Evaluation report on OTO 1999/092 Human factors assessment of safety critical tasks

Prepared by **Det Norske Veritas**
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Evaluation report on OTO 1999/092 Human factors assessment of safety critical tasks

R Johnson BEng, MSc
G Hughes BSc, MBA, MErgSoc
Det Norske Veritas
Cromarty House
67-72 Regent Quay
Aberdeen AB11 5AR
United Kingdom

Kerr McGee North Sea (UK) Ltd commissioned DNV to conduct an assessment of safety critical tasks for the Leadon Field Development. This was the first step in a Joint Industry Project (JIP) to evaluate the methodology presented in Offshore Technology Report OTO 1999/092, "Human Factors Assessment of Safety Critical Tasks". This report presents the findings of the JIP and provides feedback to the Health and Safety Executive on this methodology. The evaluation considered:

- the usability of the methodology;
- the benefits of its use;
- typical costs to implement;
- deviations or modifications to the methodology; and
- opportunities for further development.

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EXECUTIVE SUMMARY

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- The usability of the methodology
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- Deviations or modifications to the methodology
- Opportunities for further development

OTO 1999 092, "Human Factors Analysis of Safety Critical Tasks" presents a process by which the impact of Human Factors on Major Accident Events can be assessed. The method has already gone a long way towards making standard, well validated ergonomic tools available and accessible to non-specialists.

The Task Criticality Screening Tool presented in OTO 1999 092, is a particularly powerful tool for systematically linking tasks to the Major Accident Events. Other benefits from application of this tool include; prioritisation of tasks in order to make more effective use of time and resources, systematic identification of high potential human error and direct linkage of risk reduction measures to the Major Accident Hazards. Additional benefits for Kerr McGee's Leadon Development were the facilitation of communication between Design Engineers and Operations Personnel, support to the decision making process for final design and verification that measures taken to address human factors were effective with respect to Major Accident Hazards. This evaluation identified a few areas of weakness in the existing methodology:

1. The method is intended to be used by non-specialists however, human factors support is required throughout the whole process.
2. For the Leadon Development, the participants in the study benefited from some introductory training to the process and the issues to be covered.
3. The methodology includes a depth of analysis technique which is intended to be used to vary the level of analysis based on the criticality rating of the task. This is quite complicated to apply requiring vary degrees of partial Hierarchical Task Analysis as the task becomes more critical. This was a particular problem for the Leadon Development, as the procedures were under development at the time of the study. The project concentrated on the High Criticality Tasks with some of the procedures being developed along side the Hierarchical Task Analysis.

The general finding of this evaluation is that this tool has many applications for both onshore and offshore installations. The approach has sufficient flexibility to enable development of Task Criticality Screening Tools for application in a number of areas, through the definition of the diagnostic questions to suit the situation. These areas include:

- maintenance activities
- safety critical roles
- occupational health and safety

1 INTRODUCTION

Kerr McGee North Sea (U.K.) Ltd commissioned DNV to conduct an assessment of safety critical tasks for the Leadon Field Development. This was the first step in a Joint Industry Project (JIP) to evaluate the methodology presented in Offshore Technology Report OTO 1999 092, "Human Factors Analysis of Safety Critical Tasks". This report presents the findings of the JIP and provides feedback to the HSE on this methodology. The evaluation considered:

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Safety critical tasks are those where human causal factors and personnel activities have a contribution to the Management of Major Accident Events in the following areas:

1. Initiating events
2. Prevention and Detection
3. Control and Mitigation
4. Emergency Response

Safety Critical Task Analysis is a process by which the impact of Human Factors on Major Accident Events can be assessed.

The Leadon Field Development is a purpose built FPSO, the Global Producer III, and the project looked at the design of the production and marine systems to identify safety critical tasks, to identify the sources and consequences of human error within those tasks and to assess the adequacy of the risk reduction and control measures. The focus of the study was on activities conducted during normal operation, which could contribute to a major accident hazard. The process enabled the project to identify which tasks could contribute to the initiation of a Major Accident Event and provided demonstration that these issues were suitably and sufficiently managed. The lessons learned during this process are presented in Section 2.0.

