12 HUMAN FACTORS ASPECTS OF SAFETY REPORT ASSESSMENT

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1. INTRODUCTION

1.1 This guidance is for assessors completing the human factors assessment and is relevant to all types of safety report.

1.2 All human factors assessment must use the criteria and guidance set out in Appendix: 12G *'Human Factors Assessment Criteria and Guidance'*.

1.3 Human factors assessment must be recorded on the form SRAM 22*'Human Factors Assessment Record'*

1.4 The criteria are designed to follow in sequence the specific requirements set down in Schedule 3 of the 2015 COMAH regulations and to reflect relevant purposes set out in Regulation 8 of the same regulations. These are minimum legal requirements and are clear and enforceable (Regulation 9).

1.5 Demonstrations should be proportionate to the hazard and risks of identified major accident hazards. This aspect can only be decided by an operator when all the elements of Schedule 3 have been determined. The determination of proportionality is an iterative process both for an operator and an assessor

1.6 Use of assessment criteria

The criteria will be applied by a competent assessor against the content of the safety report. In this context, a competent assessor will have a good understanding of the safety report assessment process, its place within the HID Regulatory Model and of any stated benchmarks.

a. Criteria will be **"met"** when all relevant items are included in descriptions and the necessary supporting information has been provided;

b. Criteria will be **"not met"** when all relevant items are not included in descriptions or the necessary supporting information has not been provided;

c. Criteria will be **"not relevant"** when they are not relevant to the establishment (e.g. functional safety criteria are unlikely to be relevant to a warehouse);

d. Criteria will be **"previously met"** when the previous assessor recorded the criterion as "met".

2. THE GENERAL APPROACH TO HUMAN FACTORS ASSESSMENT

2.1 The safety report demonstrates how measures taken will prevent foreseeable human failures that could lead to major accidents. The operator has a systematic approach to managing human performance based on a thorough understanding of human reliability and where the site is vulnerable to human failure. There is a system in place to:

(i) Identify all safety and environmentally critical tasks at the site, and specifically those which could initiate, prevent, control or mitigate the representative set of major accident scenarios;

(ii) Analyse the tasks for the potential for human failure;

(iii) Identify appropriate risk control measures matched to the type of human failure and implement them;

(iv) Identify any performance influencing factors and introduce measures to optimise performance;

2.2 Scope of Assessment

The human factors specialist discipline covers a range of topics including:

a. Human reliability;

b. Ergonomic design of plant, equipment, working environment and tasks; and

c. Optimisation of organisational performance influencing factors.

2.2.1 Human Reliability

(i) A structured and systematic approach to identifying and managing human failure is evidenced for both operation and maintenance functions;

(ii) Human factors are integrated into accident, incident and near-miss investigations.

2.2.2 Ergonomic Design

(i) Human factors are integrated into the operator's management of change and design processes and the operator has arrangements to integrate human factors into all major modifications and new builds;

(ii) A hierarchical approach to the selection of risk control measures has been adopted and there is a clear justification for the allocation of functions to humans or to automation;

(iii) Human failure is systematically addressed during the design of safety instrumented systems;

(iv) Plant, equipment, workstations etc are designed with user capability in mind, considering construction, operation, maintenance and decommissioning tasks;

(v) The design (and upgrade) of control rooms and interfaces is user-centred;

(vi) Alarm systems are designed and managed to take account of limitations in human performance;

(vii) Environmental effects such as working space, temperature, lighting etc, and their effects on human performance are considered in the design process.

2.2.3 Optimisation of Organisational Performance Influencing Factors (PIFs)

(i) Robust and systematic arrangements for the management of organisational change;

(ii) A structured framework to ensure that there are adequate numbers of competent people with realistic workloads to prevent, control and mitigate major hazards at the establishment – especially during abnormal / upset conditions;

(iii) Suitable arrangements are in place to manage shift work and fatigue;

(iv) Effective arrangements for safety critical communications including shift handover systems;

(v) A description of supervisory arrangements.

2.3 Use of examples in the Safety Report

Establishments should describe their systems for:

(i) Identification of safety critical tasks;

(ii) Task analysis and human failure analysis;

(iii) Management of organisational PIFs as appropriate.

Where appropriate, establishments should consider providing examples of:

(i) Task analysis and human failure analysis;

(ii) Documented assumptions underpinning assessment of human performance in SIL and LOPAs;

(iii) Accident, incident or near-miss investigation reports;

(iv) Documents showing management of organisational PIFs as appropriate.

3. BENCHMARKS

3.1 The benchmarks for human factors assessment are set out in Appendix 12G. Details of international, European and national standards, as well as relevant published guidance, are included. These will be used by all assessors to assess the safety report and to ensure consistency of assessment.

