20.0 GUIDELINES IN PRODUCING AN EFFECTIVE SHIFT AND TASK HANDOVER SYSTEM

Bob Miles
Health And Safety Executive

SUMMARY

This report reviews available literature on the topic of shift handover. The topic is defined and the task of controlling complex systems is examined, with particular reference to the offshore industry. Relevant theoretical work on effective communication is described and implications for effective communication at shift handover are drawn. The report then examines published accidents/incidents, where failures of communication at shift handover were amongst the contributory causal factors. Lessons from these incidents for effective shift handover are also explored. Various studies and surveys which have sought to understand and improve the process of shift handover are then described. Finally, existing guidance on shift handover is analysed and compared to knowledge which has been identified elsewhere in the review. The report draws conclusions regarding the current state of knowledge and highlights implications for best practice.

INTRODUCTION

Maintaining continuity between shifts is important, not only in the offshore sector but in all continuous process operations. The present review will therefore draw upon research from all continuous process industries to inform good practice in offshore oil operations. It is anticipated that this report will also be useful to onshore continuous process industry operators.

Shift Handover: A Definition

Consider the situation when a person with sole responsibility for a task takes a break from work, the returns to the same task following their absence. If the task has not been progressed or altered by someone else, communication is not an issue. Contrast this with work which is shared between more than one person or continues during an absence. Under such conditions, communication and coordination assume crucial importance. In industries which operate continuous processes, continuity is maintained across shift changes via shift changeover. Shift changeover typically includes 1) a period of preparation by outgoing personnel, 2) shift handover, where outgoing and incoming personnel communicate to exchange task-relevant information and 3) cross-checking of information by incoming personnel as they assume responsibility for the task. The goal of shift handover is the accurate, reliable communication of task-relevant information across shift changes, thereby ensuring continuity of safe and effective working.

CONTROLLING COMPLEX SYSTEMS: THE TASK

Offshore oil exploration and production are continuous 24-hour operations. Personnel typically reside on the offshore installation for 2-4 week periods, working alternating 12-hour shifts. Their goal is to maximise exploration, production or support functions without compromising safety.

Complex technical systems place demands on the operator's information-processing and decision-making skills. The operator may be physically remote from the system, and rely on an internal "mental model" to understand and control the invisible process. The accuracy of this model determines how effectively operators start-up, monitor, adjust and shut-down the process. Successful control requires three components to be present:

- clear specification and understanding of the future goals of production
- an accurate mental representation of the current state of the process
- an accurate internal model of process dynamics.

Many continuous process tasks are characterised by long system response times between process alterations and effects. Actions may not have their effects until subsequent shifts. Without adequate communication of information at shift handover, diagnosis of effects resulting from actions on previous shifts is problematic.

Amongst the distinctive features of offshore facilities are their geographical isolation and unusual shift patterns. All or part of the crew may leave the facility in a short period of time. Clarification of issues not adequately recorded or communicated at shift handover is therefore potentially problematic. Significant fluctuations in alertness and performance have been observed over two-week offshore shift cycles, the most marked and adverse effects occurring during the shift-change phase. Furthermore. offshore workers can be exposed to high noise levels. both on and off-duty, which increases potential for misunderstood verbal communications.

THEORETICAL WORK

This section of the report reviews theoretical work on effective communication. By using concepts from the mathematical theory of communication, cognitive psychology and organizational behaviour, human communication can be analysed to understand how effective, reliable communication is best achieved. Aids and barriers to effective communication are identified and summarised and implications for effective shift handover communication drawn.

Communication theory and its implications

Table 20.1 displays aids and barriers to effective communication derived from communication theory, and their implications for ensuring effective shift handover communication.