An industry workshop was held on the 17th of April 2002 at Lord Cullen House, the HSE Offices in Aberdeen to present the methodology to the oil and gas industry and gain feedback on its applicability to the offshore safety case regime. The outcomes of this workshop are given in Section 3.0.

2 METHODOLOGY

2.1 OVERVIEW

The methodology used to conduct this study was taken from the Offshore Technology Report, OTO 1999 092, "Human Factors Assessment of Safety Critical Tasks" Reference [1]. The methodology was developed using existing fixed production installations considering the activities associated with production and well operations conducted on these types of facilities. As the Leadon field development was a purpose built FPSO in the detailed design stage, a number of modifications to the technique were required to fulfil Kerr McGee's requirements. These are discussed in more detail below.

The methodology consists of several steps as shown in Figure 2.1 below.

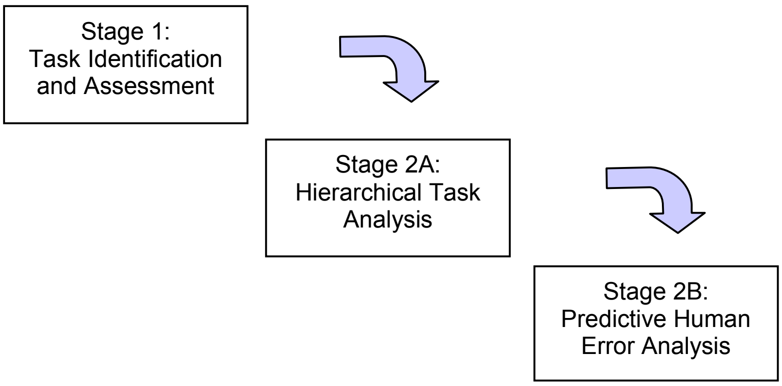

Figure 2.1: Key steps in methodology

2.1.1 Team familiarisation with methodology

The study kicked off with a training session for participants. This covered the steps that would be involved in conducting the study and the level of participation that would be required. It was designed to give the participants enough knowledge of the technique to be able to participate effectively, to raise awareness of the benefits of the process and gain buy-in from the project members.

2.1.2 Stage 1: Task identification and assessment

The first stage in the study consisted of two main steps:

- Identification of the key tasks performed on the installation, and
- Assessment of task criticality.

The aim of this stage of the assessment was to identify which tasks were critical to the control of Major Accident Hazards (MAH). The emphasis of the study was on normal operations as the results of this study were to contribute to the Operations Safety Case.

This stage concentrated on production and marine tasks performed during normal operations only. Tasks and activities connected with commissioning or maintenance were not included.

The methodology presented in "Human Factors Assessment of Safety Critical Tasks", Reference [1] gave a list of generic production tasks for use in this stage of the analysis. However, as this study was looking at an FPSO, there were a number of systems in the generic list that were not applicable to the Leadon Development and there was a need to develop a list of marine tasks for inclusion in the study. These are included in Appendix 2.

The generic production list was reviewed and updated for the Leadon development in consultation with the Project Process Engineer. A list of marine systems and tasks were developed in consultation with the Project Marine Engineer and Naval Architect. These lists provided the input for the Stage 1 Criticality Assessment of Tasks. Assessment of task criticality for production tasks was conducted using the diagnostic questions set given in OTO 1999 092. For marine tasks, these were modified slightly to reflect the hazards associated with marine tasks. This is included in Appendix 3.

This part of the study was conducted in several group sessions facilitated by DNV using the diagnostic questions given in OTO 1999 092, Reference [1]. Separate sessions were held to cover production and marine tasks. Tasks were ranked as High, Medium or Low Criticality by the group and High Criticality Tasks were taken for further analysis at the next stage. Additionally, team members identified a few tasks that had not been ranked as "High Criticality" but that they felt needed to be reviewed as part of the Stage 2 analysis. OTO1999 092 classes the tasks into five categories, High, High/Medium, Medium, Medium/Low and Low. For this study, High and High/Medium were grouped to give High and Medium and Medium/Low were group to Medium Criticality Tasks.