4. PROPORTIONALITY

4.1 Assessors will take a proportionate approach to safety reports, which considers:

(i) the potential consequences of human failure at the establishment (i.e. the consequences of scenarios where humans could initiate, prevent, control or mitigate the major accident); and

(ii) the degree of reliance on human performance.

4.2 Although there is an expectation that all establishments should follow the basic principles set out in the benchmark criteria, assessors will be proportionate regarding the extent to which the establishment provides descriptions or evidence of their management of human performance.

4.2.1 For example, a refinery operation with complex continual processes will be expected to have a highly structured approach to task analysis, human failure analysis, and human factors integration, and documented procedures for managing the full range of organisational PIFs.

By contrast, a batch processor operating only one process will be expected to have a process for identifying the potential for human error and relevant PIFs and to be able to describe their processes for managing those organisational PIFs which are relevant.

4.3 Unless the establishment carries out a particularly novel or high risk activity, only site records that are produced as a result of applying established human factors benchmark standards, or equivalent, can be requested.

5. PRE-CONSTRUCTION AND PRE-OPERATION SAFETY REPORTS

5.1 All engineering projects follow a common process of design, construction, commissioning and operation. These activities comprise sub-tasks and are spread over a schedule that can be subject to significant change, therefore the contents of pre-construction and pre-operation safety reports develop over time. It is therefore difficult to select a defined point in time when a pre-construction or pre-operation safety report can be issued.

5.2 For the purposes of human factors assessment, a rolling submission is more practical than complete submissions, however, either option is acceptable.

5.3 In line with HSE RR001 and Energy Institute Guidance (EI Human Factors Briefing Note 16), it is good practice for operators to have a human factors integration plan for new construction projects and major modifications, which includes:

(i) The human factors issues to be addressed during the project (such as staffing requirements, design for operability and maintainability, procedures, training and competence);

(ii) Any constraints on human factors integration (such as the intention to use legacy plant and equipment);

(iii) Activities used to assess and address human factors issues (such as task and human failure analysis, staffing levels assessment etc);

(iv) Dependencies to and from other development activities (e.g. where HF is needed to inform design, or where design might impact on HF);

(v) Plans for user involvement (scheduling of user trials, prototype development, simulation etc);

(vi) Methods for monitoring progress against the plan; and

(vii) Forums for negotiating human factors trade-offs (e.g. more staff may be cheaper than fully automated systems or vice versa).

Where establishments do not have a human factors integration plan, they should show in their Pre-Construction and Pre-Operation safety reports the measures they have taken to address these matters.

5.4 Pre-Construction Safety Reports

The type of human factors information provided during the design phase would include reference to ergonomics standards, guidance and human factors methods used to inform the design. A human centred design approach should be adopted where humans play a key role in the safe operation and maintenance of plant and processes. Task analysis may be used as a design tool to determine where human machine interfaces are required, and to determine the likely staffing and competency requirements for operation. Design risk assessments should take account of human interactions with the system and the types of human error that could occur. This analysis can inform the appropriate allocation of function to human and/or machine. Overall, the information provided should demonstrate a structured approach to the inclusion and assessment of humans in the design.

5.5 Pre-Operation Safety Reports

The information provided at this stage in the process should deal with 'conformity to design'. Where humans have to be accommodated for within the design there should be a process that ensures the as constructed plant and process affords the level of accommodation intended in the design. This may be achieved by using methods such as walk through/talk through task analysis. Prior to operation, there should be evidence of formal procedures being produced and arrangements for the selection and training of operators and maintenance staff. These should include required responses to foreseeable upsets and emergencies where there is a major hazard risk. Overall, the information provided should demonstrate the systematic application of a structured approach to the inclusion and assessment of humans in the design and construction of plant and processes.

Pre-Operation safety reports should include details of significant changes to the previously specified design and relevant additional information resulting from the detailed engineering phase which may have an impact upon human factors considerations.

5.6 For large projects (involving external design / construction contractors) the operator's arrangements for managing outstanding issues / actions ('snag items') identified during 'pre-handover' inspection should be described.

6 POTENTIAL SERIOUS DEFICIENCY AND SIGNIFICANT OMISSION

6.1 Examples of potential serious deficiencies in the on-site measures (as described in the safety report) include but are not limited to:

(i) the apparent reliance on human performance as the only control measure e.g. if human response to an alarm is the only control measure for a process deviating from safe operating parameters. The need for manual intervention in critical high-hazard systems (e.g. manual emergency shutdown of a continuous process) should trigger a category 'A' visit to site.

