hazardous by ingestion)	
Process stream	Hydrocarbons (BTX) Mercury	Health category 4-5	Process areas
Exhaust fumes	NOx Mixed, e.g CO/CO2, PAH etc	Health category 1-5	General areas

Table 7 Example Chemical Health Hazard categories

Table F.3 No Title

Health hazard categories		
Health hazard categories	**Hazard Code**	**Risk-/Safety Phrases**
5	**Very serious**	
	Very toxic (T+)	
	Acute toxicity (Acute toxicity)	**R26, R27, R28 (H330, H310, H300)**
	Irreversible toxicity (Serious chronic health hazard)	**R39 (H370, STOT SE cat 1)**
	Toxic (T) (Serious chronic health hazard)	
	Carcinogens Cancer1 and Cancer2	**R45, R49 (H350)**
	Mutagens Mut1 and Mut2	**R46 (H340)**
	Toxic to reproduction/teratogen Rep1 and Rep2	**R60, R61 (H360)**
	Harmful (Xn) (Serious chronic health hazard)	
	Sensitizing	**R42 (H334)**
4	**Serious**	
	Toxic (T)	
	Acute toxicity (Acute toxicity)	**R23, R24, R25 (H331, H311, H301)**
	Chronic effects (Serious chronic health hazard)	**R48 (H372 STOT RE cat 1)**
	Corrosive (C) (Corrosive)	
	Harmful (Xn) (Serious chronic health hazard)	**R35 (H314 cat 1A)**
	Cancer3	**R40 (H351)**
	Mut3	**R68 (H371 STOT SE Cat 2)**
	Rep3	**R62, R63 (H361)**
	Irritant (Xi) (Health hazard as specified)	
	Sensitizing	**R43 (H317)**
	Bioaccumulation	**R33 (STOT RE cat 2)**
	YL Group 4 and 5	
3	**Moderately serious**	
	Corrosive (C) (Corrosive)	**R34**
	Harmful (Xn)	

	Acute toxicity (Health hazard as specified)	**R20 (H332), R21 (H312), R22 (H302)**
	(Serious health hazard if inhaled)	**R65 (H304)**
	Irritant (Xi) (Corrosive)	**R41 (H318 and EUH070)**
2	**Less serious**	
	Irritant (Xi) (Health hazard as specified)	**R36, R37, R38, (H319, STOT SE cat 3 and H335, H315), R66, R67 (STOT SE cat 3 and H336)**
	Avoid inhalation	**S22, S23**
	Avoid contact	**S24, S25**
	Use personal protective equipment	**S36, S37, S38, S39**
	Ventilation required	**S51, S52 (P260, P262, P280, P281, P285, P271)**
1	**Insignificant**	
	Unclassified	
	Subjective symptoms	

Table 8 Chemical Risk Assessment Matrix

Table F.4 Table 9 Example Chemical exposure category

Area	**Chemical / Chemical Group**	**Work task**	**Intrinsic property**	**Health risk category**	**Assessment of:** • Physical property • Fre-quency • Amount • Number of person • Use and handling • Route of ex-posure • Dis-tance to source	**Exposure category**	**Resulting Risk**	**Comments and proposed new technical barriers**

					• Te-chnical barrier			
A1	**Name**	**Detailed description**	**R/H sentence/ labelling**	**□ 5 □ 4 □ 3 □ 2 □ 1**	**Assessment of the listed factors**	**□ 5 □ 4 □ 3 □ 2 □ 1**	**□ 3 □ 2 □ 1**	

Table F.5 No Title

Exposure category	
Qualitative	**Quantitative**
Extremely High	**>> reference value (<150 %)**
Very High	**≥ Reference value (Suggested: 100-150%*)**
High	**50 % to 99 % of reference value**
Moderate	**10 % to 50 % of reference value**
Low	**< 10 % of reference value**
Very low / negligible	**~background value**

Table 10 Chemical - Typical matrix for risk assessment of long time and average exposure level.