2.1.3 Stage 2: hierarchical task analysis and predictive human error analysis

Stage 2 of the analysis consisted of two steps. The first step was decomposition of the task into its composite parts using Hierarchical Task Analysis. A flowchart depicting the subtasks required to conduct the task was produced for each. The second step required identification of the key sub-tasks where a human error could occur, which had the potential to contribute to a major accident hazard. The method did not consider those sub tasks where the consequences of human error were primarily production downtime.

Once these critical subtasks were identified, the method considered:

- The type of error
- The potential consequences of the errors in terms of loss
- The measures in place for error recovery
- The measures in place for risk reduction

The set of error guide-words given in OTO 1999 092 was used for identification of the type of human error. When this technique considers error recovery, it is referring to opportunities for the operator to realise an error has been made and take corrective action before loss occurs. An example would be an alarm indicating the system status is going out of operating parameters or a procedural or software check that actions have been performed as expected.

The measures in place for risk reduction include measures that prevent or reduce the likelihood of an error occurring and measures which reduce the loss potential of the error.

Stage 2 analysis of safety critical tasks was conducted in small sessions consisting of a DNV facilitator, an operations or marine representative and where possible, the design engineer. The participants were selected as appropriate for the task being analysed.

To support these sessions, information relating to the design of the system for example operating logic diagrams, PFD diagrams and draft procedures were brought by the participants and used as reference where required.
The results of Stage 2 were issued and reviewed by the participants to ensure accuracy of the recorded information.

2.2 APPLYING THE METHODOLOGY

2.2.1 Challenges

There were a number of challenges associated with applying the methodology as presented in "Human Factors Assessment of Safety Critical Tasks", Reference [1]. Some of these were due to the methodology itself, others due to project specific issues. These challenges are discussed here.

Timing

The Leadon Development Project at the time of the study was in the detailed design phase, with building beginning on many of the packages. The study was difficult to conduct at this particular stage of the project development. It was generally felt that the identification of safety critical tasks (Stage1) would have been of more benefit to the project had they been conducted earlier in the design process and incorporated into the design HAZOP sessions.

Hierarchical Task Analysis was a new technique to most people involved in the study and the presentation of information used in this technique varies considerably in layout and denotation from standard engineering logic and flowcharts. Due to the lack of specific tasks and associated written procedures for the Leadon Project, the tasks and sub tasks were more difficult and time consuming to map out than would be the case for an operational installation. However, the interaction between design engineers and operations personnel required for this analysis was of great benefit to the project.

Concern Over the Outcomes

The timing of the study also had an effect on the project personnel who were concerned that the outcomes of the study would mean considerable and costly last minute changes to design. However, as considerable effort had already been made to consider human factors within the project, the study was able to demonstrate the benefits of this effort in terms of the impact on the management of Major Accident Events.

Adapting the Generic Task List

Reference [1] gave a list of generic production tasks for use in the first stage of the analysis which is intended to be reviewed for applicability to the installation under study. However, as this study was looking at an FPSO, there were a number of systems in the generic list that were not applicable to the Leadon Development and there was a need to develop a list of marine tasks for review. At the time of the study a complete set of tasks were not available for the installation and a limited number of draft procedures were available. This made it difficult for the teams to conduct Stage 1 of the analysis without additional effort on prior preparation of Leadon specific task lists. Considerable work went into initial development of a task list specific to the Leadon Development and which helped when performing the criticality ranking of the tasks. The Stage 2 Analysis sessions took longer than expected as in some cases the procedures were being developed or updated as a result of the analysis.

For an established installation, it should be a much easier task to identify and develop a comprehensive list of tasks for review in Stage 1 and there should be sufficient available information and experienced operators to conduct Stage 2 analysis.