Table 20.1: Communication Theory & Implications for Effective Shift Handover Communication

Aids to Effective Communication	Implications for effective shift handover communication
The intended communication must first be encoded and physically transmitted in the form of a signal, which may be written, spoken or gestured. The introduction of redundancy to a communication reduces the risk of erroneous transmission.	Information should be repeated via more than one medium, e.g. verbal and one other method (for example, written, diagrammatic, etc.)
Availability of feedback increases accuracy of communication.	Two-way communication with feedback is essential at shift handover.
Effective communication can be aided by qualitative aspects of speech, such as assessments of comprehension, confidence, competence gained via pace, phrasing, hesitancy and fluency.	Verbal face-to-face communication at handover is desirable.
Accurate alignment of present and future perceived system states (mental models) with actual system states, depends on successful communication. Successful communication is facilitated by a shared mental model.	Miscommunications and misunderstandings are most likely to occur when mental models held by incoming and outgoing personnel differ widely. This can occur during deviations from normal working, plant maintenance, following a lengthy absence and between experienced and inexperienced staff. In order to achieve shared mental models, handovers can be expected to take longer at such times.
Written communication is facilitated by design of documents which consider the information needs of the user, support the communication task and demand inclusion of relevant categories/types of information.	Operator supports (logs, computer displays) based on specification of the information needs of personnel at shift handover are likely to facilitate accurate communication.
Barriers to Effective Communication	Implications for Effective Shift Handover Communication
The intended message may be buried in irrelevant, unwanted information or “noise”, which requires time and effort to extract and interpret.	Key information needs to be specified and presented, and irrelevant information excluded.

Natural language is inherently ambiguous	Efforts need to be expended to reduce ambiguity by 1) carefully specifying the information to be communicated e.g. specifying a plant item and tag 2) facilitating two-way communication which permits clarification of ambiguity (which plant item are you referring to?.
Transmission of information is limited by the capacity of the communication channel.	Eliminate unnecessary information.
Misunderstandings are an inevitable feature of human communication and effort needs to be expended to identify, minimise and repair misunderstandings.	Communication needs to be two-way, with both participants taking responsibility for achieving accurate communication.
People and organizations frequently refer to communication is unproblematic, implying successful communication is easy and requires little effort. Over-confidence and complacency are common.	Effort need to be expended by organizations to address complacency by 1) emphasising the potential for miscommunication and its possible consequences 2) setting standards for effective communication 3) developing the communication skills of organizational members.

Summary

The review of communication theory indicates that to ensure effective shift handover communication organizations should:

- give effective shift handover communication a high priority
- pay particular attention to handovers which occur when staff have returned following a lengthy absence from work; during plant maintenance; during deviations from normal working; and when handovers take place between experienced and inexperienced staff
- specify key information needed by the incoming operator to update their mental model of plant status
- use operator supports (logs, displays etc.) designed on the basis of the operator's information needs include communication skills in their selection criteria for shift-workers
- develop the communication skills of existing staff.

Individual handovers should:

- be conducted face-to-face
- be two-way, with both participants taking joint responsibility for ensuring accurate communication

- use verbal and written means of communication
- be given as much time as necessary to ensure accurate communication.

ANALYSIS OF PUBLISHED INCIDENTS

Many accident analyses cite miscommunication as being amongst the contributory causes. In the aviation domain, constructive goal-oriented communication distinguishes successfully resolved safetv-critical incidents from those which were less effectively managed.

The discontinuity of work which inevitably accompanies shift-working has been associated with an increased rate of accidents. Several studies report an increased rate of accidents at or near shift changeover, with the highest incidence at the commencement of the shift. The MHIDAS database identifies three major accidents, resulting in 20 fatalities, 35 injuries and £46 million worth of damage which occurred at or following shift changeover. However, the specific reasons for the higher incidence of incidents at or near shift changeover are not known.

There are five known published investigations into accidents/incidents where failure of communication at shift handover was held to have been a contributory causal factor. These were major accidents/ incidents resulting in actual or potential loss of life, major property damage and/or environmental impact. These incidents were therefore subject to very close scrutiny. It should be emphasised that, in each of the incidents described, failures of communication at shift handover formed part of a complex combination of design and operational failures. It is believed by the present author that these highly-publicised incidents form the tip of an iceberg of numerous unpublished lost production incidents or near-misses caused by failures of communication at shift handover.