Health Risk Category

Table F.6 No Title

Very serious						
Serious						
Moderate						
Less						
Insignificant						
	Negligible Very Low	**Low**	**Moderate**	**High**	**Very High**	**Extremely High**
Exposure Category						

F.4 Job Hazards Analysis

F.4.1 Method

A JHA is carried out in a JHA team consisting of project personnel and representatives of the user group.

F.4.2 Stepwise procedure

1. **Delimit the analysis to work activities within an area, in connection with a machine, etc.**
2. **Identify the activities of the area/machine.**

These work tasks shall be used as a basis for risk estimation and evaluation.

A step-by-step breakdown of the tasks / activities to a sufficient level of detail shall be carried out and documented in the JHA matrix.

1. **Identify relevant hazards for each activity/sub-activity.**

With the task analysis broken down into sub-tasks these are each evaluated to identify any hazards that might affect the worker(s). Hazards/hazardous situations and events associated with the various work tasks shall be identified, e.g. risks of severe injury or fatality due to moving parts of machinery, trapping/ entanglement, falling to a lower level, sliding/stumbling/collision, ejected materials, fire/explosion, and/or toxic/corrosive chemicals.

A description of each actual hazard and why a hazardous situation may arise shall be documented in the JHA matrix.

As an aid to identify acute health hazards, the hazard list 4.1.3 may be used as a starting point.

1. **Estimate the expected frequency and consequences of accidents due to exposure to the identified hazards.**

For hazards that can result in occupational injuries, a typical risk matrix Table 11. with rating criteria for the frequency of occurrence and consequences of hazardous situations shall be used. For each hazardous situation identified, the consequence ('C'), frequency ('F'), and the resulting risk ('R') shall be documented in the JHA matrix.

- First, the most serious consequence that from a realistic point of view may occur shall be identified and rated on a scale from 1 to 4.
- Next, the expected frequency of the consequence shall be estimated, also on a scale from 1 to 4. Frequency estimations are based on frequency and duration of work or other presence inside danger zone, probability of occurrence of the hazardous situation, and possibility to avoid or limit the harm.
- Finally, the resulting risk shall be estimated and characterised as High, Medium or Low.

Estimation of the risk from occupational accidents serves as a basis for identifying needs of remedial actions, incl. safety measures / safeguarding in design. The risk assessment is divided into initial risk assessment and residual risk assessment. In the initial risk estimation, existing design safety measures shall be considered.

1. **Evaluate need for remedial actions.**

Additional safety and operational measures (identified during the JHA) are part of the residual risk assessment.

Safety measures shall be identified. Design safety measures and safeguarding and the residual risk shall be documented in the JHA matrix.

The operational precautions necessary to reach an acceptable residual risk shall be identified.

These may include adherence to certain job procedures, use of personal protective equipment, permit to work system, etc.

Operational precautions assumed to be implemented by the user, and the residual risk shall be documented in the JHA matrix.

F.4.3 Job Hazard Risk Matrix

Table F.7 Table 11 Job Hazard Risk Matrix

Consequence	**Frequency**			
	1 time per 100 years or less 1	**1 time per 10 years 2**	**1 time per year 3**	**10 times per year or more 4**
First-aid injury 1	Low	Low	Moderate	High
Lost time injury 2	Low	Moderate	High	High
Permanent disability 3	Moderate	High	High	High
Fatality 4	High	High	High	High

F.4.4 JHA documentation matrix

Table F.8 Table 12 JHA documentation matrix

No.	Dangerous manual task / interaction	Hazards / Hazardous situation and event	Risk			Safety measures / Safeguarding in design	Operational precautions by user	Residual Risk			Status
			C	F	R			C	F	R	
1.	Operation										
	…….										
	……..										
2.	Cleaning										
	……										
	……..										
	……..										
3.	Inspection										
	……..										
	……..										
	……..										
4.	Maintenance										
	……..										
	……..										
	……..										
5.	Other operation modes										
	……..										
	……..										
	……..										

