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JOINT INDUSTRY PROJECT ON HUMAN FACTORS IN OFFSHORE OPERATIONS

UK LITERATURE REVIEW

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EXECUTIVE SUMMARY

A UK literature review has been conducted on behalf of EQE International Inc., Houston, in support of the Joint Industry Project on Human Factors in Offshore Operations. The types of information reviewed include past and current methods of human factors assessment; UK incident and accident data; and human factors issues concerning well control, service vessel operations and crane operations.

The review has focussed on identifying techniques that may be applied in the assessment of hazards associated with offshore activities. Summaries of potentially useful methods are presented with information concerning previous applications and possible advantages and disadvantages.

At present, human error data pertaining to offshore activities in the North Sea are scarce. The study has identified that the shortage of relevant information has been a factor in the general reluctance of the UK oil and gas industry to perform human reliability assessments of offshore activities.

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1.0 INTRODUCTION

A UK literature review has been conducted on behalf of EQE International Inc., Houston, in support of the Joint Industry Project on Human Factors in Offshore Operations.

The objective of the review was to identify, obtain and review published information regarding the impact of human factors on offshore operations. More specifically, the study concentrated on literature pertaining to conditions experienced by the UK offshore industry. The types of information that have been reviewed include:

- past and current methods of human factors assessment applied in the UK;
- UK incident and accident data;
- literature dealing specifically with human factors issues concerning:
    - well control;
    - service vessel operations; and
    - crane operations.

A coarse evaluation of techniques has been performed to identify those which have the potential to be applied in human factors assessment of offshore activities.

2.0 METHODOLOGY

Figure 1 illustrates the methodology employed in conducting the literature search and review.

The study has employed the resources of EQE's in-house libraries in Aberdeen and Warrington, and also those of Aberdeen City Library, Aberdeen University Library and Robert Gordon University Library. EQE's arrangements with these libraries have provided access to:

- each library's collection (books, journals, etc);
- CD-Rom databases;
- Bath Information Database System (BIDS); and
- British Lending Library (BLL) collection.

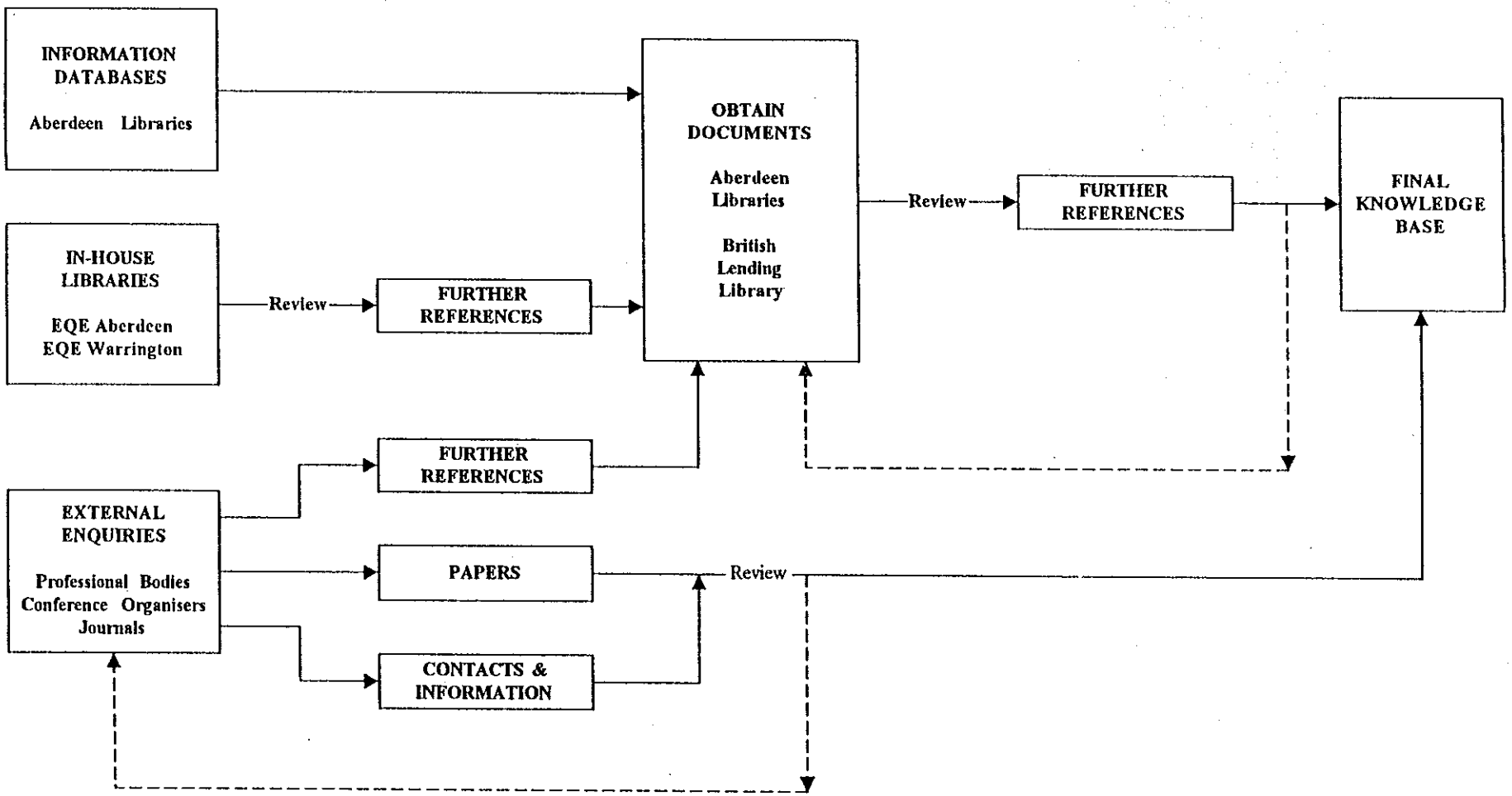
Information databases (COMPENDEX and Petroleum Abstracts) have been examined to generate a list of potentially relevant references. The following key phrases were employed in conducting the search:

- human error
- human factors
- human failure
- human reliability
- task analysis
- task modelling
- influence diagram
- blowout
- kick
- kick detection
- service vessel
- crane

A number of external agencies have also been contacted to establish further contacts, identify additional references and gather relevant human factors information and literature. These are listed in Table 1.

A schedule of the material obtained is presented in Table 2. There are also a number of documents which, although they may be relevant, we have not been able to obtain during the duration of the study. References to these documents appear in Table 3.

FIGURE 1. METHODOLOGY OF LITERATURE SEARCH AND REVIEW



3.0 REVIEW

3.1 Coverage

In accordance with the objectives, the literature search and review has been focussed on information pertaining specifically to offshore operations in the UK. However, a significant quantity of more general human factors literature has been developed in other sectors of industry and in different parts of the world. Hence, a selection of more general but relevant literature has been incorporated within the survey.

It is evident from the schedule of material obtained (Table 2) that a significant proportion of the literature has been published fairly recently. The review is considered to have featured much of the latest information available in the public domain.

The scope of the review was limited to published literature and, by definition, did not extend to proprietary information held in corporate libraries. However, this is acknowledged as a significant source of information.

Relatively little cross-referencing is observed within the population of literature surveyed. In the main, this may be attributed to the breadth of the subject area defined in the scope. The coverage may therefore be characterised as more broad than it is deep.

3.2 Human and Organisational Factors

In recent years, advances in engineering technologies and design of equipment have produced significant improvements in the integrity of production facilities. As a consequence of these 'hardware' improvements, an increasing proportion of incidents may be attributed to human error. This has resulted in greater examination of the contribution of human factors to the causes of incidents. Inevitably, the development of methods to reduce the potential for human error is attracting significant interest from industry and regulators alike. This is particularly the case in the offshore industry, where a high proportion of activities involve human interaction in some way, and where human failures have the potential to cause accidents of greater consequence than is perhaps the case in other industries.

In guidance for considering human factors in the control of risk, HSE (1993, ref.1) and the Engineering Council (1993, ref.2) describe three areas of influence which affect human performance - the organisation, the job and personal factors. The guidance encourages management to consider not only the errors individuals might commit, but also the underlying managerial and environmental conditions that contribute to the causation of accidents.

In a review of human errors in process safety, Wreathall (1993, ref.3) acknowledges that the human contribution to disasters is only partly specified by the human factors and organisational issues. One part missing is the context in which the actions take place. Work is only just starting in this area and, as yet, no methods exist to identify the specific conditions necessary to induce an error from an operator.

At this point a distinction may be made between techniques that are applied to address human factors at the *individual level* and those applied at the *organisational level.*

Methods that fall into the latter category may generally be described as audit-based, e.g. see Donald *et alia* (1991, ref.4) and Embrey (1989, ref.5). Many involve the use of questionnaires and structured interviews at various levels of the management system, followed by an analysis of the responses to provide an indication of the organisation's integrity as a whole. The subject of this type of assessment is usually an entire worksite. Examples of this type of assessment tool are:

- *MANAGER*, developed with HSE funding (ref.6,7);
- *FLAIM*, developed with US Minerals Management Service funding for assessing fire hazards offshore; and
- *TRIPOD*, developed for oil industry applications and funded by Shell (ref.8-11).

The remainder of this review concentrates on techniques aimed at addressing human factors at the *individual level.* The subject of this type of assessment is a specific task or activity. Organisational factors are only considered as they affect individuals' abilities to carry out the given task correctly and are treated as influences, or 'performance shaping factors'. The importance of any particular organisational factor may only become apparent once several activities have been assessed within a given worksite.

3.3 Human Factors in Hazard Assessment

Hazard assessment involves consideration of the combined influence of equipment (hardware) and human performance on system integrity. The following is an account of how human factors may be addressed within hazard assessment. The contribution of hardware reliability, although significant in affecting the system as a whole, is not the focus of this review. Elements of a human reliability assessment (HRA) may be summarised as follows:

Problem Definition.
The activity which constitutes the subject of the assessment is defined in terms of the system objective and the process by which it is achieved. In the context of hazard assessment, the system objective is defined in terms of a safety goal. This ensures that subsequent analyses are concentrated only on those actions which are relevant to the safe execution of the task.

