NOPSEMA
Australia's offshore energy regulator

INFORMATION PAPER

Human Factors – Procedures and Instructions

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Key Messages

- Procedures and instructions are commonly applied as a control or mitigation for hazardous events, and so contribute to reduction of risk to a level that is as low as reasonably practicable.
- Failure of procedural controls is regularly identified as a contributing factor to incidents and near-misses.
- The effectiveness of procedures and instructions is limited or enhanced by the quality of content and the degree of compliance with these within the workforce.
- Workforce compliance with procedures and instructions is influenced by the quality and relevance of content, the readability and accessibility of the information, and the perceived effectiveness of the prescribed processes.
- Non-compliance with procedures and instructions can be minimised by improving their content, format, layout, and relevance.
- Good quality procedures and instructions, combined with high levels of workforce compliance, can improve safety, integrity and environmental performance.

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Key Definitions for this Information Paper

The following are some useful definitions for terms used in this information paper. They are a suggested starting point only and are not prescriptively defined.

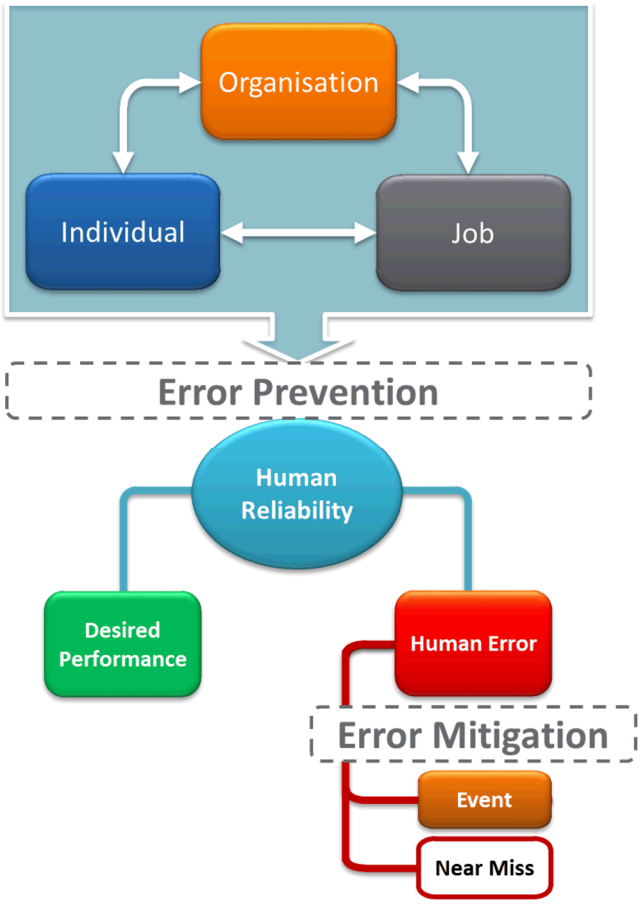
Hazardous Event	*A collective term encompassing safety, integrity, and environmental incidents, used for readability purposes within this information paper.*
Human Factors	*The ways in which the organisation, the job, and the individual interact to influence human reliability in hazardous event causation.*
Human Reliability	*The likelihood that an individual will make an error while performing a task.*
Human Reliability Analysis	*A process used to quantify the human error potential within a task.*
Performance-Shaping-Factors	*Factors that are applied as multipliers to the base error rate for a task during human reliability analysis.*

1. Introduction to the Human Factors Information Paper Series

'Human Error' has long been identified as a contributing factor to incident causation. Commonly cited statistics claim that human error is responsible for anywhere between 70-100% of incidents. It seems logical, therefore, to blame incidents on individuals or small groups of people and to focus remedial actions at the individual level (e.g. training, disciplinary action, etc.). However, by taking this approach in addressing human error, organisations ignore the latent conditions in their work systems that contribute to human error across the workforce. Rather, human error should be recognised as an outcome of combined factors, instead of the root cause of an incident. Organisational, job, and individual factors all interact to influence human reliability, that is, the likelihood that an individual will perform their task effectively or make an error.

This publication forms part of a series of information papers focusing on human factors. NOPSEMA defines human factors as "the ways in which the organisation, the job, and the individual interact to influence human reliability in hazardous event causation". Reliable behaviour results in desired performance, while unreliable behaviour may result in human error, which can lead to events and near misses. This interaction is represented in Figure 1.

Figure 1 – A Model of Human Factors



The Human Factors Information Paper Series is designed to provide information about the ways in which organisational, individual, and job factors influence human reliability, and how organisations can minimise or optimise the effect of these factors, to assist in the prevention and mitigation of hazardous events and drive continuous improvement in safety, integrity and environment performance.