6.2 Significant omissions in the content of the safety report may include:

(i) Failure to show that the operator has identified where the establishment is vulnerable to human failure and has a system in place to identify appropriate control measures (e.g. task analysis and human failure analysis)

a. For safety critical operations; and

b. For safety critical maintenance, inspection and testing activities.

(ii) Failure to describe the how operator interaction with process control systems (whether manual or via a DCS system) have been optimised including allocation of function and design in accordance with ergonomics standards.

Appendix 12D 'Human Factors Assessment Criteria and Guidance'

TECHNICAL CRITERION	GUIDANCE
Predictive	

10.1.2 The safety report should demonstrate that a systematic process has been used to identify events and event combinations which could cause major accident hazards to be realised
Schedule 3 Para 5(a)
	Human factors are fully integrated into the major accident hazard risk assessment process. Supporting documents (Link Tables; LOPA analyses; Bowtie Diagrams etc) clearly illustrate the part played by people in initiating, preventing, controlling and mitigating the consequences of major accident hazards.
	
	The potential for dependency between successive human tasks has been recognised and accounted for e.g.:
	• the Human Error Probability for one task may be significantly influenced by an error in a previous, related step/task:
	• different people doing the same task may make the same error;
	• the same person may make the same error during a number of tasks;
	• a checker may fail to detect an error, for the same reason the user made the error;
	
	To meet this criterion the Safety Report should describe:
	• the methodology for identifying safety-critical tasks[1] at the establishment (including e.g. routine; non-routine; abnormal and upset; first line emergency response; safety-critical maintenance, inspection and testing activities);
	• The methodology used for task and human failure analysis – an appropriate system could include:
	  ○ Structured on-plant task analysis, to gain a thorough understanding of the task and identify safety-critical steps (the latter being the focus for in-depth analysis);
	  ○ Systematic identification of the different types of human failure (slips, lapses, mistakes and violations etc) using a recognised methodology e.g. Human-HAZOP guidewords;
	  ○ A framework to evaluate local Performance Influencing Factors;
	  ○ Active involvement of front-line personnel who currently perform the task being analysed (with support from competent facilitators).
	• A suitably-prioritised programme of task and human failure analysis that accounts for the full range of safety-critical tasks and major accident hazard scenarios at the establishment. A typical programme may run over a number of years.
	• Arrangements to ensure that those who undertake or facilitate task and human failure analysis are, and remain, competent to do so.

[1] Though accepted terminology defines such tasks as 'safety'-critical, the definition includes all tasks where human action or inaction could result in significant environmental impact (e.g. a MATTE).

Appendix 12D 'Human Factors Assessment Criteria and Guidance'

<table>
<tr><th>TECHNICAL CRITERION</th><th colspan="2">GUIDANCE</th></tr>
<tr><td rowspan="2"></td><td colspan="2">Benchmarks:</td></tr>
<tr><td>http://www.hse.gov.uk/humanfactors/topics/humanfail.htm
http://www.hse.gov.uk/humanfactors/topics/core3.pdf</td><td>Energy Institute (2011) Guidance on human factors safety critical task analysis.</td></tr>
<tr><td rowspan="3">10.2 The safety report should contain estimates of the probability (qualitative or quantitative) of each major accident scenario or the conditions under which they occur. This should include a summary of the initiating events and event sequences (internal or external), which may play a role in initiating each scenario
Schedule 3 Para 5(a)</td><td colspan="2"><u>To meet this criterion the Safety Report should show that</u>:
When quantitative human reliability assessment (QHRA) is used to determine human error probabilities (HEPs) - e.g. for initiating events and layers of protection:
The process has been carried out by a competent human factors assessor (competent in both human factors and the methodology used);
All assumptions are grounded on a thorough and systematic qualitative assessment (e.g. by describing the qualitative assessment methodology or by including sample documents which explain the assumptions made);
Use of generic HEP data is unacceptable unless it has been qualified to reflect the local circumstances or is more than or equal to an HEP of 0.1.</td></tr>
<tr><td colspan="2">Benchmarks:</td></tr>
<tr><td colspan="2">Energy Institute (2012) Guidance on quantified human reliability analysis (QHRA)</td></tr>
<tr><td>10.4.1 The safety report should clearly describe how the operator uses risk assessment to help make decisions about the measures necessary to prevent major accidents and to mitigate their consequences.
Reg 8 (a),(b),(c)
Schedule 3 para 5</td><td colspan="2"><u>To meet this criterion the Safety Report should show that</u>:
Control measures implemented to reduce or remove the likelihood of human failure are:
matched to the human failure types identified; and
where necessary, optimise the local performance influencing factors that make the error more likely.
Training and procedures are not viewed as the sole defence against human failure - they form an integral part of a broader range of measures to reduce the potential for human failure. The safety report explains the basis for allocation of function:
it is clear from the risk assessment methodology that:
where appropriate, the human contribution to failure is removed (e.g. by a more reliable, automated system);
automation is selected for the right reasons – there is consideration of involving the operative in the process and maintaining their situation awareness, and of the potential for alarm overload.</td></tr>
<tr><td colspan="3">Safety Management System</td></tr>
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TECHNICAL CRITERION	GUIDANCE