Maintaining Focus

In order to make the study manageable, focus had to be maintained on production and marine tasks during normal operations. It was a challenge to maintain a focus on these issues with respect to Major Accident Hazards, as it was easy for participants to drift into occupational safety issues and production downtime. This is likely to be a problem for all installations and highlights the need for experienced facilitation of the analysis sessions.

Applying the Assessment Criteria

When conducting the criticality assessment of the tasks the assessment criteria were difficult to apply. For instance, one of the assessment criteria was "to what extent are ignition sources introduced into / during the task?". Due to the design of the electrical equipment to be intrinsically safe, this criterion usually rated a score of 0 or no exposure. The assessment criteria were difficult to apply to the marine tasks list, in particular where these systems interfaced with the production systems as they were specifically designed for production tasks. Some modifications were made to enable the team to apply the criteria to the marine tasks. The revised criteria are included in Appendix 3.

The assessment criteria resulted in the tasks being ranked into one of five criticality bands, including two bands described as "High/Medium" and "Medium/Low". These additional categories did not provide any value to the study process so the rating was adjusted to give three clear categories of "High", "Medium" and "Low". Once the scores had been collated and criticality assigned to the tasks, the session members felt that the scores were consistent with their experience of the criticality of these types of tasks.

Continuity from Stage 1 to Stages 2

The participants involved in Stage 1 and Stage 2 of the process were different. Stage 1 participants were those with a knowledge of the whole installation whilst Stage 2 participants were individual Design engineers and operations personnel involved in the drafting of the procedures. As the task lists were developed on Stage 1 participants' understanding of the types of tasks that would be required on the installation, this understanding was difficult to bring forward into Stage 2 of the process where the understanding of the individual systems were much more detailed. This was managed by including an extra review of the outcomes of Stage 2 with participants from Stage 1. It is unlikely that this problem would be experienced by an established installation as the tasks performed on the installation are unambiguous and it should be possible to ensure that the same individuals participate at each stage of the analysis.

2.2.2 Deviations

Due to the challenges in applying the OTO Methodology to the Leadon Development discussed above, a number of deviations were made from the methodology. These are presented and discussed in this section.

The following deviations from the OTO Methodology were made:

1. The generic task lists were not suitable for direct application to the Leadon Development due to the process design and the importance of marine tasks to the vessel's integrity. Additional preparation sessions were included to tailor the generic lists to the process systems and to develop a set of marine tasks.

2. When conducting the Stage 1 'Criticality Assessment' of the tasks due to the design of the electrical equipment to be intrinsically safe, diagnostic question 2 "to what extent are ignition sources introduced into / during the task?" usually rated a score of 0 or no exposure.

3. The diagnostic questions were difficult to apply to the marine tasks list, in particular where these systems interfaced with the production systems. Diagnostic question 1 was expanded to include the sea, weather and other vessels as "hazardous conditions". Diagnostic question 2 was treated as described in Point 3 above.

4. The methodology as described in Reference [1] had 5 criticality bands for assessment including two bands described as "High/Medium" and "Medium/Low". These additional categories did not provide any value to the study process so the rating was adjusted to give three clear categories of "High", "Medium" and "Low". This was done by taking the lowest score for "High/Medium" as the first score in "High" and the lowest score in "Low/Medium" as the first score in "Medium". Once the scores had been collated and criticality assigned to the tasks, the session members felt that the scores were consistent with their experience of the criticality of these types of tasks.

5. The next step in the methodology as described in Reference [1] application of a depth of analysis technique. This involves varying levels of Stage 2 Assessment of all tasks dependant on their assigned criticality. Due to lack of finalised operations and marine tasks, the time and resources that would be required to follow this approach made it unfeasible. Instead, all "high" criticality tasks were given full assessment in Stage 2 as well as tasks identified by the team as needing more detailed assessment. This was felt to be adequate as some of the "high" criticality tasks were start-up procedures, and the majority of the tasks discussed for each system were covered as subtasks.