F.4.5 Example of Hazard List

Mechanical

- crushing
- shearing / cutting / stabbing / puncture
- entanglement / drawing-in / trapping
- impacts
- friction / abrasion
- high pressure fluid ejection
- falling / ejected objects
- slipping / tripping / falling persons
- loss of stability / overturning

Electrical

- live parts (direct / indirect contact)
- electrostatic discharge

Thermal

- hot surfaces (contact)
- flames / explosions (contact)
- heat sources (radiation)
- cold stress (outdoor work)

Noise

- excessive impulse noise (blow, bang, slam)

Vibration

- excessive whole-body vibration
- excessive hand-arm vibration

Radiation

- low frequency electromagnetic fields
- radio frequencies / micro-waves
- infra-red / visible / ultra-violet light
- lasers
- ionizing X-rays, ion beams, etc.

Materials and substances

- dangerous fluids / aerosols (contact)
- dangerous gases / vapours / mist / fume / dust (inhalation)
- fire / explosion hazards
- biological hazards

Ergonomics

- excessive muscular load
- work in kneeling / squatting / lying positions
- asymmetric load on body
- hazards from neglecting ergonomic principles in design

Hazardous situations / events

- break-up during operation
- intervention in combined machinery
- noise interfering with communication
- inadequate design / location / identification of manual controls and displays
- mental overload / under load / stress
- malfunction from human errors
- failure of power supply
- failure of control systems / circuit

F.5 Ergonomic Risk Assessment (ETA)

F.5.1 Purpose

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

This method is meant to ensure a complete Ergonomic Risk Assessment.

F.5.2 Stepwise procedure

F.5.2.1 Step 1

In the first part of the risk assessment you can use input from the coarse task analysis described above. All work activities that might have a risk of muscular-skeletal afflictions should go through a detailed risk assessment.

F.5.2.2 Step 2

The second part of the risk assessment is more complex.

F.5.2.2.1 Manual handling or heavy muscular load

You need to determine if the specific work task includes manual handling/heavy muscular loads as defined by the examples listed below:

- pushing and / or pulling
- displacement
- heavy lifting
- carrying
- work above shoulder height or below knee height

If relevant, a detailed description of how the task is performed is given in this column

F.5.2.2.2 Monotonous repetitive work

Then you need to determine if the specific work task includes monotonous repetitive work. Monotonous repetitive work consists of one single or a few simple work tasks that are repeated at a high speed or over a long period of time and can lead to health damage.

Some characteristics of monotonous repetitive work are listed below:

- Simple work tasks
- Few and monotonous work movements
- Fixed/inappropriate work posture
- High precision requirements
- High speed
- Concentration demanding
- Vision demanding
- Requiring the use of force
- Low self-determination

If relevant, a detailed description of how the task is performed is given in this column.

F.5.2.2.3 Working position

Then you need to describe the relevant working positions to conduct the specific work task.

Working positions and movements is determined on which strain the body is under the influence of (Shoulder/neck, back, Arms/hands, legs), and the injuries that will arise.

Especially injurious positions:

- Bending forward position
- Bent and twisted positions
- Working away/distance from the body
- Above shoulder level and beneath knee level
- Work in fixed or static position

By evaluation of movements one should:

- Avoid extreme joint movements
- Avoid unexpected and jerky movements
- Avoid continuous asymmetric load on body
- Not combine demands on precision and use of force.

F.5.3 Barriers

Next step is to describe technical barriers, and you should at least give a description of the arrangement within the area, lifting and transportation aids and access with regards to the specific work task. Use of tools/equipment is most probably described in the first part of risk assessment and these tools might also work as barriers.

F.5.3.1 Operation - Organizational measures

If necessary you can also describe the organizational measures that are relevant for the specific work task. Examples are given below:

- Organization of work
- Collaboration
- Variation
- Rotation
- Rest and recovery
- Avoid time pressure
- Training

F.5.4 Risk Assessment

This assessment must be completed when all relevant information is gathered. It is necessary to hold competence within ergonomics. A description of the different risk ratings is given below. It is important to use the figures provided in the risk rating criteria (below)when doing the risk assessment.