11.5 The safety report should describe how the operator allocates resources to implement the MAPP
Schedule 2 para 1(c)
	i. STAFFING LEVELS
	The safety report should explain how senior management provide sufficient human resources to maintain adequate staffing levels for the full range of safety-critical tasks at the establishment.
	<u>To meet this criterion the Safety Report should describe</u>:
	• The methodology by which appropriate staffing levels have been set for:
	  ○ the full range of normal operations including e.g. start-up of continuous processes;
	  ○ the full range of maintenance operations including turnarounds where relevant; and
	  ○ especially during abnormal or upset conditions i.e. how staffing arrangements affect the reliability and timeliness of detecting, diagnosing and recovering from major accident hazard scenarios;
	• The methodology used where staffing arrangements have been formally assessed using recognised models (e.g. CRR 348/2001: 'Entec Report' and the Energy Institute user guide for the methodology 'Safe Staffing Levels');
	• Arrangements for ensuring that the identified staffing levels are maintained;
	• Arrangements for detecting, assessing and addressing workloads which are either too high or too low.
	ii. MANAGEMENT OF SHIFT WORK
	The safety report acknowledges that fatigue may result in slower reactions, reduced ability to process information, memory lapses, absent-minded slips, lack of attention etc.
	<u>To meet this criterion the Safety Report should describe</u>:
	• The framework for managing fatigue using appropriate standards and good practice (e.g. HSG256 Managing Shiftwork) including:
	  ○ a policy that specifically guards against fatigue by addressing shift patterns, working hours, overtime etc. (and goes beyond the requirements of the Working Time Directive);
	  ○ guidance on shift roster design that takes account of shift types, shift length, rest periods, rotation and social factors etc.;
	  ○ consideration of environmental factors (e.g. temperature, noise levels, ventilation, lighting etc. in control rooms);
	  ○ systematic assessment of changes to working hours and shift patterns;

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<tr><th>TECHNICAL CRITERION</th><th colspan="2">GUIDANCE</th></tr>
<tr><td rowspan="3"></td><td colspan="2">

arrangements to set, record, monitor and enforce limits & standards for working hours, overtime, on-call working, shift swapping etc.;
arrangements to capture/monitor relevant data for contractors who carry out safety-critical tasks;
arrangements to educate personnel and contractors in fatigue risks and sleep management;
arrangements for personnel and contractors to report fatigue problems.

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<tr><td colspan="2">Benchmarks</td></tr>
<tr><td>Staffing Levels
www.hse.gov.uk/humanfactors/topics/staffing-levels.htm
www.hse.gov.uk/humanfactors/topics/workload.htm</td><td>Shift Work
www.hse.gov.uk/humanfactors/topics/fatigue.htm
HSG256 Managing Shiftwork</td></tr>
<tr><td>11.6 The safety report should show that the performance of people having a role to play in the management of major accident hazards is measured and that they are held accountable for their performance
Schedule 2 para 2(a)</td><td colspan="2">
i. SUPERVISION
The safety report explains the on-site arrangements for supervision of operational and maintenance teams.
<u>To meet this criterion the Safety Report should describe</u>:

Competence standards have been established for supervisory personnel which include:

non-technical skills (e.g. leadership, managing poor performance, communicating effectively);
technical skills (relevant to the plant and process); and
management of organisational PIFs within their control (competence assurance, workload, staffing levels, shiftwork, fatigue etc).