2.2.3 Benefits

Prioritisation and focus of resource

By conducting the Stage 1 Criticality Assessment of the Leadon Task List, it was possible to focus time and resources on those tasks identified as High Criticality in Stages 2 and 3. The project was able to dedicate precious time and resources to these tasks and demonstrate a robust approach to the prioritisation of these tasks. In terms of Major Accident Events, this meant that the most important tasks were analysed to sufficient depth to demonstrate that they are adequately managed. In real terms, this meant that the study went on to analyse in detail the top 9 tasks out of a possible 81.

Design improvements

The outcomes of the task analysis are very specific and tangible. Any recommendations or findings are linked closely to the task step and the required result is made clear. The outcomes in some cases supported decision making, for example, the choice of hard pipe connections over flexible pipe for manual drainage of liquids from the pulsation damper bottles. Flexible pipes would have met the engineering standards but due to access restrictions and the physical requirements of making the hose connections, hard pipes were chosen to remove any potential for human error which could result in damage or hydrocarbon release. Manual ignition of the flare was identified as one of the high criticality tasks. As this task is normally required when automatic systems have failed, the process of analysis identified the procedural controls, risk assessment and competency and training requirements for conducting this task.

Facilitated meaningful interaction of operations and design personnel

The process facilitated meaningful interaction of operations and design personnel in that during Stage 2 and 3, they were working together to describe the interactions between the operator and the system. This enabled operations staff to identify how this system differed from those they had previously worked with and gave the design engineer an insight into how this system would be operated in truth. This also allowed a two-way exchange where the design engineers were able to take action on some of the findings of the Stage 2 and 3 discussions. An example would be in the Separation Package. The operations personnel were able to develop the procedure for the various types of start up conditions and to gain real understanding of the characteristics of each by working on the Hierarchical Task Analysis with the design engineer.

Simple and structured approach

The approach in the study is very structured and quite simple to follow once some initial training is given. The tools are consistent with the approaches normally used by engineers on major engineering projects. The tools themselves have been widely used in the Human Factors arena and are well validated so that there is confidence in the study findings.

Demonstration

The study enabled the project to demonstrate that a robust approach had been used to identify how Human Factors could contribute to a Major Accident Event on the installation and also to document the measures in place to control those Human Factors issues.

Aided development of operating procedures

An unexpected benefit of this process was that the outcomes of Stage 2 and 3 could be directly used to develop the operating procedures for the tasks identified in the study. In particular, one of the operations personnel involved found the Hierarchical Task Analysis beneficial and used this methodology for the development of other operations procedures.

Potential benefits

There are many other potential benefits from integrating the information gathered from this analysis into an organisation's HSE management process for example in the development of procedures, and competency assurance processes. In particular, this information could contribute to the management of change.

2.2.4 Cost of application

The estimated manhour requirements for conducting this analysis are given in Table 2.1 below.

Table 2.1: Manhours for Leadon Development Study

Stage of analysis	*Kerr McGee resource (mandays)*	*Consultant (mandays)*
Participant Training	3	2
Development of Task Lists	1	2
Criticality Assessment	11	4
Stage 2 Analysis of 9 tasks	16	10
TOTAL	**31**	**18**

This estimate is based on the work required for each of the tasks necessary to complete the analysis. It has not been possible to estimate the financial costs of the design changes made or any additional resource requirement to implement the recommendations made. However, it has also not been possible to estimate the potential savings in terms of production downtime, equipment damage, environmental impact or harm of implementing these changes.

One of the companies represented at the Industry Workshop were working on a project to conduct this type of analysis for all their installations. The process they had developed internally requires more time to analyse critical tasks. However, the company described significant benefits from using this approach.

3 INDUSTRY WORKSHOP

Two half-day Industry Workshops were held on the 17th April 2002 at Lord Cullen House. The aim of the event was to rollout the methodology as described in OTO 1999 092, Reference [1], and gain feedback on its applicability to the industry. The event was co-hosted by the HSE and DNV and attended by representatives from the offshore oil and gas industry, production and drilling, and onshore process industry. The event consisted of a presentation from the HSE on their expectations for Human Factors in the Safety Case, a presentation from DNV giving a description of the methodology, exercises covering key stages in the methodology and a feedback session where DNV shared learning from the Leadon Development Project and industry gave their views on human factors and the applicability of the methodology to their operations. This section presents the feedback gathered at this event.