Error Identification.
The model of the system is analysed to identify the potential for human errors to occur, their underlying causes and opportunities for recovery action. Various taxonomies and theoretical models of human errors exist, many of which form the basis for human error analysis techniques.

Representation.
The aim at this stage is to produce a clear and understandable representation of the system and failure-producing conditions. This should illustrate the potential for error-producing conditions to occur and how failures may be propagated through the system to produce undesirable consequences.

Assessment.
The consequences of human errors are analysed to estimate the system's capability of meeting its objective. The contributions of specific errors and their underlying causes are analysed in terms of their impact on overall system performance. An initial qualitative assessment may be performed to screen out errors with insignificant impact on safety. Selected failure conditions may then be subjected to further assessment, which could involve quantitative analyses.

Risk Reduction.
The aim at this stage is to identify risk reduction measures and assess their effectiveness in improving system reliability. This may involve some form of sensitivity analysis to demonstrate that the benefits of implementing modifications to reduce or control risk are cost-effective.

DeJoy (1990, ref.12) and Kirwan (1990, ref.13) also present generic methodologies for comprehensive human reliability assessment. Kirwan is a particularly useful document in that it defines what output is expected at each stage of the assessment and identifies the most prominent and promising of the methods available at the time, many of which are described below.

3.4 Techniques for Conducting Human Reliability Assessments

This section of the review is a summary of techniques which appear appropriate for analysing offshore activities. The principal sources of information have been identified and are reported here.

A framework for addressing the impact of human factors within hazard assessment is described in the preceding section. The techniques available are now summarised in terms of the elements just described. Some of the techniques cover many or all of the elements and some techniques are submethods of others. In practice the boundaries between elements of an assessment are not clearly defined, inevitably resulting in some overlap.

Hashemi (1992, ref.14) outlines the main human factor related issues affecting the safe design and operation of offshore installations and examines the effectiveness and practicality of considering complex human factor issues within safety studies.

The literature contains a number of publications which provide broad overviews of techniques in general.

The principal guide on task analysis is reputed to be Kirwan & Ainsworth (1992, ref.15). Part 1 provides an overview of the task analysis process, Part 2 describes 25 types of task analysis techniques, and Part 3 demonstrates the application of task analysis techniques using ten case studies. The guide divides the techniques into five categories:

1. task data collection methods, e.g. task observation; interviews; analysis of procedures; incident analysis; structured walkthroughs of procedures; and examination of system documentation;
2. task description methods, e.g. charting and networking; task decomposition; and hierarchical task analysis;

3. task simulation methods;
4. task behaviour assessment methods (error identification within task analysis); and
5. task requirements evaluation methods.

By encompassing all these aspects, the guide considers techniques within its definition of 'task analysis' that extend beyond the problem definition stage of human reliability assessment.

Williams & Munley (1992, ref.16) also discusses methodologies for identifying the potential for human error in industrial systems, and describes the limitations of current systematic techniques such as HAZOP-based approaches.

The Human Reliability Assessor's Guide (1988, ref.17) comprises a comprehensive survey and evaluation of eight techniques for quantitatively determining human error probabilities. Part 1 of the guide defines the criteria employed in the assessment while Part 2 provides detailed descriptions and evaluations of the techniques (APJ, PC, TESEO, THERP, HEART, IDA, SLIM and HCR) with illustrative case studies.

Kirwan (1990, ref.13) utilises some of the Human Reliability Assessors Guide findings as part of a broader overview of human reliability analysis.

Techniques that appear as though they may be used in the assessment of offshore activities include:

THERP - Technique for Human Error Rate Prediction;
IDA - Influence Diagram Approach;
SCHEMA - System for Critical Human Error Management and Assessment;
Task Analysis;
Function Analysis;
Link Analysis;
Human HAZOP (Hazard and Operability) Study;
SHERPA - Systematic Human Error Reduction and Prediction Approach;
PREDICT - Procedure to Review and Evaluate Dependency in Complex Technologies;
Sneak Analysis;
Event Tree Analysis;
Task Hazard Identification;
SHARP - Systematic Human Action Reliability Procedure;
APJ - Absolute Probability Judgement;
PC - Paired Comparisons;
HCR - Human Cognitive Reliability;
HEART - Human Error Assessment and Reduction Technique;
SLIM - Success Likelihood Index Methodology; and
TESEO - Tecnica Empirica Stima Errori Operatori.

The techniques are summarised below. Wherever possible, information concerning previous applications and advantages/disadvantages is included, together with a shortlist of the most relevant literature reviewed. Other references are summarised in Table 2.

THERP - Technique for Human Error Rate Prediction

THERP is a methodology which covers all elements of human reliability assessment. It was developed in the 1960's at Sandia National Laboratories to reduce the incidence of production defects in nuclear weapons development. Due, in part, to its age the method has been employed in many industrial applications, including offshore operations. It is typically applied to highly proceduralised tasks and features a database of human error probabilities which has found widespread use in probabilistic risk assessment.

Problem definition is by means of task analysis, with information gathered from systems analysts and from plant visits.

The identification of human failures is based on treating human components of a system as if they were analogs of machines, with simple failure modes. Hence, THERP tends to focus on identifying slips and lapses resulting in errors of omission. The method is limited in its ability to consider inappropriate but deliberate actions (errors of commission). THERP does, however, allow consideration of error recovery and, to a certain extent, dependency between human dependent failures.

Conventional event trees are employed to represent the propagation of errors through the system.

THERP allows quantitative assessment of human reliability by employing the database of human error probabilities.
The data are based on a mixture of field experience and expert judgement and relate to manual actions. They do not explicitly cover cognitive error probabilities.

Finally, THERP allows a reevaluation of system failure probability based on recommended changes being implemented.

Due to its popularity, THERP has been the subject of a great deal of scrutiny - perhaps more than other techniques.

Criticisms of the method include:

- the resource requirements are considerable;
- it is not good for evaluating cognitive errors;
- it does not produce explicit design recommendations; and
- large discrepancies exist between different analysts' estimates for the same task.

However, it is well known and generally acceptable for many applications. It is also scrutible, auditable and compatible with probabilistic risk analysis techniques, e.g. fault trees.

References:

Human Reliability Assessor's Guide (1988, ref.17)
Kirwan (1990, ref.13)

IDA - Influence Diagram Approach

Developed from the field of decision analysis, the inflence diagram approach may be taken to assess all elements of a human factors assessment. The influence diagram captures the model held by a group of experts regarding the dependence between the likelihood of success of a given operation and the factors which are perceived to have an affect.

The variables affecting the outcome are identified by a 'brainstorming' process, followed by refinement of the model and representation in the form of an influence diagram. Unlike other methods, IDA allows for interdependence between performance shaping factors. The structure of the diagram provides a qualitative indication of the factors which are most significant in influencing the outcome. Expert judgement may be applied at this stage to screen out error-producing conditions of minor significance.

The influence diagram may be converted into the fault tree format (and vice versa) and a computer program named DPL is available for this purpose.

Quantification is achieved by determining the 'balance of influence' at each level of the model. Several iterations may be required before consistency is accomplished throughout the model, although the results at this point are final and require no additional calibration.

The technique is flexible in terms of the level of decomposition that it can handle and has found application in the offshore industry.

However, IDA is potentially expensive in terms of the human resources involved as it relies heavily on input from a group of experts at all stages of the process.

References:

Human Reliability Assessor's Guide (1988, ref.17)
Kirwan & Ainsworth (1992, ref.15)

SCHEMA - System for Critical Human Error Management and Assessment

SCHEMA is an integrated framework of techniques for human factors assessment. The method has been implemented as a computer program called *THETA - Top-down Human Error and Task Analysis*. Techniques employed in the SCHEMA methodology are as follows:

- hierarchical task analysis for problem definition;
- human error analysis, which identifies action errors; checking errors; retrieval errors (information from displays, procedures, and memory); transmission errors (communication between individuals); and selection errors;
- qualitative screening;
- quantitative assessment, using SLIM; and
- suggested risk reduction strategy, implementation and monitoring of results.

References:

Embrey (1990, ref.18)

Task Analysis

Task analysis is primarily a means of problem definition, although elements of error identification may also be incorporated when conducting a study of human reliability. As well as describing the intended sequence of actions, such an application of task analysis indicates points at which errors may be discovered and then recovered.

Several forms of task analysis process are available, a selection of which are as follows.

HTA - Hierarchical Task Analysis

Operator actions are considered in terms of the goals the operator is trying to achieve. The result is a task model, indicating both the actions that need to be carried out (tasks and subtasks) and the sequences in which they are performed (plans).

TTA - Tabular Task Analysis

The information contained in the diagram obtained from HTA may be supplemented by recording data in tabular format using TTA. This form of task analysis is particularly useful for dynamic situations which involve a considerable amount of decision-making.

Sequential Task Analysis

This form of task analysis examines operator actions as they occur in chronological order. The technique is most suitable for proceduralised tasks, although in practice hierarchical aspects should also be considered when producing a task model.

Any number of techniques may be employed in order to perform a task analysis. A comprehensive review of the methods available, which includes examples of previous applications, is given by Kirwan & Ainsworth (1992, ref.15). This document stands out as the most useful source of information on task analysis, and presents case studies demonstrating previous applications in the offshore industry.

References:

Kirwan & Ainsworth (1992, ref.15)

Function Analysis

Function analysis is a method which identifies the roles of people in a system and their inter-relationship with equipment and subsystems and is applied in support of task analysis. Several techniques are available for performing function analysis, including link

analysis which is described below.

Link Analysis

Link analysis is an ergonomic tool, principally of use in designing plant or control room layout. It identifies the physical elements of a system and the interfaces between them which are then represented as nodes and arcs, respectively on a *link diagram.* The length of each arc indicates its relative importance e.g. frequency of use, within the system. It is then analysed to indicate the optimal layout in terms of person-machine interfaces (operation of equipment) and person-person interfaces (communications). The technique has been applied offshore in the design of control rooms.