The Sellafield Beach Incident

During November 1983 highly radioactive waste liquor was accidentally discharged to sea from BNFL's Sellafield Works. The subsequent Nuclear Installations Inspectorate investigation found that, due to a failure of communication between shifts, a tank which was assumed to contain liquid suitable for discharge to sea, but in fact contained highly radioactive material, was discharged to sea creating an environmental hazard. This incident occurred during plant shutdown for routine annual maintenance. As a written description of the tank contents was carried forward from one shift log to the next, across several consecutive shifts, the written description of the tank contents changed from “ejections from HASW” to “ex HASW washout.” As a result of this change, what had originally been interpreted as highly radioactive material was later interpreted as being low level effluent suitable for discharge to sea.

In this incident, the contents of the tank were described in terms of their origin, rather than their nature. Liquid waste handled at the plant could be categorised as highly active liquid waste, medium active liquid waste or low level effluent. Failure to describe the tank's contents in such unambiguous categorical terms, when coupled with transcription errors made as written log book contents were copied from page to page, led to a misunderstanding.

A subsequent safety audit of BNFL Sellafield Works found that plant managers' responsibilities for shift handover were outlined by a statement of objectives, rather than procedures which indicated how an effective handover should be conducted. The audit report recommended the establishment of a common procedure for handover between shifts at all managerial and supervisory levels.

The Piper Alpha Disaster

The Cullen Report concluded that one of the many factors which contributed to the Piper Alpha disaster was failure of transmission of information at shift handover. Specifically, knowledge that a pressure safety valve had been removed and replaced by a blind flange was not communicated between shifts. Lack of this knowledge led to the incoming shift taking actions which initiated the disaster.

The Cullen Report concluded that there were no written procedures for shift handover. Furthermore, the type of information which the lead production operator wrote on his notepad and communicated at shift handover was left to his discretion. There was no pre-determined analysis or categorisation of important items to include in the handover and maintenance work was not always included in logs.

The Sutherland fatality

The Cullen Report also refers to an incident in 1987 when an offshore contractor's rigger was fatally injured whilst preparing to crane-lift a motor. The platform operator subsequently pleaded guilty to a prosecution under the Health and Safety at Work Act. The complaint specified "inadequate communication of information from the preceding day-shift to night-shift". Further information on this incident is not publicly available.

The Windscale Vitrification Plant Shield Door Incident

In this incident, a container of highly radioactive vitrified waste was raised into a control cell for monitoring. Due to failure of six separate engineered and procedural protective systems, two shield doors designed to protect people outside the cell from radiation were left open. No-one was exposed to radiation as a result of the incident, however the potential for significant overexposure did exist.

Failure of the six protective systems was due to a complex coincidence of design and procedural errors. The sequence of events leading up to the incident began with maintenance work on a cell robot. Due to unforeseen complications, this work continued over four consecutive shifts. To resolve problems encountered during maintenance, a temporary plant modification proposal (TPMP) was issued to temporarily override a programmable logic controller. Details of the TPMP were referred to in the Shift Manager's TPMP book, shift log book and the permit to work.

Following completion of the maintenance work, the control cell was re-commissioned without removal of the temporary over-ride. It appears the existence of the temporary over-ride had been forgotten as an initial reference to its existence had not been carried forward from shift to shift in the Shift Manager's log book.

Ironically, the programmable logic controller which had been temporarily overridden contained a coding error which rendered it ineffective. Had this device been working properly, recommissioning the control cell with the temporary override still in place would have made raising the container impossible, thus preventing the incident.

The HSE report on the incident highlighted the need for "proper transfer at the time of shift handover of the necessary information on the status of the plant, particularly in relation to any modifications, whether temporary or permanent, and any permits to work (p.11)".