Supervisory roles and responsibilities are clearly defined in the context of major hazards;
Supervisors role in managing compliance with safety-critical rules/procedures;
Where appropriate, the limitations of self-managed teams (poor leadership; poor communication external to the team etc.) and other 'flatter' management structures are acknowledged and addressed;

ii. BEHAVIOURAL SAFETY
<u>To meet this criterion the Safety Report should describe</u>:
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<tr><th>TECHNICAL CRITERION</th><th colspan="2">GUIDANCE</th></tr>
<tr><td rowspan="4"></td><td colspan="2">Where the report references behavioural safety programmes as a means of ensuring compliance with procedures:
The limitations of behavioural safety programmes are fully acknowledged (e.g. a potential bias towards personal injury, rather than low probability / high consequence events; a tendency to focus on the behaviour and performance of front-line personnel, rather than management);
A range of relevant standards and performance measures exist to ensure that an appropriate balance is struck between major hazard performance and personal health & safety performance.</td></tr>
<tr><td colspan="2">Benchmarks</td></tr>
<tr><td>Supervision
www.hse.gov.uk/humanfactors/topics/supervision.htm</td><td>Behavioural Safety
www.hse.gov.uk/humanfactors/topics/behaviouralsafety.htm</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>11.10 The safety report should show that the operator has arrangements for communicating information important for the control of major accident hazards within the operator's organisation
Schedule 2 para 2(a) and (c)</td><td colspan="2"><u>To meet this criterion the Safety Report should describe</u>:
i. SHIFT HANDOVER
Arrangements for shift handover:
The standard/procedure for shift handover which has been implemented;
Support equipment which is provided (structured written or electronic logs);
Allocation of time for incoming and outgoing shifts to discuss plant status face-to-face;
Arrangements to minimise distractions during handover;
Arrangements to schedule maintenance within shifts, or arrangements to control maintenance work that crosses shifts.
ii. REMOTE COMMUNICATIONS
Arrangements for remote communications and the measures taken to ensure:
remote communication equipment (radios; intercoms; PAs; intranet) is suitable and reliable;
users are competent in the use of equipment and associated radio protocols.</td></tr>
<tr><td colspan="2">Benchmarks</td></tr>
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TECHNICAL CRITERION	GUIDANCE
	Communications www.hse.gov.uk/humanfactors/topics/communications.htm
11.13 The safety report should show that the operator has adopted procedures for planning modifications to, or the design of new installations, processes or storage facilities **Schedule 2 para 2(d)**	**To meet this criterion the Safety Report should describe:** **MANAGEMENT OF ORGANISATIONAL CHANGE** The safety report recognises that even subtle changes to organisations (reducing staff numbers; combining departments; de-layering; introducing self-managed teams; multi-skilling; other changes to roles & responsibilities etc.) can have a significant impact on the management of major hazards. The report shows that there is a clear policy and procedure which: • Is framed around recognised good practice (see below); • Sets out guidelines on timing the implementation of changes (so that there is sufficient time for consolidation; staggered to avoid too many simultaneous changes); • Explains the assessment process, considering risks and opportunities resulting from the change (where you want to get to), as well as risks arising from the process of change (how you get there); • Describes how personnel and contractors will actively participate before, during and after the change; • Explains how all safety-critical tasks and key major hazard responsibilities will be identified and successfully mapped across to the new organisational structure; • Describes how staffing levels will be formally assessed pre- and post-change (see Criterion 11.9 above); • Makes clear links to associated PIFs (workload; fatigue etc); • Explains arrangements to ensure training, support and supervision for staff with new or changed roles will be provided; and to ensure there is adequate planning for competent cover during the training period; • Where roles and responsibilities are outsourced, explains how intelligent customer capability will be retained; • Explains arrangements for a full review to be undertaken prior to 'go-live'; and how performance should be monitored post-change;
	Benchmarks

TECHNICAL CRITERION	GUIDANCE
	Organisational Change www.hse.gov.uk/humanfactors/topics/orgchange.htm Chemical Information Sheet No CHIS7 – Organisational Change and Major Accidents
11.16 The safety report should show that the operator has adopted mechanisms for investigation and taking corrective action: a) in cases of the proactive performance measures showing a deterioration in risk control measures; and b) in relation to any incident or event with the potential to cause a major accident. **Schedule 2 para 2(f)**	Human factors is integrated into investigation. **To meet this criterion the Safety Report should describe how:** • The investigation process is clearly defined via procedures and checklists, encouraging investigators to determine why human failures occur; • A systematic approach is adopted (e.g. investigations follow a path similar to human failure analysis in reverse); • Immediate causes (active human failures) as well as latent human failures (e.g. decisions remote in time and place from the incident) are addressed; • Contributory factors (PIFs) are identified at job, individual and organisational levels. The demonstration could include the documented findings of an accident investigation.
	Benchmarks
	Investigation – Human Factors www.hse.gov.uk/humanfactors/topics/investigation.htm
General Principles	
12.2 The safety report should show how the measures taken will prevent foreseeable failures which could lead to major accidents. **Schedule 3 Paras 4 and 5**	**This criterion to be considered last.** This is a high-level demonstration informed by the quality and depth of demonstrations made for the full range of human factors technical criteria. The report should demonstrate: • A structured, systematic approach to managing human performance in the context of major accident hazards; • Risk control measures, and the supporting Major Accident Prevention Policy and safety management system, are built upon a sound understanding of how human failure plays a part in initiating, escalating, and failing to mitigate the consequences of, major accidents. Overall, where reliance is placed on people as part of the package of necessary measures, the report demonstrates that human factors issues (including human reliability) are being addressed with the same rigour as technical and engineering measures