High Risk

The probability of a musculoskeletal injury is very high. Changes in working conditions to reduce the risk from high to low are necessary. However this does not mean that work with high risk of musculoskeletal injury is illegal.

Moderate Risk

There is a certain risk of developing repetitive strain injuries in the short or long term. The strain must be further evaluated. In particular, factors such as duration, tempo and frequency of strain are essential. The combination of several strains may increase the musculoskeletal injury considerably .

Low Risk

The risk of repetitive strain injuries for most workers is limited. If there are special circumstances, or if the employee still incurs strain injuries, a closer assessment should be conducted.

F.5.5 Suggested measures

To control risk the workshop participants have to suggest measures to reduce the risk level

Table 13 Matrix for ergonomic risk assessment

Use input from Corse Task Analysis and do the risk assessment for relevant tasks

Table F.9 No Title

Task	Manual Handling/ Heavy muscular	Monotonous repetitive work	Working position	Barriers	Organizational measures	Risk Assessment	Suggested Measures

	load						
						□ **3** □ **2** □ **1**	

F.5.6 Ergonomic Risk rating criteria

1. Hva er dette

Table F.10 Table 14 Rating Model for Push and pull

Activate/start	>300N	300 - 150N	<150N
Maintain	>200N	200 – 100N	<100N

Table F.11 Table 15 Rating Model for monotonous repetitive work

Way of working	The work is repeated several times a minute.	The work is repeated many times per hour.	The work is repeated a few times pr. hour.
Work positions and movements	Locked or awkward postures and movements	Limited opportunities to vary postures and movements	Well-designed workplace. Good opportunities to vary posture and movement
Control	The work is entirely controlled by external things or other people	This work is partially controlled by external things or other people. Limited opportunities to influence how the work is performed.	Good opportunities to choose way of working. Influence of planning and how work should be organized.
Work task / Responsibilities Training	The employee performs an isolated task in a production process. Short training	The employee performs multiple tasks in a production process. Rotation of duties occurs. Training in several areas	The employee is involved in several or all tasks in a production process, including planning and control. Continuously skills development

Fig. F.5

Table F.12 Table 17 Rating Model for work posture

Work position		**High Risk**	**Moderate Risk**	**Low Risk**
Fig. F.6 Seated	neck	Bent / twisted locked with visual requirements	Periodically locked	Most middle position, movement
	back	bent / twisted / often / inflexible for longer periods	Bent / twisted during periods	Freedom of movement, properly fitted backrest
	arms	Lifted, working at / above shoulder height more than ½ arms distance from the body often / long periods	Lifted in periods	Working height and radius well adapted to work task and worker
	legs	Lacking space	Limited legroom	Good legroom

		Missing footrest Long in the same position Prolonged pedal work	poor footrest Some pedal work	Good footrest Small pedal work
Fig. F.7 Standing / walking	neck	Bent / twisted locked with visual requirements	Periodically locked	Most upright, position, freedom of movement
	back	bent / twisted / often / inflexible for longer periods	Bent / twisted during periods	Most upright, position, freedom of movement
	arms	Lifted, working at / above shoulder height of more than 3/4 arms distance from the body often / long periods	Lifted in periods	Working height and radius well adapted to work task and worker
	legs	Lacking space unstable surface Long in the same position Prolonged pedal work	Limited space, poor surface, periodically in the same position, pedal work	Plenty of space, clean, flat, non-slip, shock-absorbing surface mobility, little pedal work
Fig. F.8 Squatting / kneeling		More than a ½ hour at a time, over more than half the working day poor surface	Periodically	Small and short-lived
Fig. F.9 Lying		More than a ½ hour at a time, over more than half the working day poor surface Constant upraised arms without armrests	Periodically	Small and short-lived

Fig. F.5 Table 16 Rating Model for Manual Handling/Heavy muscular load

Fig. F.6 Picture from 15092014 Annex F Methods for WE Risk Assessment til xaitporter Nja.docx