A serious injury during offshore maintenance

HSE guidance on how offshore workers can help improve health and safety includes a case study on failure of communication at shift handover. A man was seriously injured while repairing a valve in a high pressure line. The accident happened when workers on one shift isolated the valve by shutting a valve on either side and opening the drain-line between. They knew the isolating valves were not operating properly so they closed the drain-line again. They left a message for the next shift that it must be re-opened first to blow the line down. The permit to work and Isolation Certificate did not describe the method of isolation in detail. During the shift handover, the message was not passed on. A fitter (who was unfamiliar with that type of job) removed the clamp bolts holding the pipe flanges together, instead of just loosening them and cracking a joint. Pressure had built up in the line again and a coupling blew apart. The fitter received very serious head injuries and will never fully recover.

Published incidents and communication theory

When analysed in terms of communication theory, these incidents forcibly demonstrate the consequences of:

- failing to take account of the inherent ambiguity of natural language
- the increased potential for misunderstanding present when people hold differing mental models of plant status

- failure to consider the information needs of others, and provide a means of capturing key information unambiguously

- over-reliance on one means of communication, namely one-way written communication. In four of the five incidents, communication by written means failed as the intended message was misunderstood or simply not communicated.

Summary

The incidents described identify areas of risk at shift handover.

- All the incidents involved planned maintenance work.

- In some of the incidents planned maintenance work continued over a shift change. Thorough communication of such work should be afforded a very high priority.

- Operator supports (logs) were not designed to capture key information reliably and unambiguously.

- A lack of procedures which specified how to conduct an effective shift handover was evident.

- Inaccurate and unreliable carry-forward of written information from shift to shift was evident. For example, reference to a temporary safety system over-ride was not carried forward.

EMPIRICAL WORK

This section of the report first describes two studies which compared the effects of 8-hour versus 12-hour shifts on communication between shifts. Two further groups of empirical studies are then reviewed which sought to a) observe, understand and describe how personnel responsible for continuous process tasks hand over the task to incoming personnel and b) improve the content and process of shift handover.

8-Hour vs. 12-Hour Shift Working

The effects of a change from 8-hour to 12-hour working in fifty US and Canadian chemical and petroleum industries were examined in a 1977 study. A field survey of managers' opinions concluded that, on balance, inter-shift communication gained in continuity with 12-hour shift working as the number of handovers per day decreased by 50%. 12-hour shift personnel frequently received their shift handover from the same person who they had briefed 12 hours earlier. Communications between production and maintenance staff were also reported to improve, as most maintenance work was started and completed within the 12-hour day shift, rather than spanning the two 8-hour morning and evening shifts. The need to brief incoming staff about ongoing maintenance work was therefore reduced. Disadvantages of 12-hour working for communication included less opportunity to interface with day staff and a need for greater reliance on written communication and log-keeping. Further consequences of 12-hour working were longer breaks between tours of duty, necessitating longer shift handovers to ensure all information was understood and incoming staff requiring a longer time to become reacquainted with operations.

The effect of a change from 8-hour to 12-hour shifts was studied in depth at a US experimental nuclear reactor. Possible effects on alertness and shift to shift communication were examined. Computerised cognitive tests of alertness were conducted. Accuracy of log book entries was quantified before and after the change from 8-hour to 12-hour working, and operators were questioned about effects of the change. Operators were slightly less alert on 12-hour shifts. The base-line error rate in log books, which was initially very low, declined further following the change. Operators reported greater ease in supervising day-shift craft personnel. Eighty percent of operators reported shift handover communication was easier under the 12-hour shift system. Much of the improvement was attributed to the fact that, on 12-hour shifts, the incoming personnel received their shift handover from personnel they handed over to 12 hours earlier. The change to 12-hour working meant breaks between work lengthened from 4 to 7 days. A significant proportion of staff reported that shift handover communication was more difficult following a 7-day absence, taking longer to "get back in the groove" of what had happened.

Shift Handover In Process Industries

The first group of empirical studies concern process operators, supervisors and managers in the nuclear reprocessing, chemical, paper manufacture and oil-refining industries.