References:

Kirwan & Ainsworth (1992, ref.15)

Human HAZOP (Hazard and Operability) Study

The classic HAZOP approach has been adapted to identify the potential for human failures arising from deviations from intended sequences of actions. Human HAZOP techniques systematically consider deviations from a set of keywords at each stage of a task model, documented procedure, or work programme. Several techniques exist, each with a set of keywords tailored for specific applications. Examples of these include: *Driller's HAZOP; Operators' HAZOP;* and *PHECA - Potential Human Error Cause Analysis.*

References:

Willis, Deegan & Owens (1994, ref.19)
Kile & Magnussen (1994, ref.20)
Kirwan (1990, ref.13)
Kirwan & Ainsworth (1992, ref.15)

SHERPA - Systematic Human Error Reduction and Prediction Approach

SHERPA is a human error analysis technique. At each step in the task model, SHERPA is applied to identify systematically the potential for human error to occur. It is a structured question-answer routine and is available in the form of a computer program.

The technique is based on popular models of human error causation derived from psychological theory. Output is in the form of a human error analysis table which determines whether errors can be recovered immediately, at a later stage, or not at all, and attempts to link error reduction measures to causes.

References:

Kirwan (1990, ref.13)

PREDICT - Procedure to Review and Evaluate Dependency in Complex Technologies

The PREDICT approach is intended to identify seemingly bizarre human actions and where these actions violate assumptions about the independence of systems. HAZOP-based approaches are said to be limited in that they examine only what is happening within the process and therefore do not consider interaction between systems. The PREDICT approach differs from HAZOP in that it directs the analysis both inside and outside the process and places greater emphasis on identifying ways in which latent failures may reveal themselves. The approach features an extended set of guidewords which, although allowing a comprehensive analysis, may in practice be tedious to apply.

References:

Williams & Munley (1992, ref.16)

Sneak Analysis

Sneak analysis is a method for identifying latent failures in a system. Hence, when applied to human reliability assessment, it is particularly useful in identifying errors of commission. It is based on a systematic consideration of failure modes for each element of a process and identifies the ways in which the errors can cause the system to fail.

The method was developed for the analysis of electrical circuits and was subsequently applied in the development of computer software. It is generally applicable to any 'flow oriented' system and has been applied to identify human errors in process systems.

References:

Hahn, Blackman & Gertman (1991, ref.21)

Event Trees

Event trees are logic diagrams which illustrate how success or failure of specific events within a given sequence give rise to various outcomes. A specific failure is analysed to assess the opportunity for recovery at various stages of the scenario.

When applied to human factors assessment, the event tree represents the affect of human actions on the system (errors and recovery paths) and, through quantification, the likelihood of undesired consequences occurring. Variants of event trees include the *Operator Action Event Tree (OAET)*, the *Human Reliability Analysis Event Tree (HRAET), Extended Operator Action Tree (EOAT),* and the *Commission Event Tree (COMET).*

In general, event trees have been found to be sufficient for simple models, but may not be appropriate for describing systems with interdependency.

References:

Kirwan & Ainsworth (1992, ref.15)

Task Hazard Identification

Task hazard identification is merely the combination of a human HAZOP with an Operator Action Event Tree. The results are employed as input to fault tree models.

SHARP - Systematic Human Action Reliability Procedure

SHARP is a qualitative screening method which is applied in HRA prior to full quantification. It filters out errors which are apparently incapable of affecting the system goal.

References:

Kirwan (1990, ref.13)

APJ - Absolute Probability Judgement

Otherwise known as 'direct numerical estimation', APJ is the most direct approach to quantifying HEPs. It is the simple use of engineering judgement to predict a human error probability for a given action. Where input from several experts is employed, a number of methods exist for compensating for biases to deliver a single value.

The approach has been applied to many industrial applications, including operations offshore. The Human Reliability Assessor's Guide presents a case study of APJ, applied in combination with THERP to assess the risk of drilling into a live (producing) well. The assessment was conducted at the design stage for a proposed platform.

References:

Human Reliability Assessor's Guide (1988, ref.17)

PC - Paired Comparisons

Paired comparisons is a method for generating human error probabilities based on engineering judgement. A panel of experts develops a scaled ranking of tasks in terms of relative likelihoods of error. Two or more tasks with known HEPs are used to calibrate the scale and hence determine HEPs for the remainder.

There is no evidence of any application to the offshore industry.

References:

Human Reliability Assessor's Guide (1988, ref.17)

HCR - Human Cognitive Reliability

HCR is a quantitative technique which provides cognitive error probabilities as a function of time elapsed since the onset of an incident. The method assumes that the likelihood of successful diagnosis increases with the time available to make a decision. HCR was

developed in the nuclear industry as a means to evaluate the likelihood of control room operators taking the appropriate actions to control an incident and avoid escalation to a major accident.

The technique considers the effect of three performance shaping factors (operator experience, stress and interface quality) using one of a set of three time-reliability correlations. The correlation parameters are derived from nuclear power plant simulation data.

There is no evidence of any application to the offshore industry.

References:

Human Reliability Assessor's Guide (1988, ref.17)

HEART - Human Error Assessment and Reduction Technique

The HEART method was developed in the mid 1980's as a means of generating human error probabilities for use in probabilistic risk assessment at the design stage of a project. The method concentrates on evaluating the impact of a set of generic 'error producing conditions' which excludes factors which experience has shown do not contribute significantly to overall system reliability. Hence, some screening is inherent in the method.

The technique is based around a database of human error probabilities, which is a mixture of expert judgement and data from the ergonomics and psychology literature. The factors are well defined and specific, making them easy to measure.
Since much of the 'expertise' is incorporated within the method, it requires only one analyst to apply. The technique is therefore relatively quick and simple to use.

References:

Human Reliability Assessor's Guide (1988, ref.17)
Kirwan (1990, ref.13)

SLIM - Success Likelihood Index Methodology

The SLIM technique is a means of generating human error probabilities for use in probabilistic risk assessment. It employs a panel of experts to analyse a specific set of tasks and define their relative likelihood of success given the performance shaping factors (PSFs) affecting human reliability in those tasks. Reference tasks with known human error probabilities are included in the assessment so that the data may be calibrated.

The process may be summarised as follows:

- identify the performance shaping factors (PSFs) that affect the set of tasks;
- rate the tasks on the PSFs;
- apply weightings to the PSFs according to their relative importance on affecting the likelihood of success;

- evaluate the success likelihood index (SLI) for each task; and
- transform the SLIs to HEPs.

The SLIM approach is comprised of two modules. The first is called *MAUD (Multi Attribute Utility Decomposition)* - a computer application which elicits the judgement of several experts and then resolves ambiguities and biases between the inputs. The second module, *SARAH (Systematic Approach to the Reliability of Humans)* is the mathematical routine which calibrates the SLIs and converts them to HEPs.

The resource required to perform a SLIM assessment is relatively high. However, once an initial database has been established, the technique is relatively rapid to apply. It is highly scrutible and auditable, and has a good theoretical basis.

References:

Human Reliability Assessor's Guide (1988, ref.17)
Kirwan (1990, ref.13)

TESEO - Tecnica Empirica Stima Errori Operatori

The TESEO method is an empirical technique to estimate operators' errors, which was developed in Italy in the late 1970's, primarily for the process industries. The human error probability for a given task is predicted as a function of five factors which are assumed to be the major determinants of operator performance in any situation being considered.

TESEO is simple, quick and easy to use. It is also quite crude and both the model and data lack theoretical justification. There has been little publicised use of the technique and no evidence of it having been applied in the offshore industry.

References:

Human Reliability Assessor's Guide (1988, ref.17)
Atallah, Shah & Betti (1990, ref.22)

3.5 Human Factors in Offshore Activities

The literature has been searched for publications dealing specifically with human factors in three offshore activities:

- well control;
- service vessel operations; and
- crane operations.

3.5.1 Well Control

Principles behind well control are described in depth in Blowout Prevention (PETEX, 1980, ref.23). The topics include kick detection, mistakes in well control and kick control

for offshore operations.

There are numerous publications on current best practice and human factors issues in safe drilling. A selection of these are Wand & Rasmus (1994, ref.24), Bamford & Wang (1994, ref.25), and the series of articles on Blowout Control currently being published in *World Oil*.

3.5.2 Service Vessel Operations

For service vessels, Jolly & Woodall-Mason (1994, ref.26) describe how incident investigation and analysis was used to improve safety through changes to hardware, procedures and organisation. Gibson (1992, ref.27) includes a section on emergency duties as part of a comprehensive description of supply vessel operations.

3.5.3 Crane Operations

Human factors issues in crane operations did not feature in any of the literature surveyed.

3.6 Accident and Incident Data

Until recently, the Department of Energy published an annual report, also known as *The Brown Book* (ref.28), which contained statistics for "all accidents and dangerous occurrences on or near installations and pipeline works or on attendant vessels in the course of any operation in connection with an installation in the UKCS". The data are coarsely divided across eleven broad categories, including Drilling, Boats and Cranes. The statistics pertain only to major incidents (deaths, serious accidents and dangerous occurrences) and provide no indication of the impact of human factors.

In the wake of the Piper Alpha disaster, the responsibility for safety in the UKCS was transferred to the Health and Safety Executive, Offshore Safety Division (HSE-OSD). Accident statistics ceased to be published in *The Brown Book* in 1991. The most recent data are the 1993 Offshore Accident and Incident Statistics, published by HSE-OSD in report number OTO-94-010 (ref.29). Incidents are recorded by severity, by operation, and by broad incident type. Again, the data are not refined enough to specify the human contribution.

The OREDA handbook (ref.30) contains offshore reliability data collated from the experience of operators in the Adriatic Sea, and the UK and Norwegian sectors of the North Sea. The data are recorded according to the item of equipment in which failure occurred. Similarly, WOAD (ref.31) is a database of worldwide offshore accident statistics covering the period 1970-1991. Again, the data do not indicate the contribution of human error to failure rates.