Fig. F.7 Picture from 15092014 Annex F Methods for WE Risk Assessment til xaitporter Nja.docx

Fig. F.8 Picture from 15092014 Annex F Methods for WE Risk Assessment til xaitporter Nja.docx

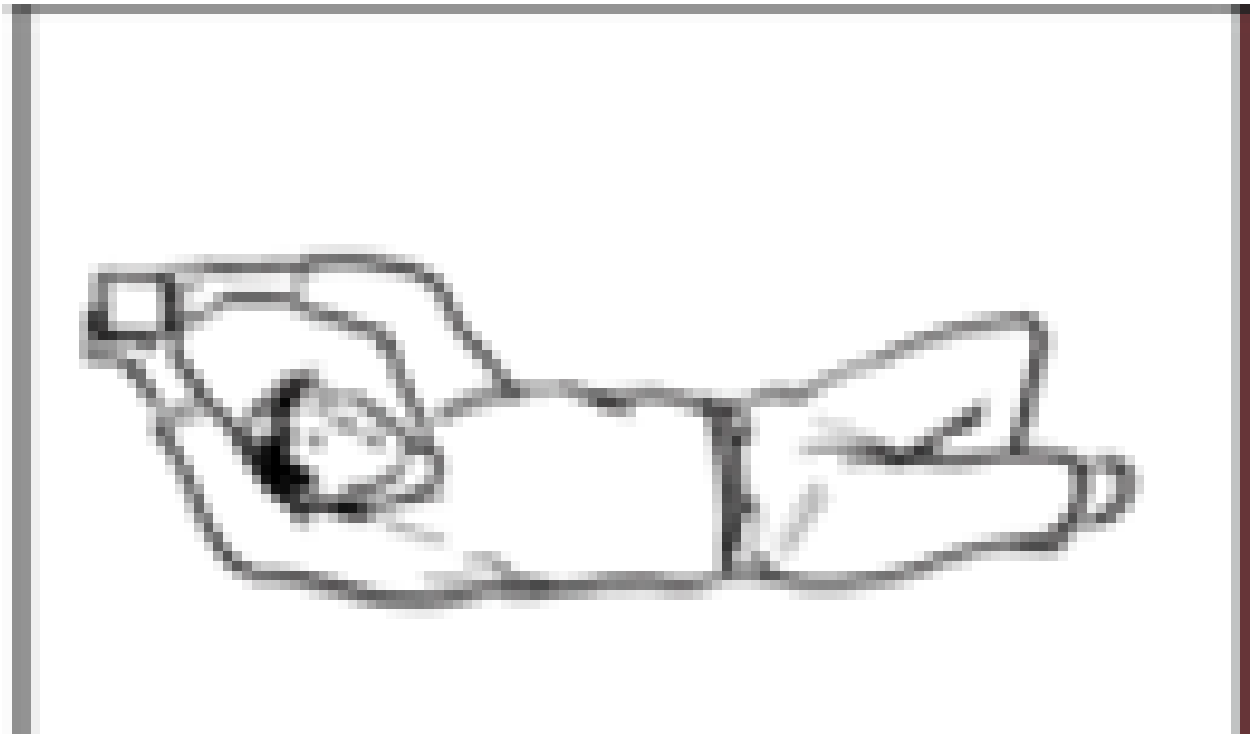

Fig. F.9 Picture from 15092014 Annex F Methods for WE Risk Assessment til xaitporter Nja.docx