Chemical Industry

A recent survey of permit-to-work systems in 19 small to medium-sized UK on-shore chemical plants identified communication at shift handover as a problematic issue. Fifty maintenance fitters, supervisors and managers were interviewed. One of the survey questions concerned the sequence of events at shift changeovers. When asked whether work should carry on over the shift change with an existing permit? the majority of fitters and supervisors replied that a new permit should be issued. In contrast. the majority of managers were of the opinion that work should carry on with the existing permit. A lack of clarity about how to keep incoming personnel informed of the current work situation was evident. The survey report recommended that a formal procedure for both maintenance and production shift handovers be developed which included face-to-face communication between in-coming and outgoing supervisors and a means of informing the incoming shift of work in progress.

Nuclear reprocessing industry

Formal shift handover procedures and two-way face-to-face communication were evident when production supervisors and managers in a nuclear reprocessing plant were observed during shift changeover35 and their handovers tape-recorded. Considerable time and effort was devoted to preparation for shift handover by outgoing personnel. During their shift information was collated, checked and recorded in a written log which summarised plant status. This log had a pre-determined structure to ensure that key items of information pertaining to safety, production and technical problems (ongoing and resolved) were included. The process of collation and checking intensified towards the end of the shift. Information was collated from a variety of sources including other written logs, face-to-face discussion with colleagues and personal inspection of the plant.

All handovers occurred face-to-face with the shift log present, providing an opportunity for the incoming participant to give feedback or ask for clarification. The content of the shift log was used to structure the verbal handover, which elaborated upon the written log entries. During the handover, outgoing personnel gave information and opinions. Incoming personnel gave their colleagues passive and active feedback.

The crucial importance of a two-way discussion at shift handover was demonstrated by detailed analysis of sixteen taped handover conversations and written logs. A total of six instances of misunderstandings arising during conversation were identified. The majority of these misunderstandings occurred during discussion of deviations from normal working. Four of these misunderstandings related to safety issues. On each occasion the misunderstanding was identified and repaired by the potential "victim" of the misunderstanding taking an active part in the handover by asking for confirmation, clarification and repetition.

When incoming personnel had been absent for a ten-day rest period, additional effort was expended by outgoing personnel when preparing for such handovers. A summary of important events which had occurred during the incoming participant's absence was prepared and included in the verbal handover. The average ten-day handover took longer to complete. Significantly more information was given during ten-day handovers. The difference in length was accounted for by the outgoing participant giving additional historical information to bring the incoming participant up-to-date with current plant status. Following a ten-day handover, incoming personnel read through the logs covering the period of their absence to update their knowledge and cross-check this with the information given to them by their colleague.

Management procedures pertaining to shift handover recognised the importance of face-to-face communication, specifying that handovers must be conducted in this fashion. The problematic nature of ten-day handovers was also recognised, and it was expected that such handovers would take longer to complete than normal handovers. A thirty-minute shift overlap was allowed for all handovers.

Paper manufacturing industry

The importance of two-way communication at shift handover in preventing misunderstandings was also illustrated by a study of process operators in a French paper manufacturing plant. During one handover, an operator arriving to commence a shift observed a colleague adjusting the paper-making machine. In the absence of a verbal or written handover, the incoming operator made an incorrect assumption about the cause of the breakdown. Whilst no adverse consequences resulted this incident demonstrates how the absence of verbal communication increases the potential for misunderstandings.

Oil-refining industry

Improvements to communication at shift handover were reported following a research-based intervention in a UK oil refinery. Prior to the intervention. process operators and supervisors recorded information to be communicated at shift handover in an unstructured desk diary. Although shift handover was deemed important by management. no guidance was available to operational personnel specifying how to conduct an effective handover.

The intervention involved process operators and supervisors in defining the information they would need at the start of a shift to do their work safely and effectively. Information needs were categorised and these categories used as the basis for designing structured log books for each post. Critical incident interviews were held with experienced personnel to elicit effective handover behaviours, from which behavioural guidelines were developed, specifying how to conduct an effective shift handover.