TECHNICAL CRITERION	GUIDANCE
	(Guidance to COMAH Regulations L111, para 412)
Design	

12.2.1.1 The safety report should describe how the establishment and installations have been designed to an appropriate standard.
Regulation 8(c)
Schedule 2 paras 2 (a) and (c)
	HUMAN FACTORS IN DESIGN
	To meet this criterion the Safety Report should show:
	• There is a clear policy and/or procedure to ensure the application of inherent safety principles at the outset of the design and modification process;
	• That the operator applies a hierarchy of control measures, which aims to remove reliance on humans, or improve system design, where human performance has an unacceptable probability of failure;
	• Acknowledgement that training is a weak control measure, and prioritises automation and user-centred design over procedures and training;
	• The implications of introducing human failure into an automated system (via design, inspection, testing, maintenance etc.) are acknowledged and addressed;
	• The need for manual intervention in critical high-hazard systems (e.g. manual emergency shut down of a continuous process) is clearly justified. (This is a priority for verification by inspection.);
	• Where possible, human performance is further assured by mechanical or electrical means (e.g. sequentially interlocked valves; interlocked earth-proving for road tanker off-loads);
	• Where procedures and training are relied upon as a risk control measures, the report shows that these tasks have been identified and analysed; and that the analysis supports the development of the procedure; and the procedure is used as the basis of the competence management system (e.g. by adoption of the Human Factors Roadmap);
	• Plant, equipment, workstations and control systems are designed with human performance in mind;
	• How the company integrate human factors in the design and commissioning process for all large projects;
	  ○ Human factors principles are integrated into design and development;
	  ○ Human factors are considered throughout the development lifecycle;
	  ○ Relevant front-line personnel including both operations and maintenance personnel are actively involved in the design process;

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<tr><th>TECHNICAL CRITERION</th><th colspan="2">GUIDANCE</th></tr>
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Usability / operability and maintainability are assessed and inform a user centred design;
The design process identifies the procedural and training needs of relevant users;
Relevant general design standards (see below) have been applied on site.

The demonstration could include a worked example.
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<tr><td></td><td colspan="2">Benchmarks:</td></tr>
<tr><td></td><td>BS EN ISO 26800:2011 (Ergonomics – General approach, principles and concepts)
BS EN ISO 6385:2004 (Ergonomic principles in the design of work systems)</td><td>BS EN ISO 9241-210:2010 (Ergonomics of human-system interaction. Human-centred design for interactive systems)
www.hse.gov.uk/humanfactors/topics/design.htm</td></tr>
<tr><td>12.2.1.3 Layout of the plant should limit the risk during operations, inspection, testing, maintenance, modification, repair and replacement.
Regulation 8(c)
Schedule 3 Paras 3(d) and 4(a)</td><td colspan="2"><u>To meet this criterion the Safety Report should describe</u>:
How systems are designed for operability and maintainability:

Plant and equipment, including layout on site, are designed with human performance in mind (e.g. accessibility for inspection, testing and maintenance);
The working environment (noise; temperature; lighting etc.) has been considered;
Plant and components are clearly identified and labelled so as to reduce the likelihood of error;
Up-to-date P&IDs, schematics, line-diagrams, job-aids and other diagnostic tools are available for maintenance.

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<tr><td></td><td colspan="2">Benchmarks</td></tr>
<tr><td></td><td colspan="2">www.hse.gov.uk/humanfactors/topics/06maintenance.pdf</td></tr>
<tr><td>12.2.1.4 Utilities that are needed to implement any measure defined in the safety report should have suitable reliability, availability and survivability.
Regulation 8(c)
Schedule 3 Paras 4(a) and 5(d)</td><td colspan="2"><u>To meet this criterion the Safety Report should describe</u>:
Where appropriate, the survivability and availability of human control systems following utility failure:

Where appropriate, there is some means of ensuring that power supply to human control systems survives during a major accident e.g. via an uninterruptible power supply (UPS);
UPS systems provide sufficient time to enable orderly shutdown and/or evacuation;
UPS systems support all necessary instrumentation and equipment:

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TECHNICAL CRITERION	GUIDANCE
	○ control room interfaces; SCADA systems; mimic panels; ○ level monitoring and gauging equipment; ○ process alarms; site-wide evacuation alarms; ○ radio base stations; land-line communication systems; ○ ROSOVs and other remotely operated shut-down equipment; • There is adequate emergency lighting to carry out relevant shut-down tasks; where appropriate, hand-held torches are available.
12.2.1.11 The safety report should show how safety-related control systems have been designed to ensure safety and reliability. **Regulation 8(c)** **Schedule 3 Paras 4(a),(b) and 5(d)**	**To meet this criterion the Safety Report should describe:** How the potential for human failure is acknowledged and systematically treated in the design of safety instrumented systems. The design process prompts a multi-discipline, team approach (including input from operators and human factors specialists). The operator has identified tasks where: • human failure could lead to a demand on the safety function (e.g. errors in setting process parameters, conflicting responsibilities that may distract the operator's attention; unauthorised use of system overrides etc.); • human action could reduce the demand rate on the safety function (e.g. responding to alarms); • failure of the safety function requires actions to mitigate the consequences of the event. The safety report is realistic about levels of risk reduction claimed for alarm systems and considers: • availability of the operator to respond; • adequacy of time to respond; • the potential for alarm flooding; • whether the operator knows how to respond (i.e. there is a clear, documented response for each critical alarm, supported by training). Assumptions about human performance in the control system are documented; an example could be included in the report. The safety report identifies and addresses human failures that increase the likelihood of the safety function failing to work on demand (inspection, testing, maintenance, calibration etc.); The safety report describes how the operator identifies and addresses the potential for operatives to override safety functions. Where appropriate, the safety report considers the availability of human control systems during upset and emergencies (e.g. is CR toxic refuge, can operatives reach shut off valves on plant etc)

Appendix 12D 'Human Factors Assessment Criteria and Guidance'