Ynnesdal & Bentsen (1994, ref.32) introduce *Synergy*, a pilot scheme for registration and analysis of Norwegian offshore incidents affecting health, safety and the environment. Waterfall *et alia* (1994, ref.8) present an approach to incident investigation and analysis which is aimed at monitoring the performance of safety management systems. It incorporates the TRIPOD theory to record human and organisational factors contributing to dangerous incidents.

There has been little effort in the UK offshore industry to collate human reliability data for any of its operations. The offshore risk assessment culture is still geared up to hardware-based reliability data. Safety cases have, in general, been submitted on the basis that failure data have human error inherent within them. Rather than examining human factors as the cause of incidents, the emphasis has been on considering the impact of human factors in response, i.e. from the potential escalation of incidents through to full and safe evacuation.

Although there is as yet no database in the public domain, there is evidence to suggest that human error data collection has begun in parts of the oil and gas industry, e.g. see ref.33.

Data for Drilling Operations

Some incident and accident statistics are provided by Baker (1992, ref.34) in a review of trends in drilling accident causation and risk reduction. Kick frequency data is presented in a recent article by Aarestad (1994, ref.35) which describes a Norwegian initiative for information and data exchange.

The Oil Industry International Exploration and Production Forum (1992, ref.36) Hydrocarbon Leak and Ignition Database contains an entire appendix on blowout frequency. Approximately 10% of wells in the database are located in Europe, i.e. UK, Norway, the Netherlands and Denmark.

Data for Service Vessel Operations

The performance of attendant vessels in emergencies offshore is the subject of an Offshore Technology Report OTH 87 274 (ref.37). The report examines the availability and capability of attendant vessels in providing emergency services based on a review of worldwide data. It also provides details of several evacuation incidents.

Lloyds Casualty Reports are renowned as a frequent and accurate source of information on incidents involving service vessels, e.g. impacts with rigs.

Data for Crane Operations

SINTEF (1989, ref.38) presents a method to assess the probability of dropped objects causing damage to subsea facilities. As part of this method, estimates of drop probability are established on the basis of past accident reports and expert judgement. Actual data are drawn mainly from the UK sector from sources such as *The Brown Book* (ref.28). The data are general (average over a large number of platforms) and provide no indication of the contribution of human error.

4.0 PROJECTS IN PROGRESS AND FORTHCOMING EVENTS

While researching the latest developments in human factors in offshore operations, several projects and conferences have been identified as potential sources of future information. These are included in the review as they are likely to represent the 'state of the art', even though no reports or proceedings are yet available.

The Robert Gordon University (RGU), Aberdeen is conducting several human factors projects for the offshore industry, the results of which will be published by HSE. The topics of these studies include analysing stress in survival course trainees; application of information technology to training; and risk perception in offshore workers. RGU has organised a conference "Understanding Risk Perception", Aberdeen, February 2nd 1995, where the findings of the study will be presented.

HSE continues to fund studies by the Department of Experimental Psychology, Oxford University into human factors, shift work and alertness in the offshore oil industry. Other human factors projects commissioned by HSE include a human factors analysis of drilling control (report at approval stage) and a study on physical selection for rescue craft crew.

Conferences recently organised by IBC Technical Services Limited include "Task Analysis for Industry", London, December 6th 1994, and "Drilling Technology Conference", November 24th 1994.

Incident and Accident Data

Incident data collection is an increasingly important issue in the UK. The HSE is currently in the process of amalgamating incident data from all industries into a single database and is keen to extend industry's obligations for incident reporting to cover 'near-misses' as well as 'major incidents'. In the offshore industry, the role of the UKOOA/HSE Failure Rate Data working group includes human error data but at present the group is focussing on hydrocarbon equipment leak data.

5.0 CURRENT APPLICATIONS OF TECHNIQUES

There is evidence to suggest that the qualitative and pragmatic methods of task observation and analysis have found some application in the offshore industry, though their use is by no means widespread. A criticism of these techniques is that although they indicate where deficiencies in human factors may have an adverse influence on the safe execution of tasks, they do not provide sufficient information to effectively address the problems identified. All too often, results indicate a need for more training, better procedures, greater competence, etc., but are not specific in terms of the *level* of improvement that would be considered sufficient.

Other, fundamental criticisms of current techniques include:

- several techniques are based on models of human failure that are yet to be validated; and
- with the apparent exception of the Influence Diagram Approach, techniques generally model performance shaping factors as independent, when in fact this may not be the case.

To gain acceptance, techniques must demonstrate the benefits of introducing change and that such measures will prove to be cost-effective. However, as Atallah, Shah & Betti (1990, ref.22) points out, no studies are available to show the link between performance shaping factor modification and reduction in human error probability. This makes it difficult to perform meaningful cost-benefit analysis.

As described above, there is a general lack of data on human error probabilities in the public domain. This may be attributed to:

- the 'denominator problem', i.e. estimating the number of opportunities for errors to occur in real tasks;
- confidentiality and unwillingness to publish data relating to poor performance; and
- lack of awareness of the usefulness of data collection.

However, regulatory bodies are taking a keener interest in the reporting of incidents and of the human factors contributing to the causes. The Norwegian Petroleum Directorate is already actively addressing this problem in the Norwegian offshore industry. In the UK, HSE is also eager for improved reporting of incidents, although at present, apart from major incidents (deaths, serious accidents and dangerous occurrences), incident data is provided mostly on a voluntary basis.

Other potential sources of human error probabilities are simulator data and lab-based studies. However, these data are obtained in artificial environments, so their applicability to real situations is questionable.

It may also be possible to translate human error data from other industries. Potential sources include the nuclear industry and the Gulf of Mexico offshore industry.

Due, in part, to the paucity of human reliability data, several of the techniques featured in the review have been developed to generate human error probabilities (HEPs) as input

to quantitative risk assessment (QRA). These methods are generally perceived as too subjective and not entirely appropriate in meeting the data requirements of QRA. They have found little application in the UK offshore industry and so, in the absence of any 'hard' data, there has been a general reluctance to perform quantitative analyses.

6.0 CONCLUSIONS

The literature review has covered a broad subject area and features much of the most current information available. It has focussed on identifying references to techniques which may be used to assess the impact of human factors on the safety of offshore activities. Sources of offshore incident and accident data have been examined, though it has been discovered that these seldom provide information concerning the contribution of human failure.

There has been an apparent reluctance within the UK offshore industry to perform human factors assessments. This may be attributed to a number of factors:

1. human reliability data specific to offshore activities are scarce;

2. as a consequence, quantitative assessment relies heavily on expert judgement and is therefore perceived as time consuming, subjective and difficult to validate;

3. in terms of practical risk management, results have proved of little use in improving the control of hazards; and

4. there is an apparent lack of validation, theoretical or otherwise, for techniques in general.

TABLE 1. ORGANISATIONS CONTACTED

	Establishment	Contact Name	Address/ Phone	Comments
	IBC Technical Services Ltd	Sarah Ashmore	Gilmoora House, 57-61 Mortimer Street, London, W1N 7TD 071-637-4383	Organisers of *Task Analysis for Industry (6/12/94)*. First HF conference they've organised.
	IBC Technical Services Ltd	Oil & Gas Div. Helen Smith	Gilmoora House, 57-61 Mortimer Street, London, W1N 7TD 071-637-4383	Organisers of *Drilling Technology Conference* (24/11/94). Also: *Offshore Drilling Technology.*
	BICS International Conferences	Owain Jenkins	Oil & Gas Section, City Headquarters, 1st Floor, Chandos House, 12-14 Berry Street, London, EC1V 0AQ. 071-336-7988 (direct line)	Organisers: *Incorporating Human Factors into Offshore Safety Cases.*
	University of Birmingham	Barry Kirwan	Human Factors Dept 021-414-4247 (direct line)	Helpful. Source of further contacts and references.
	Techword Services	Michael Wright	0442 257635	Publishers of Offshore Research Focus - HSE, OSO, Matsu funded research.
	Taylor & Francis		071-405-2237	Technical publishers renowned for their ergonomics series.
	Safety and Reliability Society	Charlie Farnell	Clayton House, 59 Piccadilly, Manchester, M1 2AQ Tel: 061-228-7824 Fax: 061-236-6977	Sent list of relevant SaRS Proceedings.
	Institute of Chemical Engineers	Helen Langham (Library)	Davis Building, 165-171 Railway Terrace, Rugby, CV21 3HQ Tel: 0788 578214 Fax: 0788 560833	Performed literature search of "human factors" - IChemE databases.
	HSE	Enquiries	Information Centre, Broad Lane, Sheffield, S3 7HQ. Phone: 0742-892345 Fax: 0742-892333	Compiled list of relevant publications
	HSE OSD	Chris Dykes	Aberdeen 0224-252500	Helpful. Source of information on well control.
	HSE OSD	Stephen Connelly	Bootle 051-951-4000	Concerned with UK offshore incident statistics and accident data.