The project affected 315 personnel in 63 posts refinery-wide. Some 2-3 months after implementation, 70 personnel (21% of users) were interviewed to evaluate the intervention's effectiveness. Three-quarters of those interviewed believed the introduction of structured logs had a beneficial effect on how log books were completed, citing greater continuity between shifts, more information being passed between shifts and key items (e.g. equipment out of service) being recorded in writing and discussed verbally. Over half of those interviewed believed the introduction of structured logs had also led to improvements in the way handovers were conducted. Colleagues talked through the log book in a more structured fashion and major problems were being highlighted more reliably. Involving end-users in design and implementation of communication methods and processes was held to be a major influence on the project's success.

Shift Handover In Nursing Care

There are many parallels between continuous process tasks in industry and provision of in-patient nursing care. Both are delivered on a 24-hour basis by shift workers, who must communicate information on the human or technological systems they monitor and control across shift changes. In nursing, inaccurate communication or misunderstandings can lead to hazardous actions and medicolegal liability. A body of research on communication at shift handover in the nursing profession exists, which is summarised below.

A review of the nursing literature identifies two major considerations: the goal of the nursing task and the process of communication. Definition of the task role lends clarity to the goal of shift handover; namely to accurately communicate information so that safe nursing care can be provided from an adequate knowledge base. The review recommends basing the format and content of intershift reports on a conceptual model of the nursing task, thereby guiding the gathering of discrete, useful data to achieve the task goals.

Empirical studies of nursing have identified a number of problems associated with shift handover, implemented solutions and evaluated outcomes. Problems included reactive, routine factual reports rather than problem solving reports, missing, unnecessary or inaccurate information of variable quality and failure to carry forward information over successive shifts.

Solutions attempted were of three types: meeting nurses' information requirements by formatting documentation on the basis of a conceptual model of the nursing task, altering other methods of communication at shift handover and providing training on giving shift reports.

One study implemented a computer generated shift report solution to provide pertinent and necessary information, reduce time spent on shift handover and minimise interruption to ongoing work. Report categories were established, with an emphasis on reporting of abnormal findings/results. Guidelines for giving and receiving a report were also written. The need to transcribe information which had not changed from shift to shift was eliminated via the use of a computer system, thereby reducing the risk of transcription errors. When evaluated, the reported benefits included improved communication of pertinent information

In a separate study, nurses opinions on the efficacy of tape-recorded versus oral shift-to-shift reports were sought. Although taped reports were held to be less time consuming, they were deemed most appropriate for patients whose condition required little elaboration. In contrast, intensive care and coronary care nurses preferred a verbal report as the complex measures involved in a patient's care required elaboration and discussion with their relief. Taped reports had been tried and found inadequate.

In a third study, concern existed over traditional methods of inter-shift reporting which were largely verbal, time-consuming and contained a considerable amount of unnecessary information. Staff were encouraged to become involved in designing and implementing new methods and processes of inter-shift communication. A revised reporting format was introduced, and written guidelines for giving a shift report prepared. The project was informally evaluated. Benefits reported included more accurate and comprehensive written information and more efficient use of time. Staff involvement was seen as crucial to the project's success.

Summary

This review of empirical studies of shift handover identifies that:

- when compared to 8-hour shifts, communication at shift handover is reportedly improved in 12hour shifts. Greater reliance is however placed on written communication, and longer shift handovers are required. More effort is also needed to brief personnel who have been absent for longer periods.
- specification of information needs, and introduction of a method for capturing such information systematically, aids communication at shift handover (e.g. structured written log, computer-based log).
- information needs should be analysed on the basis of task goal.
- provision of guidance on how to conduct an effective shift handover has been found useful.
- critical incident technique is a useful method for identifying effective and ineffective behaviours at shift handover.
- misunderstandings do occur during shift handovers between experienced operators, and are repaired by face-to-face, two-way communication.
- involvement of end-users when implementing changes to established methods of communication at shift handover aids their acceptance and use.
- additional preparation, time and effort is required for shift handovers which take place after a lengthy absence. This fact should be reflected in management procedures and day-to-day practice.
- written transcription of information from page to page across successive shifts is time-consuming and error-prone, and can be aided by use of a computer-based log system.