3.1 POSITIVE FEEDBACK

The methodology was generally well received and the participants felt that the workshop was a good forum for sharing learning and knowledge. Key points included:

- Although developed for addressing Major Accident Hazards, the methodology is versatile and adaptable for application in addressing health, safety, environmental and business risks.
- There is potential to adapt the methodology for use in planning abnormal operations or for risk assessment of normal operations.
- The use of operators within the HTA and walkthrough of the task is a valuable process for use in other risk assessment practices.
- The method asks "Is the operator capable of using the equipment?" as well as "is the equipment designed to be used by the operator?", acting as a defence check.
- The method is complementary to other improvement strategies such as safety culture and behavioural modification programmes.
- The methodology can be used to link into the management system, e.g. training and competency processes, and into the Major Accident Hazard Risk Assessment tools e.g. HAZOP.
- As well as picking up on hardware and software issues, the methodology can also identify physiological factors such as workload, individual capability, as well as psychological factors such as morale, confidence, and mental fatigue.

3.2 LIMITATIONS OF THE METHODOLOGY

A few key points were discussed as potential limitations to the effectiveness of the methodology. These included:

- The importance of the involvement of a Human Factors Expert was demonstrated through some of the queries and concerns raised. Concerns were raised over the appropriate level of application, and guidance sought on how human factors issues affected human error. These issues are more effectively dealt with by ensuring an expert is available to facilitate and guide the process.
- The cost of applying this method in terms of organisation resources may discourage its use. The need for a mixed discipline group through the whole process means that it would become increasingly difficult to assure the availability of people to participate.

- The feeling was that whilst the methodology effectively considered major accident hazards, no consideration was given to the occupational health and safety. For the majority of people attending the workshop, the latter was much more important to their operations.
- There was a feeling that the method lacked a "follow-up" and that there was danger that error reduction recommendations were not followed through or implemented. Information was sought on how this could be continuously improved.
- The methodology does not consider the frequency, planning and time-scale of the identified safety critical tasks. It could be used with other methodologies that would cover these.

3.3 THE WAY FORWARD

A number of suggestions were made on how to bring the method forward. These were:

1. Legislation requires human factors to be risk assessed and demonstrated within the Safety Case. It is recognised that there is a need for tackling and identifying human error potential and demonstrating error reduction and recovery. It was felt by the group that more detailed guidance could be provided from the HSE on how this is to be achieved.
2. The methodology requires the involvement of the workforce. It is important to highlight this and identify approaches to be used to facilitate meaningful involvement of the workforce.

4 AREAS WITH POTENTIAL FOR DEVELOPMENT

The method had already gone a long way towards making standard, well validated ergonomic tools available and accessible to non-specialists. Considerable effort had been made to simplify the requirements of these tools and provide a means for prioritising tasks in order to make more effective use of time and resources. The Task Criticality Screening Tool presented in Reference [1] is a particularly powerful tool for systematically linking tasks to the Major Accident Events. This tool has many applications for both onshore and offshore installations and has sufficient flexibility to be able to apply it in a number of situations.

Whilst the consensus is that this is a very useful tool with great potential and many benefits, there are a number of areas that could be developed further. These are presented below, firstly for the Leadon Development Project, then from the Industry perspective.

4.1 LEADON DEVELOPMENT PROJECT

4.1.1 Process needs a human factors specialist

The methodology is intended to be used by personnel without any human factors expertise. The project found that there was need for a human factors specialist for the duration of the study to tailor the technique to suit the Leadon Project, to facilitate the study sessions and maintain focus on human factors issues. To provide guidance on the use of the tools and to help identify where human factors interventions had been made by the project and to develop appropriate recommendations where required. This is likely to be the case for established installations also.