F.5.7 Guidelines for Valve Criticality Analysis

F.5.7.1 Process description

Fig. F.10

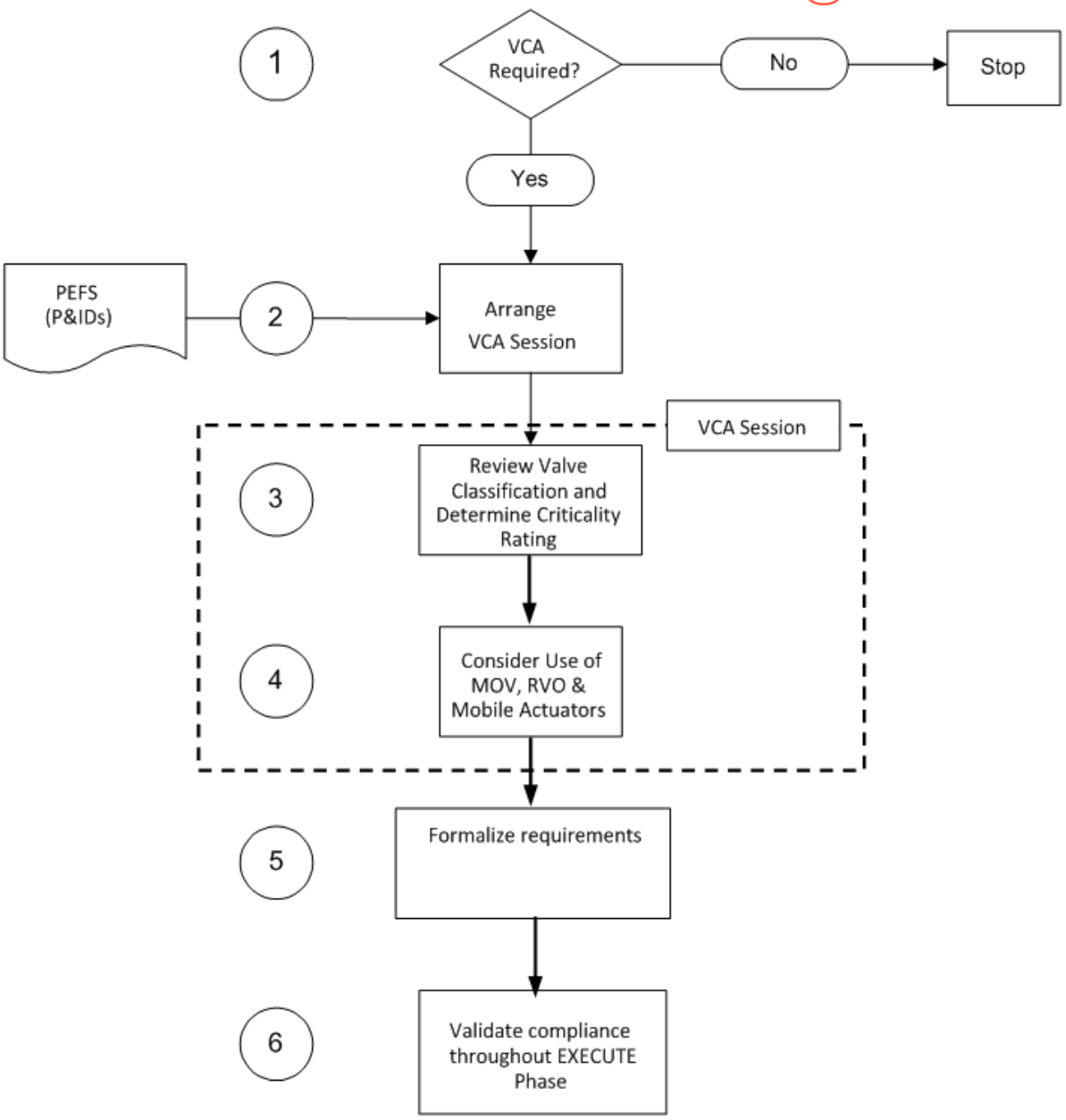

Fig. F.10 Picture from Guidelines for Valve Criticality Analysis.docx

F.5.7.2 Criticallity rating

F.5.7.2.1 General

Valves shall be rated by criticality. The following three categories are recommended. These criteria shall be reviewed and agreed upon prior to starting the analysis. The final criteria shall balance ease of access for operations against maintenance access and project costs. Risks to health and safety, including risk of human error, shall be kept as low as reasonably practical.