EXISTING GUIDELINES

Given the important contribution of effective shift handover communication to industrial safety, what guidance is available to those seeking to improve their current practice? Five sets of guidance were reviewed to answer this question.

1. The Health and Safety Executive report entitled "Dangerous maintenance", which includes guidance on how to prevent maintenance accidents in the chemical industry

2. Oil Industry Advisory Committee (OIAC) guidance on permits-to-work in the petroleum industry 3. Health and Safety Executive guidance on human factors in industrial safety

4. The Institute of Electrical and Electronics Engineers human factors guidance for Nuclear Power Generating Stations

5. Human Factors Reliability Group guidance on reducing human error in process operations

The first two sets of guidance refer specifically to permits-to-work and ask "is there a shift-change procedure for permits-to-work?" and "does the permit include a handover mechanism for work which extends beyond a shift or other work period. including work which has been suspended?".

HSE human factors guidance poses the question "what arrangements (e.g. written logs. formal handover procedures) are there for conveying information between shifts on matters such as maintenance in progress. plant out of service, process abnormalities etc.?" This guidance also asks " are procedures for communication between departments (e.g. operations and maintenance) and within departments well-defined and monitored?" IEEE guidance recommends "proper (shift) turnover methods" be incorporated to ensure that the next shift has received and understands the current operating status of all plant and systems. Human Factors Reliability Group guidance draws attention to the importance of shift handover by referring to the Piper Alpha disaster and highlights the need for written procedures.

Summary

All of the guidance reviewed succeeds in drawing attention to the importance of shift handover, and in some cases refers to information which is particularly important to communicate accurately; i.e. permits-to-work, maintenance in progress, plant out of service, process abnormalities.

None of the guidelines indicate:

- the elements which should be present for effective communication: i.e. analysis of information needs; face-to-face, two-way communication; written and verbal communication etc.
- all known risk areas: for example, during deviations from normal working; during maintenance, particularly if work continues over a shift change; between experienced and inexperienced staff; following a lengthy absence from work.
- a suggested approach to improving current practice, yet this is presumably why many people consult guidelines.

CONCLUSIONS

This report has confirmed the importance of shift handover in ensuring safe and efficient continuity of work on continuous process industries. On the basis of the literature reviewed, clear conclusions can be drawn about the responsibilities of organizations operating continuous processes offshore and supervisors of continuous process staff. They should:

- give effective shift handover communication a high priority
- include communication skills in their selection criteria for shift-workers

- develop the communication skills of existing staff
- provide procedures which specify how to conduct an effective shift handover
- place greater reliance on written communication when 12-hour shifts are in operation, and allow for longer shift handovers. More effort is needed to brief personnel who have been absent for longer periods
- where possible, plan maintenance work to be completed within one shift, thereby eliminating the risk of miscommunication of maintenance issues at shift handover.

Sufficient information is available to provide general guidance on how to conduct an effective shift handover, which should be:

- conducted face-to-face
- two-way, with both participants taking joint responsibility for ensuring accurate communication
- via verbal and written means
- based on a pre-determined analysis of the information needs of incoming staff
- given as much time as necessary to ensure accurate communication.

Sufficient information is also available to provide guidance on how to assess and improve current practice. This includes:

- specification of key information needed by incoming operators to update their mental model of plant status
- design of operator supports (logs, displays etc.), based on the operator's information needs
- involvement of end-users when implementing changes to established methods of communication at shift handover, thereby facilitating their acceptance and use.

This literature review has identified areas of risk, namely:

- during plant maintenance, particularly when this work continues over a shift change. Thorough communication of such work should be afforded a very high priority
- when safety systems have been over-ridden

- during deviations from normal working
- following a lengthy absence from work
- when handovers are between experienced and inexperienced staff.

Further research which compares best practice described in this report with current practice offshore would help to identify areas for improvement. A second area meriting further research is how to ensure accurate and reliable and unambiguous carry-forward of written information from shift to shift. Information technology offers a possible solution.

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