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<tr><th>TECHNICAL CRITERION</th><th colspan="2">GUIDANCE</th></tr>
<tr><td rowspan="2"></td><td colspan="2">Benchmarks:</td></tr>
<tr><td>Functional safety:
BS EN 61511 (process safety);
BS EN 61508: Functional safety of electric / electronic / programmable electronic safety-related systems</td><td>See CRR 373/2001: Proposed framework for addressing human factors in IEC 61508
www.hse.gov.uk/research/crr_htm/2001/crr01373.htm</td></tr>
<tr><td>12.2.1.12 The safety report should show how systems which require human interaction have been designed to take into account the needs of the user and be reliable.
Regulation 8(c)
Schedule 3 Paras 4(a),(b) and 5(d)</td><td colspan="2"><u>To meet this criterion the Safety Report should describe</u>:
i. MANUAL CONTROL OF SYSTEMS
Where there is a reliance on human performance to keep a system within design parameters manually, the report describes those measures taken to ensure human reliability e.g.:
Plant (e.g. valves, flow direction and contents of pipework) and materials (e.g. chemicals added manually to batch processes) are clearly labelled;
Information about the status of the process is available to the operator e.g. pressure gauges, sight glasses etc are appropriately located;
Procedure design has been optimised to support the operator in the field;
Process control systems are designed to inform the operative if unsafe parameters are entered into the system.
ii. CONTROL ROOM AND INTERFACE DESIGN
Where there is a control room:
the safety report contains a clear description of the control room environment and associated process control systems and interfaces;
relevant standards and recognised good practice are applied during upgrades and modifications of existing control room interfaces, as well as the design of new control systems;
design criteria encompass control room arrangements and layout; panel workstations; displays and controls; environmental conditions (lighting; acoustics; ventilation; temperature etc.);
the experience of operators and engineering/maintenance personnel is captured and fed back into the upgrade process;
DCS & SIS training/assessment covers specific, local operational issues as well as generic functionality of the interface and familiarisation with system operating manuals;
the safety report describes how relevant standards have been applied (and may include examples if this facilitates the description)</td></tr>
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<tr><td rowspan="3"></td><td colspan="2">iii. ALARM HANDLING
The operator has set out their philosophy with regard to the design and management of alarms. This describes how:
Alarm handling is fully integrated into the design process;
The design process acknowledges and accommodates human capabilities and limitations (including operator availability to respond; time to respond; the potential for alarm flooding etc.);
How alarms will be justified and prioritised;
Alarm systems are subject to continuous improvement (for example, there is a clear link between process change and alarm system upgrade);
Relevant performance measures are defined and monitored (average alarm rate; upset alarm rate; average number of standing alarms; bad actors etc).
In particular:
Bulk tank capacities and alarm set points are clearly defined to ensure there is sufficient time for detection, diagnosis, planning and action;
The report describes how alarm systems alert, inform and guide required operator action (including a defined, documented response for each safety-critical alarm, supported by training and assessment);
Specific examples could be included within the report to show how relevant standards and good practice (see below) have been applied on site:
EEMUA 191: 2007 (Alarm systems: a guide to design, management and procurement)
CRR 166/1998 (The management of alarm systems)
BS EN 981 / ISO 11429:1996 (being reviewed 2014) Ergonomics – System of auditory and visual danger and information signals</td></tr>
<tr><td colspan="2">Benchmarks:</td></tr>
<tr><td>Control Room and Interface Design:
BS EN ISO 11064: 2001 (Ergonomic design of control centres) – parts 1 to 7
EEMUA 201:2010 (Process plant control desks utilising human-computer interface)
ISO 9355-1 (identical to BS EN 894-1) Ergonomics</td><td>Alarm Handling
EEMUA 191: 2007 (Alarm systems: a guide to design, management and procurement)
CRR 166/1998 (The management of alarm systems)
BS EN 981 / ISO 11429:1996 (being reviewed 2014) Ergonomics – System of auditory and visual danger and information signals</td></tr>
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TECHNICAL CRITERION	GUIDANCE	
	requirements for the design of displays and control actuators. Part 1 General principles for human interactions with displays and control actuators • ISO 9241 Ergonomics of human system interaction CRR 432/2002 (Human factors aspects of remote operation in process plants)www.hse.gov.uk/humanfactors/topics/control-room.htm www.hse.gov.uk/humanfactors/topics/hci.htm www.hse.gov.uk/comah/sragtech/techmeascontrol.htm	www.hse.gov.uk/humanfactors/topics/alarm-management.htm BS EN 62682: 2015 Management of alarm systems for the process industries
Maintenance		
12.2.4.2 The safety report should describe appropriate procedures for maintenance that take account of any hazardous conditions within the working environment. **Regulation 8(c)** **Schedule 2 paras 2 (a) and (c)**	The safety report recognises that even highly-trained, well-motivated maintenance technicians can make simple slips and lapses, or fail to follow procedures, and that such failures can initiate major accidents or introduce latent system conditions. **To meet this criterion the Safety Report should describe:** • How the operator's methodology for human failure analysis has been applied to safety-critical maintenance tasks; • The arrangements to supervise and control in-house and contractor maintenance activities (e.g. systematic hand-back; independent cross-checks etc); • Communication channels that exist between shifts, and between operations, maintenance and contractor personnel; • Where activities are out-sourced, what arrangements the operator has made to retain an intelligent customer capability (i.e. retain adequate technical competence to judge whether, and ensure that, work is done to the required quality and safety standards).	
	Benchmarks	
	www.hse.gov.uk/humanfactors/topics/testing.htm	
12.2.4.3 The safety report should show that systems are in place to ensure that safety critical plant and systems are examined at appropriate intervals by a competent person.	**To meet this criterion the Safety Report should describe:** • Suitable procedures that are used for examination, inspection & proof testing, with clear pass/fail criteria; • The arrangements within the CMS to ensure personnel/contractors who conduct such activities are competent to do so, and are fully aware of related major hazards and their consequences; • where activities are out-sourced, the duty-holder has made arrangements to retain an intelligent customer capability;	

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TECHNICAL CRITERION	GUIDANCE
Regulation 8(c) **Schedule 2 para 2(c)**	**Benchmarks**
	www.hse.gov.uk/humanfactors/topics/testing.htm
Modifications	
12.2.5.1 The safety report should show the system in place for ensuring modifications are adequately conceived, designed, installed and tested. **Regulation 8(c)** **Schedule 2 Para 2(d)**	The establishment integrates human factors into major projects: • Ensuring that specific human factors activities are built in to project plans and are sufficiently resourced; • Understanding and specifying the context of use, identifying who the users are, what they will be doing, including assessing the impact of the change on workload and staffing levels; • Ensuring that descriptions of user characteristics and tasks analysis are considered as the basis for design; • Specifying the user and organisational requirements, and ensuring a balance between user-centred design options and relative cost; • Applying HF expertise to generate design options which meet user requirements (planning in time for iterative design and using prototypes to evaluate user experience); • Evaluating requirements by involving target users and HF specialists. **To meet this criterion the Safety Report should describe how:** • The design considerations outlined above have been addressed; • The management of organisational change procedure has been applied; • Human reliability has been robustly addressed in the new design; • Procedures have been updated to reflect the change; • Additional training and assessment has been provided. The demonstration could include a specific example.
	Benchmarks
	RR:001 (2002) Human factors integration: Implementation in the onshore and offshore industries