TABLE 1. ORGANISATIONS CONTACTED

	Establishment	Contact Name	Address/ Phone	Comments
	HMSO		Publications Centre, PO Box 276, London, SW8 5DT. 071 873 0011	Sent list of relevant HMSO publications
	British Lending Library	Garth Frankland	Tel: 0937 546809	Document supply service

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
1	HSE	1989	Human Factors in Industrial Safety....An Examination of the Roles of Organisations, Jobs and Individuals in Industrial Safety and a Practical Guide to Control. 4th impression HS(G)48. {London: HMSO}	8 publications recommended for further reading	EQE
2	Engineering Council	1993	Guidelines on Risk Issues	Several other refs.	HZ
3	Wreathall,J.	1993	Human Factors and Process Safety. *International Conference and Exhibition on Safety, Health and Loss Prevention in the Oil, Chemical and Process Industries, Singapore, 15-19 Feb.* {London: Butterworth-Heinemann} p.82-91		EQE
4	Donald,I.J, Canter,D.V, Chalk,J.R, Hale,A.R, and Gerlings,P.	1991	Measuring Safety Culture and Attitudes. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Questionnaire to assess safety culture and attitudes in organisations. Developed from UK steel & chemical industries. Based upon extensive review of organisational & HF literature. Correlation with safety record. 0 references	EQE
5	Embrey,D.E.	Oct 89	The Management of Risk Arising from Human Error. *Human Reliability in Nuclear Power.* {IBC Technical Services}	Preprint Discusses organisational conditions which can lead to system failures. Introduces an audit-based methodology for assessing organisational integrity. 0 references	SCH
6	Bellamy,L.J, and Geyer,T.A.W.	1992	Organisational Management and Human Factors in Quantified Risk Assessment, Report 1. HSE Contract Research Report No. 33/1992.		Ab.Uni
7	Harrison,P.I.	1992	Organisational, Management and Human Factors in Quantified Risk Assessment, Report 2. HSE Contract Research Report No. 34/1992.	Development of audit question set with a view to taking account of management factors in QRA. About 50 references	DIB

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
8	Waterfall,K.W, Tjeenk Willink,C.A, and Milne,D.J.	1994	Incident Investigation and Analysis for Exploration and Production Operations.*Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	0 references	EQE
9	Hudson,P.T.W, Primrose,M.J, and Edwards,C.	1994	Implementing Tripod-DELTA in a Major Contractor. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	Design Evaluation Tool for Accident Prevention. Establishes human error causes of incidents. Concentrates on latent failures. Implications of extending access to contractors 3 references	EQE
10	Hudson,P.T.W. *et alia.*	1991	Enhancing Safety in Drilling: Implementing TRIPOD in a Desert Drilling Operation. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Essentially an organisational audit based on theory of accident causation. Paper describes theory, results of application in desert drilling operations and implementation experience. 4 references	EQE
11	Hudson,P.T.W. *et alia*	1991	Application of TRIPOD to Measure Latent Errors in North Sea Gas Platforms: Validity of Failure State Profiles. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	TRIPOD applied to gas prod'n platforms on Dutch CS. Analyses of 10 recent accidents were compared to failure state profiles generated from interviews to validate the TRIPOD technique. 3 references	EQE
12	DeJoy,D.	May 90	Toward a Comprehensive Human Factors Model of Workplace Accident Causation. *Professional Safety.* May 1990, p.11-16.	Describes a framework for comprehensive human factors assessment. Refers to models/ tools that could be incorporated. 38 references	DIB
13	Kirwan,B.	1990	Human Reliability Assessment. Chapter 28 of *Evaluation of Human Work.* (eds: Wilson,J.R, and Corlett,N.) {London: Taylor & Francis}	57 references	SCH

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
14	Hashemi,K.	1992	Human Factor Considerations in Safety Techniques and Management. *Seminar on The Practicalities and Realities of Human Factors in Offshore Safety, 30 Sept - 1 Oct, 1992.*	Preprint.	EQE
15	Kirwan,B, and Ainsworth,L.K. (editors)	1992	A Guide to Task Analysis {Taylor & Francis}	Principal book on task analysis	Ab.Uni
16	Williams,J.C, and Munley,G.A.	1992	Human Error Identification - a New Approach. *PSA/PRA, Safety and Risk Assessment, IBC, London, 3/4 December 1992.*	Preprint 44 references	DIB
17	Kirwan,B, Embrey,D.E, and Rea,K.	1988	The Human Reliability Assessors Guide. Report RTS 88/95. Compiled by Human Factors in Reliability Group (HFRG). Sponsored by National Centre of Systems Reliability (NCSR). {SRD, UKAEA, Culcheth, Cheshire}		ABR
18	Embrey,D.E.	Post 1990	Managing Human Error in the Offshore Oil and Gas Industries.	Conference paper (preprint?) 12 references	SCH
19	Willis,D, and Deegan,F.	1994	HAZOP of Procedural Operations.*Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	2 references	EQE
20	Kile,H, and Magnusson,T.	1994	Practical System for Identification of Potential Hazards and Performance of Risk Analysis in Oil and Gas Operating Environments: Norwegian Approach. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	8 references	EQE

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Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
21	Hahn,H.A, Blackman,H.S, and Gertman,D.I.	1991	Applying Sneak Analysis to the Identification of Human Errors of Commission. *Reliability Engineering and System Safety.* v33, p.289-300.	Sneak analysis to identify human error, demonstrated by nuclear industry case study. 4 references	SCH
22	Atallah,S, Shah,J.N, and Betti,M.	20/4/90	Reduction of LNG Operator Error and Equipment Failure Rates. {Chicago: Gas Research Institute} GRI Rep.No.90/0008	HEPs derived from incident records and generic data. Discusses problem of accounting for reduced HEPs in cost-benefit analysis. 4 references	WWC
23	PETEX	1980	Blowout Prevention, 3rd Edition	0 references	Ab.Uni
24	Wand,P.A, and Rasmus,J.C.	1994	An Integrated Approach to Minimizing Risk While Drilling. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	13 references on well control	EQE
25	Bamford,A.S, and Zhihua Wang	1994	Well Control Simulation Interfaced with Real Rig Equipment to Improve Training and Skills Validation. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	Well control training. Reports on system trials in laboratory. About to go on trial in the field. 5 references to well control simulation	EQE
26	Jolly,C.W, and Woodall-Mason,N.W.	1994	Safety in Cargo Handling. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	In response to a spate of incidents, a 'Business Process Analysis' was applied to reduce accident rate. Accident event trees assisted in identifying root causes of accidents, leading to improvements in hardware, procedures and organisation. 1 reference	EQE
27	Gibson,V.	1992	Supply Vessel Operations {Butterworth-Heinemann}	Functions of supply vessels, including ship handling; anchor handling; towing; emergency duties. 12 recommendations for further reading	Ab.City

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
28	Department of Energy, London	Annual Report	Development of the Oil & Gas Resources of the United Kingdom. "The Brown Book" {London: HMSO}	0 references	Ab.Uni
29	HSE Offshore Safety Division	1994	1993 Offshore Accident and Incident Statistics. OTO-94-010	Successor to "Brown Book". Incidents reported by severity (4 categories); operation (10 types) and broad incident type (17 categories). No indication of contribution of human error.	EQE
30	OREDA	1992	Offshore Reliability Data, 2nd Edition	6 references	EQE
31	WOAD	1992	Worldwide Offshore Accident Databank.	Offshore accident statistics covering period 1970-91. Contribution of human errors not specified	EQE
32	Ynnesdal,H, and Bentsen,B.A.	1994	Information System for Exchange of Experiences from Accidents and Incidents Among Oil Companies and Contractors.*Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	"Synergy" pilot scheme: registration and analysis of events affecting health, safety and environment. Norwegian experience. 2 references	EQE
33	Azambre,J.	1991	Accident Analysis: A Tool for Safety Management. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Total's Occupational Accident Analysis and Reporting (OCAAR) System. Identifies and records root causes of accidents, including human factors, procedural factors, technical defects, etc. 0 references	EQE
34	Baker, Bob	1992	Drilling System Developments Reduce Risks Offshore. *The Impact of Technical Developments on Safety Cases. London, 19 Mar.* {IBC Technical Services}	One of 9 papers. Review of trends in drilling accident causation and risk reduction methods. Some incident and accident statistics.	RGU

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Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
35	Aarestad,T.V.	1994	Challenges in Planning, Drilling and Testing HPHT Wells. *Offshore International*	Norwegian initiative for information and data exchange. Objectives: detail problems known to have occurred; investigate reason for deficiencies (including human factors); safer & more efficient drilling thru equip technology & procedures. Presents some kick frequency data. 1 reference.	EQE
36	Oil Industry International Exploration & Production Forum	May 92	Hydrocarbon Leak and Ignition Database. Report11.4/180	Contains entire appendix on blowout frequency. Approximately 10% of wells in database are European, i.e. UK, Norway, the Netherlands and Denmark. Data are divided between well control problems and uncontrolled blowouts.	EQE
37	Offshore Technology Report	1987	The Performance of Attendant Vessels in Emergencies Offshore. OTH 87 274 {London: HMSO}		EQE
38	SINTEF	22/9/89	Dropped Objects on Subsea Installations	30 references	EQE
	-	1991	*First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	2 volumes Several papers of interest - in addition to those described above, proceedings contain several papers on HS&E auditing	EQE
	-	1994	*Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	2 volumes 9 papers of interest	EQE
	-	1993	*International Conference and Exhibition on Safety, Health and Loss Prevention in the Oil, Chemical and Process Industries, Singapore, 15-19 Feb.* {London: Butterworth-Heinemann}	One paper of interest - Wreathall (1993)	EQE

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Amato,F.S, Resweber,L.R, and Jones,M.A.	1991	Facilities Design Focus for Health, Safety, and Environment: Compliance and Compliance Monitoring. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Paper illustrating Shell's new approach to design (applied to Shell's first TLP). Human factors engineering introduced at design stage. 0 references	EQE
	Bailey,R.W.	1982	Human Performance Engineering: A Guide for Systems Designers {Prentice Hall} ISBN 0-1344-5332-4	Basic textbook pooling together the experience of human factors department of Bell Laboratories. HF explained in simple terms with many examples. Briefly describes role of function analysis and task analysis in defining human performance requirements and allocation of work in system design. Practical advice on collecting information (questionnaires, interviews, etc)	Ab.Uni
	Bainbridge,L, Lenior,T.M.J, and van der Schaaf,T.W. (eds)	1993	Cognitive Processes in Complex Tasks. Special Edition of *Ergonomics*, v36, n11.	Recent collection of 16 papers devoted to cognitive human factors (operating personnel)	Ab.Uni
	Battmann,W, and Klumb,P.	1991	Behavioural Economics and Safety. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Conditions that produce errors of violation explained in 'behavioural economics' terms: 1) unclear or conflicting constraints; 2) delayed or missing feedback; 3) conflicts between high-level and low-level safety commitments. 17 references	EQE
	Bourne,A.J, Edwards,G.T, Hunns,D.M, Poulter,D.R, and Watson,I.A.	Jan 81	Defences Against Common-Mode Failures in Redundancy Systems. A Guide for Management, Designers and Operators. SRD R 196 {London: HMSO}	Qualitative guidance on design and operation of redundancy systems to provide defences against common mode failure. 4 references	EQE