4.1.2 Participants need education in use of technique

The initial training session given to the participants was invaluable. It helped to introduce the participants to process, to gain their buy-in and to improve the effectiveness of the sessions. It was found that the participants needed some initial training in order to introduce them to the methodology and what to expect at each stage. It also informed them of the study's aim and desired outcomes, which helped to allay fears that the study would result in rework of their design.

4.1.3 Non-routine maintenance and violations

The process leads you to focus on normal production tasks and routine maintenance tasks and the opportunities for human error in these tasks. The process does not intuitively lend itself to identifying potential violations or to the analysis of non-routine tasks. A different approach may be necessary to identify safety critical maintenance tasks. An area for future work could be the development of a complementary tool for maintenance tasks. A recent report from the HSE (Reference 3) gives some approaches that may be used to address violations.

4.1.4 Need to tailor tasks lists

The generic task-lists were valuable as a check of the types of tasks we were to consider. The generic task lists were not suitable for direct application to the Leadon Development due to the process design and the importance of marine tasks to the vessel's integrity. Additional preparation sessions were included to tailor the generic lists to the process systems and to develop a set of marine tasks. Though the process of adapting the task list to suit the Leadon was a little frustrating for the project members, mainly due to the fact there were no written sets of procedures available for use, the process was useful in demonstrating that all tasks had been adequately identified and been assigned a criticality.

The review of the task list is a fundamental first step in the process for any installation as the quality of information at this stage dictates the thoroughness of the rest of the analysis. In the methodology presented in Reference 1, this is expected to be conducted by the team at the beginning of the Stage 1 Criticality Rating Session. The experience of the Leadon Development showed that it is important that sufficient time is spent preparing the task list prior to the Stage 1 session so that accurate information was gathered to support the session and the focus of the meeting was firmly on the criticality rating.

4.1.5 Safety critical roles

The technique does not enable you to consider the interaction between these safety critical tasks. For instance, the role of the control room operator is considered in this process only insofar as he/she is involved in each individual task. Whilst, consideration is given to the opportunities for control room operator error in conducting a specific task, these tasks are considered in isolation to each other and other activities the control room operator may be performing as part of his normal role. Key issues that may be missed include alarm handling, Human Computer Interface on the process control system and workload. As the Control Room Operator can be considered to be a Safety Critical Role in terms of his/her interaction at all stages of the management of Major Accident Hazards, an alternative method is required in order to demonstrate that human factors are managed within that role.

4.1.6 Assessment criteria - depth of analysis

The next step in the methodology as described in Reference [1] application of a depth of analysis technique. This involves varying levels of Stage 2 Assessment of all tasks dependant on their assigned criticality. Due to lack of finalised operations and marine tasks, the time and resources that would be required to follow this approach made it unfeasible. Instead, all "high" criticality tasks were given full assessment in Stage 2 as well as tasks identified by the team as needing more detailed assessment. This was felt to be adequate as some of the "high" criticality tasks were start-up procedures, and the majority of the tasks discussed for each system were covered as subtasks.

The application of the depth of analysis technique may be of limited value in the process. A lot of the tasks were covered as part of the High Criticality Tasks e.g. Start-up Separation includes start pumps. The process, whilst intended to reduce the amount of work required, creates work of a different nature and provides little for focus of resources and time.

4.1.7 Information gathered at stage 2

Stage 2 involved Hierarchical Task Analysis of each of the Safety Critical Tasks. An opportunity is missed here to record information relevant to each task step. Tabular Task Analysis is a process where at each task step the following information is recorded;

- Properties of the task e.g. specific actions,
- Who
- When and conditions
- Task needs and support e.g. information, controls, tools
- Specific task support available
- Feedback on success

This information is valuable and may provide a stronger link between the task step and the Predictive Human Error Analysis.

4.1.8 How to Revisit

There is a substantial amount of information gathered through this process on how Human Factors impact on Major Accident Events. It is important that this information and its value is not lost. Some guidance or the development of a "review" or "revalidation" tool would be of use in the management of change on the installation.