F.5.7.2.2 Category 1 (C-1) valves

Category 1 (C-1) valves include those essential to normal or emergency operations where rapid and unencumbered access is essential. The height, reach distances and visibility shall conform to the “preferred” location as outlined in (4).

These are valves that meet any or all of the following criteria:

1. Valves essential to production;
2. Valves essential to process safety or asset integrity;
3. Particularly large valves;
4. MOVs with high failure rates and which require rapid corrective action;
5. Valves being used in a service or under operating conditions where the failure rates are not known or may be unreliable.
6. Valves where consequence of failure to obtain quick access would be serious (e.g. process shutdown and/or damage to facilities or personnel);
7. Valves for which the expected routine operation, inspection and/or maintenance is more frequent than once every 6 months.

F.5.7.2.3 Category 2 (C-2) valves

Category 2 (C-2) valves are those that are not critical for normal or emergency operations but are used during routine inspection or maintenance activities.

These are valves that meet any or all of the following criteria:

- Valves associated with equipment for which rapid intervention is unlikely to be needed.
- Valves with a low operating or inspection frequency (i.e. less than once every 6 months).

F.5.7.2.4 Category 3 (C-3) valves

Category 3 valves are normally non-operating valves that are used or inspected in particular circumstances on an infrequent or rare basis (e.g. hot tap valves, hydrostatic test vent, high point vent or low point drain valves located in pipe rack) and are not used in HSSE critical activities.

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

F.5.8 Noise Exposure and Noise Risk Assessment

F.5.8.1 Up to and including FEED Phase

F.5.8.1.1 Noise Exposure Calculations

With input from Operator establish personnel working categories and an estimate of working times in various areas for each category. If the operator cannot contribute with a project-specific manning study, the noise control engineer shall be preliminarily responsible for making estimates of occupancy times in cooperation with available project team members with operator experience. Based on this evaluation, and using the first specification of area noise limits or early estimates of area noise levels above 78 dB (A), derive preliminary predictions of noise exposure levels for personnel. If the calculation result, including an uncertainty factor of +5 dB(A), exceeds the LEX,12h 83 dB(A) limit, revise the area limits, investigate layout changes or change equipment noise limits (obtain Best Available Technology, BAT) / location.

NOTE The uncertainty factor accounts for the uncertainty in the early calculations and for the typical, observed difference between predicted noise exposure and measured noise exposure.

F.5.8.1.2 Noise Risk Assessment

Examples of hearing loss risk factors other than due to continuous area noise are e.g.:

- unknown noise levels from valves/equipment
- noise from hand held tools
- excessive impulsive noise / short bursts of noise with a noise level above 130 dB(C)$_{, PEAK}$/110 dB(A)$_{FAST}$,
- simultaneous hazardous exposure to noise and chemicals
- *No bullet:* Risks related to noise, but not associated with hearing loss, include:

- risk for speech interference / problems with concentration due to high noise levels
- risk of fatigue related occurrences in case of inadequate restitution

Such risks to be identified during Working Environment Risk Assessment, Chemical Health Risk Assessment, Job hazard Analysis and/or requested as input from valve/equipment suppliers.

F.5.8.2 Detail Engineering and Construction Phase

F.5.8.2.1 Noise Exposure Calculations

The Installation Noise Exposure Calculation shall be updated and its predictions included in the noise prediction report. If the calculated level + 3 dB exceeds the limit of 83 dB(A), actions to prevent hearing damage shall be discussed and noise-reducing actions shall be undertaken.

F.5.8.2.2 Noise Risk Assessment

Noise risk assessment to be repeated as part of the above WE Risk Assessments and based on input from noise measurements performed in connection with Factory Acceptance Tests (FATs) of valves/ equipment and Commissioning.

F.5.8.3 Operation Phase

Noise exposure and noise risk assessments are to be updated, based on all previous noise exposure calculations and noise risk assessments (as documented in the noise prediction report from the project development phases), area noise and noise exposure surveys of the installation during normal operation, and more detailed information about noise exposures per room/area, other special noise risks, average occupancy times for each personnel category and obtained knowledge of especially noise exposed worker groups.