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Chiles,W.E.	May 92	Chiles' Tank Analysis Improves Safety, Quality. *Drilling Contractor.*	Describes how task analysis has been applied by Chiles Offshore Corp. 0 references	SJL
	CONCAWE	Dec 93	Catalogue of CONCAWE Special Interest Reports	Rep.No.93/60. Nothing except 88/56 (see below).	EQE
	CONCAWE	Dec 93	Catalogue of CONCAWE Reports	Rep.No.3/93. Nothing	EQE
	CONCAWE	Jul 88	Quantified Risk Assessment	Rep.No.88/56. General discussion of HF in QRA. 0 references	EQE
	Cracknell,D.	1993	Audit and the Living Safety Case. *Offshore Safety Cases: The Living Documents - Where Next? London, 1-2 Dec.* {IBC Technical Services}	One of 13 papers. British Gas E&P's philosophy, methodology and programme for conducting safety audits.	RGU
	Edwards,G.T, and Watson,I.A.	Jul 79	A Study of Common Mode Failures. SRD R 146 {London: HMSO}	Operator error discussed in the context of common mode failure.	EQE
	Fitzgerald,B.P, Green,M.D, Penington,J and Smith,A.J.		A Human Factors Approach to the Effective Design of Evacuation Systems. *Loss Prevention Bulletin*, n.97 {Rugby: IChemE}, p.13-22.	Discusses human behaviour in emergencies and issues to be considered in design of evacuation systems. Also published in "Piper Alpha: Lessons for Life-Cycle Safety Management".	EQE (SJL)
	Flak,L.H, Wright,J.W, and Tuppen,J.A.	Dec 93	Blowout Control: Response, Intervention and Management. Part 2 - Logistics. *World Oil*	Access to special services and equipment & materials through pre-contracting, communication and transport. 1 reference	RJT
	Flak,L.H, and Gloger,D.	Jul 94	Blowout Control: Response, Intervention and Management. Part 8 - Case History: Control of an Offshore HPHT Underground Blowout. *World Oil*	Case history of a successful blowout kill	RJT
	Flak,L.H, and Tarr,B.A.	May 94	Blowout Control: Response, Intervention and Management. Part 6 - Underground Blowouts Between Subsurface Intervals and can Result in a Significant Escalation Threat if not Recognised Quickly and Controlled Correctly. *World Oil*	Basic info on how to recognise an underground blowout and methods that can be used to regain well control. 4 references	RJT

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Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Flak,L.H, Wright,J.W, and Ely,J.	Nov 93	Blowout Control: Response, Intervention and Management. Part I - Strategy and Planning. *World Oil*	Proactive management contingency planning - roles & responsibilities. 1 reference	RJT
	Grepinet,M, and Flak,L.H.	Jun 94	Blowout Control: Response, Intervention and Management. Part 7 - After Underground Blowouts, Shallow Gas Blowouts are the Second Most Common Type of Blowout and the Most Common Type of Surface Blowout. *World Oil*	Dangers particular to shallow gas; selection of rigs; choice of diverters; preferred approach; special training needs; disaster mitigation requirements. 15 references	RJT
	Hashemi,K.	1991	An Integrated Approach to a Safety Case. *Conference in Human Factors in Offshore Safety, Aberdeen, 23/24 April, 1991.*	Preprint Integration of SMS within QMS. 0 references	DIB
	Jones,A.	1991	Human Factors and Command Control - Emergency Planning. *3rd North Sea Safety Conference, London, 30/10/91.*	Organisers: Technology Forum, HSE. No model. Some terminology; general discussion of contingency planning. 0 references	RJT
	Keen,E.	1980	Blowout Prevention, Short Course Manual	PETEX course. 0 references	Ab.Uni
	Kirwan,B, and James,N.	1989	The Development of a Human Reliability Assessment System for the Management of Human Error in Complex Systems. *Proceedings of Reliability '89.* Vol.2, Paper 5A/2	BNFL Human Reliability Management System (HRMS). Integrated framework. Modules for task analysis; human error identification; quantification; documentation and QA.	EQE
	Marine Accident Investigation Branch, DoT.	1992	Annual Report. {London, HMSO}	Merchant shipping accident statistics	WFV

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Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Pennycook,W.A, and Danz-Reece,M.E.	1994	Practical Examples of Human Error Analysis in Operations. *Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	Analysis tool developed for operating personnel to reduce potential for human errors in their work. Systematically identifies factors that contribute to errors so personnel may address fundamental causes. Overview; test applications; lessons learnt; common problems identified; benefits. 8 references	EQE
	Pertamina,R. *et alia*	1991	Personal, Place, and Time Characteristics of Offshore Accidents in Five Oil Companies Operating in Indonesis. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Presents some coarse statistics to demonstrate broad trends. Accident records analysed in terms of 20 personal, time and place variables. 1 reference	EQE
	Price,H.E, Maisano,R.E, and Van Cott,H.P.	Jun 82	The Allocation of Functions in Man-Machine Systems: A Perspective and Literature Review. NUREG/CR-2623 {Oak Ridge National Lab.}	Context: Nuclear power plant control rooms. Criteria for assessing design proposals for automated systems. Method of evaluating impact on safety.	SCH
	Raman,J.R, Gargett,A, and Warner,D.C.	1991	Application of HAZOP Techniques for Maintenance Safety on Offshore Installations. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Framework for applying batch HAZOP techniques to offshore (focus on topside processes) maintenance procedures. Suggests guidewords specific to PTW; preparation for maintenance; maintenance activity; handback & restart. Proposed use - design of maintenance manuals, procedures. 4 references	EQE
	Recht,J.L.	1965?	Systems Safety Analysis - A Modern Approach to Safety Problems. Collection of articles.	Reprinted from *National Safety News.* {National Safety Council, Chicago, Illinois} Includes description of THERP 10 references, all 1962-1965.	DIB

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Rike,J.L, Whitman,D.L, Rike,E.R, and Hardin,L.R.	Nov 93	Why Workover and Drilling Well Control Needs Differ. *World Oil*	Differences in well control between completion/workover and drilling operations	RJT
	Salvato,S.J, and Flak,L.H.	Jan 94	Blowout Control: Response, Intervention and Management. Part 3 - Insurance. *World Oil*	Control-of-well insurance coverage - policies available & what can be covered. 3 refs.	RJT
	Salvendy,G.(ed)	1987	Handbook of Human Factors {New York: Wiley}	66 chapters written by 103 people gathering information from 3850 references.	Ab.Uni
	Senders,J.W, and Moray,N.P.	1991	Human Error: Cause, Prediction and Reduction {Lawrence Erlbaum Assoc} ISBN 0-89859-593-3	Account of how human error as a subject has evolved. Philosophical. Taxonomies. 15 references	Ab.Uni
	Shrimpton,M, and Storey,K.	1994	Human Factors and Health and Safety in Offshore Oil Operations: Relationships and Management Options.*Second International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Jakarta, 25-27 Jan.* {Society of Petroleum Engineers}	Review of some Canadian, European and Australian research into impact of organisational level human factors. 16 references	EQE
	Smestad,P, Rygg,O.B, and Wright,J.W.	Apr 94	Blowout Control: Response, Intervention and Management. Part 5 - Hydraulics Modelling. *World Oil*	Matching known downhole well info with surface flow characteristics allows selection of most efficient kill method.	RJT
	Smith,A.J.	1991	The Importance of Safety Management Systems within Formal Safety Assessments. *Offshore Safety Cases: Preparation and Implementation. London, 18-19 Nov.* {IBC Technical Services}	One of 16 papers. Management and organisational influences in maintenance of adequate safety standards. SMS auditing and implementation.	RGU

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Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Sutherland,V.J.	1991	Occupational Stress and Accidents Offshore. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	One year survey of offshore personnel to: examine sources of stress; examine links between stress, personal factors and previous accident involvement; investigate individual differences as a function of occupational status, type, size & location of installation. 13 references	EQE
	Wright,J.W, Woodruff,J.F, and Thompson,D.	Mar 94	Blowout Control: Response, Intervention and Management. Part 4 - Documented Blowout Contingency Plans. *World Oil*	Emergency management & response system to reduce vulnerability to blowout. 1 ref.	RJT
	Young,D.R.	1991	Psychological Factors in Safety Performance. *First International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, The Hague, 11-14 Nov.* {Society of Petroleum Engineers}	Discusses psychological characteristics of both individuals and groups in context of health and safety offshore. 4 references	EQE

TABLE 2A. PUBLICATIONS OBTAINED AND REVIEWED BY EQE

LEGEND - SOURCES

Ab.City	Aberdeen City Library
Ab.Uni	Aberdeen University Library
ABR	Alan Reeves, EQE Warrington.
AL	Andrew Lidstone, EQE Warrington.
DIB	Derrick Bentham, EQE Aberdeen
EQE	EQE Aberdeen Office Library
HZ	Dr Zerkani, Aberdeen University
MGH	Martin Holley, EQE Aberdeen
RGU	Robert Gordon University Central Library
RJT	Rod Travis, EQE Aberdeen
SCH	Suzanne Hill, EQE Warrington Office Library.
SJL	Steve Lewis, EQE Aberdeen
WFV	Bill Venn, EQE Aberdeen
WWC	Bill Cohea, EQE Houston