4.2 INDUSTRY

4.2.1 Applicability to Occupational Health and Safety

For most of the Operator and Drilling Representatives present at the workshop, Human Factors in occupational health and safety were of more importance. There were many who were concerned with incidents that were continually happening that could be linked to either behaviour or error. The feeling was that the methodology could be amended or supported by other processes such as incident investigation in order to highlight Occupational Health Critical Tasks.

4.3 FEASIBILITY OF DEVELOPMENT PROPOSALS

The above sections give a number of recommendations on areas where this tool could be developed or supported. Due to the nature of the activities required to implement these recommendations, it may not be feasible to develop the tool to meet all requirements. Some of these areas can only be addressed within the existing methodology, however, others may be met through the provision of further supporting guidance and tools.

APPENDICES

APPENDIX 1 REFERENCES

1 *Human Factors Assessment of Safety Critical Tasks*, HSE, Offshore Technology Report OTO 1999 092, July 2000.

2 *Reducing Error and Influencing Behaviour,* HSE, HSG48, HSE Books, 2000.

3 *Techniques for Addressing Rule Violations in the Offshore Industries,* HSE, Offshore Technology Report OTO 2000 096, 2002.

APPENDIX 2 LEADON'S MARINE TASK LIST

Cargo Operations

Cargo loading
Cargo discharge
Starting pump
Open/close valves
Check stability & longitudinal strength criteria
Change filters
Ullaging, temperatures and dips

ACTIVE & PASSIVE Station Keeping System

Semi-automatic system - good weather
Manual operation - good weather
Automatic system - poor weather
Manual operation - poor weather

Changeover of operational modes on DP/TAMS

Starting & stopping thrusters
Starting generators
Operating turret turning system
Select new and change heading
Move wear points on fairleaders/reset pre tensions in mooring lines

Shuttle tanker operations

Shuttle tanker approach
Transfer and connect offloading hose at fpso
Offload (see cargo handling above)
Disconnect and retrieval of hose
Retrieval of hawser

Cargo Heating

Heater Operation
Start/stop pump

Tank Operations

Tank cleaning
Crude oil washing
Hot water washing
Slop handling
Slop transfer
Inert gas operation
Bilge operations
Start pumps
Operate valves

Power Generation
Start up
Change fuel
Put generation onto bars
Operation of power management system
Changeover between diesels
Changeover between turbines
Change over to emergency generator
Changeover lube oil filters whilst turbine online
Fuel cooling/preheating systems
Change intake filters
Steam generation

Lifting/Supply Vessel Operations

Loading/offloading
Lifting over live plant
Manually monitor loads on laydown areas/system

Fuel Gas Supply to Steam Boilers

Start up
Fuel management & boiler control
Operate individual valves
Change filters

APPENDIX 3 LEADON'S CRITICALITY RATING TOOL FOR MARINE TASKS

Diagnostic	***Definition***	***Rating Guide and Score***		
		Low (1)	***Medium (2)***	***High (3)***
1. How hazardous is the system involved?	Task involves systems with intrinsically hazardous substances or conditions including sea and weather conditions, and other vessels	Small amount of low hazard substance / condition	Large amount of low hazard or small amount of a high hazard	High amount of a high hazard / condition
2. To what extent are ignition sources introduced into / during the task?	Task uses or may produce heat, sparks or flames	Static spark or low current electrical supply	High current electrical supply, sparks from grinding	Flames for welding or cutting , internal combustion engines
3. To what extent does the task involve changes to the operating configuration?	Task involves valve moves, temporary connections, change to process flows	Simple changes to valve process status	Complex or multiple changes to valve and process status or temporary connections	Complex and multiple changes and temporary connections
4. To what extent could incorrect performance of the task cause damage?	Deviations from best practices may have detrimental effect on equipment integrity	Equipment weakened with potential to cause damage in the long term	Equipment requires repair but maintains integrity	Equipment fails catastrophically
5. To what extent does the task involve defeating protection devices?	Task requires bypass or override of indications, alarms or trips	Disabling gauges, meters or electronic displays	Disabling alarms.	Overriding trip systems or isolating safety valves

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