TABLE 2B. PUBLICATIONS OBTAINED BY EQE - NOT REVIEWED

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	-	Oct 1975	Reactor Safety Study: An Assessment of Accident Risks in US Commercial Nuclear Power Plants. {Nuclear Regulatory Commission}. Report No. WASH-1400.		SJL1
	-	1989	*Proceedings of Reliability '89.*	Other papers of interest?	EQE
	-	Sept 1986	Proceedings of *Human Reliability Assessment*, London, 9-10 Sept 1986. {IBC Technical Services Limited}	Several papers of interest	SJL2
	-	1991	*Technology Assessment and Research Program for Offshore Minerals Operations, 1991 Report.* {US Minerals Management Service}.	OCS Study MMS 91-0057	WWC
	Ball,P, *et alia*	Feb 1985		Qualitative ergonomic guidelines intended for use by management. Essentially an audit/ design checklist.	SJL2
	Bea,R.G, and Moore,W.H.	1991	Management of Human Error in Operations of Offshore Platforms. *Technology Assessment and Research Program for Offshore Minerals Operations, 1991 Report.* {US Minerals Management Service}.	OCS Study MMS 91-0057	WWC
	Bea,R.G, and Moore,W.H.	1994	Reliability Based Evaluations of Human and Organizational Errors in Reassessment and Requalification of Platforms. *International Offshore Mechanics and Arctic Engineering Conference, Safety and Reliability Symposium, Houston, Feb 1994.*		WWC
	Bell,B.J, and Swain,A.D.	1983	A Procedure for Conducting a Human-Reliability Analysis for Nuclear Power Plants. NUREG/CR--2254.		SJL3

TABLE 2B. PUBLICATIONS OBTAINED BY EQE - NOT REVIEWED

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Drury,C.G, Paramore,B, Van Cott,H.P, Grey,S.M, and Corlett,E.N.	1987	Task Analyis. In *Handbook of Human Factors*, Salvendy,G.(ed), p.370-401.		Ab.Uni
	HSE	1983	Sizewell B: A Review by HM Nuclear Installations Inspectorat. Report NII 01, Supplement 13: Human Factors		SJL2
	Hunns,D.M, and Daniels,B.K.	July 1980	The Method of Paired Comparisons. *6th Advances in Reliability Technology Symposium, University of Bradford.* {National Centre of Systems Reliability, UKAEA, Warrington} NCSR R23 Vol.1, p.31-71.		SJL1
	Hunns,D.M.	April 1982	Psychology of Communications. *7th Advances in Reliability Technology Symposium, University of Bradford.* {National Centre of Systems Reliability, UKAEA, Warrington}.		SJL1
	Kirwan,B, Martin,B, Rycraft,H, and Smith,A.	Apr 1990	Human Error Data Collection and Data Generation. *11th Advances in Reliability Technology Symposium, Liverpool, April 1990.* Preprint		SJL2
	Laughery,K.R,Sr. and Laughery,K.R, Jr.	1987	Analytic Techniques for Function Analysis. In *Handbook of Human Factors*, Salvendy,G.(ed), p.329-354.		Ab.Uni
	Livingston,A.D, Wright,M.S, and Embrey,D.E.	?	The Application of Task Analysis and Human Error Analysis to the Development of Operating Instructions in a Batch Chemical Process Plant.	Authors from Human Reliability Associates Ltd. Preprint, p13 & Fig 1 missing.	DIB
	McCormick,E.J, and Sanders,M.S.	1982	Human Factors in Engineering and Design. Fifth Edition. {McGraw Hill} ISBN 0-0704-4902-3	Classic text on ergonomics for man-machine interface in design.	Ab.Uni

TABLE 2B. PUBLICATIONS OBTAINED BY EQE - NOT REVIEWED

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Miller,D.P, and Swain,A.D.	1987	Human Error and Human Reliability. In *Handbook of Human Factors*, Salvendy,G.(ed), p.235-250.		Ab.Uni
	Moore,W.H, and Bea,R.G.	1993	Human Organizational Error in Operations of Marine Systems: Occidental Piper Alpha. *Offshore Mech & Arctic Eng Conf, Glasgow, 20-24 June - Volume II, Safety and Reliability.* p.21-29	3-28-D-002	WWC
	Moore,W.H, Bea,R.G, and Roberts,K.H.	1993	Improving the Management of Human and Organizational Errors (HOE) in Tanker Operations. *Ship Structures Symposium, Arlington, Virginia, Nov 16/17.*	3-28-D-002 Conference sponsors: Soc of Naval Architects & Marine Engs; The Ship Structure Committee.	WWC
	Reason,J.		Catastrophic Combinations of Trivial Errors. In *Psychology of Occupational Safety and Accidents* (Eds: Cox,T, Cox,S, and MacKay). Preprint - May 1985		SJL1
	Reason,J.T.	1990	Human Error {Cambridge University Press}	Referred to by Ref.9	Ab.Uni
	Samantha,P.K, O'Brien,J.N, and Morrison,H.W.	1985	Multiple-Sequential Failure Model: Evaluation of and Procedures for Human Error Dependency. NUREG/CR--3837		SJL3
	Sayers,B.A.(ed)	1988	Human Factors and Decision Making: Their Influences on Safety and Reliability. *Safety and Reliability Society Symposium, Altrincham.* {Chapman & Hall}	Several papers of interest	Ab.Uni
	Simiu,E. (Editor)	Apr 92	*Reliability of Offshore Operations: Proceedings of an International Workshop.*	NIST Special Publication 833	WWC
	Swain,A.D, and Guttmann,H.E.	1983	Handbook of Reliability Analysis with Emphasis on Nuclear Power Plant Applications {Sandia Labs, Albuquerque, NM}. NUREG/CR-1278.		SJL1

TABLE 2B. PUBLICATIONS OBTAINED BY EQE - NOT REVIEWED

Ref. No.	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	Summary/Comments	Source
	Tepas,D.I, and Monk,T.H.	1987	Work Schedules. In *Handbook of Human Factors*, Salvendy,G.(ed), p.819-843.		Ab.Uni
	Waters,T.L.	1988	Human Reliability Analysis Methods. *International Approach to Nuclear Safety (after Three Mile Island and Chernobyl)*, Blackpool, 8-10 June 1988. Preprint.		SJL2
	White,R.F.	Mar 1984	A Suggested Method for the Treatment of Human Error in the Assessment of Major Hazards. SRD R 254. {UKAEA, Warrington}		SJL2
	Whitfield,D.	1986	Meeting Report: *International Topical Meeting on Advances in Human Factors in Nuclear Power Stations, Knoxville TN, 21-24 April 1986.*	Summary of presentations giving overview of human factors R&D worldwide (1986)	SJL1
	Williams,J.C.	1988	A Data-Based Method for Assessing and Reducing Human Error to Improve Operational Performance. *IEEE 4th Conference on Human Factors in Power Plants, Monterey, California, 6-9 June 1988.*	"... The HEART Methodology Explained"	DIB

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HZ	Dr Zerkani, Aberdeen University
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RGU	Robert Gordon University Central Library
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SCH	Suzanne Hill, EQE Warrington Office Library.
SJL	Steve Lewis, EQE Aberdeen
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WWC	Bill Cohea, EQE Houston

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
*	-	1992	*The Practicalities and Realities of Human Factors in Offshore Safety, Aberdeen, 30 Sep. - 1 Oct.* {Business Seminars International}	
	-	Mar 1994	*Incorporating Human Factors into Offshore Safety Cases.* {BICS International Conferences}	
	-	1992	*Major Hazards Onshore and Offshore, Manchester, 20-22 Oct.* {IChemE Symposium Series No.130}	0-8529-5283-X
*	-	1990	*Reliability Engineering and System Safety*, v29, n3.	
	ACSNI	1993	Advisory Committee on Safety of Nuclear Installations: Study Group on Human Factors {HMSO}	
*	AIChE	1994	Guidelines for Preventing Human Error in Process Safety {AIChE}	0-8169-0461-8
	AIChE	1994	Integrating Human Factors into Process Safety Management (AIChE}	
*	Arizono,N, *et alia*	1993	Crane Operation Support System. *R & D: Research and Development*, v43, n1, p47-50	
	Ball,P. (ed)	1991	The Guide to Reducing Human Error in Process Operations {HMSO}. Human Factors in Reliability Group. SRDA-R3	
	Bellamy,L.J, and Geyer,T.A.W.	1991	Incorporating Human Factors into Formal Safety Assessment: The Offshore Safety Case. *3rd BHR Group Ltd. Management and Engineering of FIre Safety and Loss Prevention Int. Conf, Aberdeen,18-20 Feb.* p.55-63	
	Bellamy,L.J, Kirwan,B, and Cox,R.A.	1986	Incorporating Human Reliability into Probabilistic Risk Assessment. *5th Int. Symp in Loss Prevention and Safety Promotion in the Process Industries.* {Societe de Chimie Industrie}	
	Bellamy,L.J.	Jul 85	How People's Behaviour Shapes Your Plant Operation. *Process Engineering.*	
*	Bodsburg,L.	1993	Comparative Study of Quantitative Models for Hardware, Software and Human Reliability Assessment. *Quality and Reliability Engineering International*, v9, n6, p.501-518	
	Cacciabue,P.C.	1993	Methodology of Human Factors Analysis for Systems Engineering. *Proc.1993 Int. Conf. on Systems, Man and Cybernetics, Le Touquet, France.* Part 1 (of 5). {IEEE}	

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
*	Carey,M.S, and Bennett,G.R.	1992	Addressing Human Factors Throughout the Safety Lifecycle of an Installation. *Inst. Marine Eng. et al Offshore Safety: Protection of Life and the Environment Int. Conf, London,* 20,21 May. p.47-56	
	Comer,M.K, Seaver,D.A, Stillwell,W.G, and Gaddy,C.D.	1984	Generating Human Reliability Estimates Using Expert Judgement. USNRC Report NUREG/CR-3688. {Washington DC: USNRC}	
*	Comer,P.J, Fitt,J.S, and Ostebo,R.	1986	A Driller's HAZOP Method. *Society of Petroleum Engineers European Conference, London, Oct 86.* SPE 15867	
	Cox,R.F, and Walter,M.H. (editors)	1991	*Offshore Safety and Reliability.* Proceedings of Safety and Reliability Society Symposium, Sutton Coldfield, 18-19 Sept. {London: Elsevier}	1-8516-6708-3
	Cranfield & DNV	1982	Safety Shutdown Systems on Offshore Installations: A Joint Research Project Carried Out by Cranfield Institute of Technology and Det Norske Veritas. {Stavanger: Oljedirektoratet}	
	David,G.D.	1984	Ergonomic Design Could Promote Safer Drilling. *Oil and Gas Journal, December 10.* p.95-98, 103	
	Dhillon,B.S.	1990	Human Error Data Banks. *Microelectronics and Reliability,* v30, n5, p.963-971	
*	Drury,C.G.	1983	Task Analysis Methods in Industry. *Applied Ergonomics,* v14, p.19-28	
*	Eide,E, Hage,J.I, Burge,P.M, Jurgens,J, and Hughes,B.	1993	The Application of Slim-Hole Drilling Techniques to High-Temperature and High-Pressure Exploration Programs in the North Sea. *Proc. Soc. Pet. Eng. Annual Technology Conference and Exhibition, Houston.* Part 2 (of 5). p.259-268	
	Embrey,D.E, and Kirwan,B.	1983	A Comparative Evaluation Study of Three Subjective Human Reliability Qualification Techniques. *Proc. Ergonomics Soc. Conf. 1983.* Coombes,K. (Ed) {Taylor & Francis} p.137-141	
	Embrey,D.E.	1992	Managing Human Error in the Chemical Process Industry. *International Conference on Hazard Identification and Risk Analysis: Human Factors and Human Reliability in Process Safety.* {Center For Chemical Process Safety}. p.399-413	
	Etherton,J.J.(ed)	1986	Sources of Information for the Offshore Industry {Institute of Petroleum}	

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
	Fitzgerald,B.P, Green,M.D, Penington,J, and Smith,A.J.	1991	A Human Factors Approach to the Effective Design of Evacuation Systems. *Loss Prevention Bulletin*, n97, p.13-22	
	Gertman,D.I, Blackman,H.S, Haney,L.N, Seidler,K.S, and Hahn,H.A.	1992	INTENT: A Method for Estimating Human Error Probabilities for Decision-Based Errors. *Reliability Engineering and System Safety*, v35, p.127-136.	
*	HSE	1990	Study Group on Human Factors First Report on Training and Related Matters	0-1188-5695-2
*	HSE	1993	Human Factors, Shift Work and Alertness in the Offshore Oil Industry. Offshore Technology Report OTH 92 389.	0-1188-2135-0
*	HSE	1991	Study Group on Human Factors Second Report: Human Reliability Assessment - A Critical Overview	0-1188-5695-2
*	Hudson,P.T.W, *et alia*	1994	Tripod Delta: Proactive Approach to Enhanced Safety. *Journal of Petroleum Technology*, v46, n1, p.58-62	
	Hudson,P.T.W. *et alia*	1994	Tripod DELTA: A Proactive Approach to Enhanced Safety. *Journal of Petroleum Technology.*	
*	Humphreys,P.	1993	Human Reliability Assessors Guide (Long Version). SRDA-R7 {AEA Technology, HF in Reliability Group}	
	IBC Conferences	1991-	Proceedings from 14 conferences	
*	IMechE	1991	*Safety Developments in the Offshore Oil and Gas Industry, Glasgow, 23-24 Apr.* {IMechE}	0-8529-8763-3
*	Jenkins,A.M, Brearley,S.A, and Stephens,P.	1991	Management At Risk. SRDA-R4 {AEA Technology}	0-8535-6362-4
*	Kirwan,B.	1987	Human Reliability Analysis of an Offshore Emergency Blowdown System. *Applied Ergonomics.* v18, n1, p.23-33	
*	Kirwan,B.	1992	Human Error Identification in Human Reliability Assessment. Part 1: Overview of Approaches. *Applied Ergonomics.*	

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
*	Kirwan,B.	1994	A Guide to Practical Human Reliability Assessment {Taylor & Francis} Publication date: Early November.	
	Kletz,T.A.	1991	An Engineers View of Human Error, 2nd Edition {IChemE}	0-8529-5265-1
	McKinnon,R.	1982	Offshore Oil. *Occupational Safety and Health*. v12, n3, p.16-19	
	Miles,R.	1992	Human Factors Research in Offshore Safety - HSE Research and Requirements. *The Practicalities and Realities of Human Factors in Offshore Safety, Aberdeen, 30 Sep. - 1 Oct.* {Business Seminars International}	
	Mill,R.	1992	Human Factors in Process Operations	
*	Moore,B, and Hamilton, T.	1993	Shallow Gas Hazard. The HSE Perspective. *Petroleum Review*, v47, n560, p.403-407	
*	Parkes,C.	1993	Human Factors, Shift Work and Alertness in the Offshore Oil Industry. OTH-92-389. {HMSO}	0-1188-2135-0
	Pate-Cornell,M.E, and Bea,R.G.	1992	Management Errors and System Reliability: A Probabilistic Approach and Application to Offshore Platforms. *Risk Analysis*. v12, n1, p.1-18	
	Patel,S.C.	1993	Design and Usability Evaluation of Work Control Documentation. *Proc 37th Annual Meeting of the Human Factors and Ergonomics Society, Seattle.* {Human Factors and Ergonomics Society Inc., Santa Monica} p.1156-1160	
	Pederson,O.M.	1985	Human Risk Contributions in Process Industry. Report No. Riso-M-2513. {Riso National Laboratory, DK-4000, Roskilde, Denmark}	
*	Pennycook,W.A, and Embrey,D.E.	Apr 1993	An Operating Approach to Error Analysis. *First Biennial Conference on Process Safety and Loss Management, Edmonton.*	
	Petersen,D.	1984	Human Error Reduction and Safety Management {New York: Aloray}	
	Pheasant,S.T.	1987	Ergonomics Standards and Guidelines for Designers {British Standards Institute Standards}	0-5801-5391-6

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
	Price,M.	1988	Drilling Injury Concentrations on Modern Fixed Platforms and in Connection with Mechanised Drilling Equipment (Norwegian Offshore Drilling Operations, 1980-1986) {Rogaland Research Institute}. Report No. RF 22/88	8-2722-0161-5
	Rasmussen,J.	1982	Human Errors: A Taxonomy for Describing Human Malfunctions in Industrial Installations. *Journal of Occupational Accidents*, v4, n.2-4, p.311-333	
*	Reason,J.T.	1991	Disasters and Human Failures. *Psychological Aspects of Disasters.* Taylor,A, Lane,D, and Muir,H. (eds.) {British Psychological Society}	
	Roberts,K.H.	1990	Some Characteristics of High Reliability Organizations. *Organization Science*, v1, n2, p.160-177	
	Sanders,M.S, and McCormick,E.J.	1992	Human Factors in Engineering and Design, Ed.7 {McGraw Hill}	0-0711-2826-3
	Shanks,F.E, and Williams,K.R.	1993	Slim-Hole Exploration Requires Proper Technical Preparation. *Proc. Soc. Pet. Eng. Annual Technology Conference and Exhibition, Houston.* Part 2 (of 5). p.235-244	
	Shepherd,A.	1986	Issues in the Training of Process Operators. *International Journal of Industrial Ergonomics*, v1, 49-64.	
	Staples,L.J.	1993	Task Analysis Process for a New Reactor. *Proc 37th Annual Meeting of the Human Factors and Ergonomics Society, Seattle.* {Human Factors and Ergonomics Society Inc., Santa Monica} p.1024-1028	
	Sutherland,V.J, and Cooper,C.L.	1984	Occupational Stress in the Offshore Oil and Gas Industry. In *International Reviews of Ergonomics: Current Trends in Human Factors Research and Practice.* Volume 3, ed. D.J.Oborne {Taylor & Francis}	
	Tompkins,B.G, Watson,W.D, *et alia*	1982	Human Factors Affect Panel/Console Design for Offshore Facility. *Oil and Gas Journal*, v80, n32, p.147-152	
	Wardell,R.W.	1989	The Application of Ergonomics to Oilwell Drilling Rigs. *Proceedings of the Human Factors Association of Canada 22nd Annual Conference, Mississauga, Ontario, 26-29 Nov.* p.135-139	
	Watson,W.D, and Moore,P.	1993	Momentum Kill Procedure Can Quickly Control Blowouts. *Oil and Gas Journal*, v91, n35, p.74-77	

TABLE 3. MATERIAL IDENTIFIED BUT NOT OBTAINED DURING STUDY

	Author/ Establishment	Date	Title, *Journal/Conference*, {Publisher}	ISBN Number
*	Weir,A.P.	1993	New Directions in Task Analysis. *Proc 37th Annual Meeting of the Human Factors and Ergonomics Society, Seattle.* {Human Factors and Ergonomics Society Inc., Santa Monica} p.1037	
*	Whalley,S.P, and Kirwan,B.	1989	An Evaluation of Five Human Error Identification Techniques. *Sixth International Loss Prevention Symposium, Oslo.*	
*	Whalley,S.P.	1988	Minimising the Cause of Human Error. *Tenth Advances in Reliability Symposium, London.* (G.P.Libberton (ed)), p.114-128	
	Whittington,C, Livingston,A, and Lucas,D.A.	1992	Research into Management, Organisational and Human Factors in the Construction Industry. HSE Contract Research Report 45/1992 {HMSO}	
*	Williams,J.C.	1988	A Data-based Method for Assessing and Reducing Human Error to Improve Operational Performance. *IEEE Fourth Conference on Human Factors and Power Plants*, Hagen,E.W.(ed) {New York: IEEE}	
*	Wreathall,J, Schurman,D.L, and Anderson,N.A.	1991	An Observation on Human Performance and Safety: The Onion Model of Human Performance Influence Factors. *Proceedings of the International Conference on Probabilistic Safety Assessment and Management (PASM)*, Apostolakis,G.(ed) {New York: Elsevier}	

* Prioritised items, ie those that appear directly applicable to present scope of study (well control, cranes, ship ops, methodologies)