1.1. Intent and purpose of this information paper

Procedures and instructions are commonly applied as a control or mitigation for hazardous events. Root cause analyses following incidents and near-misses regularly identify failure of procedural controls as a contributing factor (e.g. procedure not followed). Procedure failures are identified in almost 30% of all accident and dangerous occurrence notifications reported to NOPSEMA. Given the prominence of procedures and instructions in hazardous event causation and prevention, organisations should ensure that procedures critical to safety, integrity, and environment are of the best possible quality.

The SPAR-H Human Reliability Analysis Method (US NRC, 2005) identifies the multiplying effect that procedure quality has on the likelihood of error. Extracts from the SPAR-H are presented in Table 1.

Table 1 – SPAR-H Extract – Error Multipliers

"Diagnosis" task: base error rate 1%		
Performance Shaping Factor (PSF)	**PSF Level**	**Error Multiplier**
Procedures	Not available	50
	Incomplete	20
	Diagnostic/symptom oriented	0.5

This table indicates that, in ideal conditions a worker conducting a diagnosis task has a 1% likelihood of making an error. However, where procedures for that task are not available, the likelihood of making an error increases to 50%. Conversely, where procedures are oriented towards assisting in diagnosis and symptom recognition, the likelihood of error is reduced to 0.5%.

This information paper discusses procedures and instructions as a job-level performance shaping factor within the human factors framework. It is designed to foster continuous improvement in the development, implementation and maintenance of procedures and work instructions. It provides information that organisations may wish to consider in relation to their procedures and work instructions.

It should be noted that procedures and instructions are classified as administrative controls, and as such are limited in their ability to prevent and mitigate hazardous events. Such controls are highly susceptible to human error, and should not be used as a primary or sole barrier to hazardous event prevention. Additionally, non-compliance with procedures and instructions should not incur an automatic disciplinary response. A human factors approach should be taken to identify whether the non-compliance was deliberate or not. If the non-compliance was not deliberate, then action should be taken to identify potential performance-shaping factors contributing to error. If the non-compliance was deliberate, then further investigation is required to identify the antecedents and consequences which supported the decision to violate. For example, the procedure may be incorrect leading to a perceived need to violate, in order to complete the work.

Further information on addressing rule non-compliances can be found in the Health and Safety Executive publication: ***Techniques for Addressing Rule Violations in the Offshore Industries***.

Further information on human error and human reliability analysis can be found in the ***Human Factors*** page on the NOPSEMA website.

Please note: Information papers provide information, background and practices to foster continuous improvement within industry. NOPSEMA acknowledges that what is good practice, and what approaches

are valid and viable, will vary according to the nature of different organisations, offshore facilities and their hazards.

2. Procedures and Instructions

This section describes some of the ways in which organisations can improve their procedures and instructions, to assist in the reduction of risk to a level that is as low as reasonably practicable. Emphasis is placed on factors that are likely to improve workforce compliance with procedures and instructions. Information and recommendations provided within this section pertain to document content, structure and layout, implementation, and modifications.

2.1. Content

The accuracy and relevance of procedure and instruction content is one of the key drivers for workforce compliance. When procedures or instructions do not reflect current practice, are not updated following significant changes (e.g. new or modified technology, organisational restructuring, etc.), or are not indicative of the best way of doing the job, non-compliances become more likely. When work is conducted outside of approved procedures, the potential for the introduction of unknown and uncontrolled risks and hazards is increased. It is therefore vital that, for tasks critical to safety, integrity and environment, procedures are well-maintained and relevant, and are designed and managed in such a way that encourages compliance.

Active workforce involvement in the development of procedures and instructions is one of the best ways to ensure accurate and relevant content, encouraging compliance and reducing risk. The people who do the work have a realistic view of what is achievable and the level of detail that is appropriate, and should also be able to describe likely barriers to workforce compliance with the procedure. In addition to improved content, such involvement can lead to a sense of workforce ownership over the material developed, where the procedure is viewed as belonging to the workforce rather than as a management tool. This can also improve compliance as members of the workforce are more likely to perceive the procedure as useful, and to have a vested interest in the success of the procedure they have developed.

Consideration should also be given to the level of detail contained within the procedure or instruction. Too much detail may discourage use, while too little detail may facilitate error. The appropriate level of detail will differ from case to case. A high level of detail may be necessary for tasks that are unusual or conducted infrequently, highly complex, or where a specific set of actions must be performed in the correct order each time the task is completed, such as a facility shutdown procedure. Less detail may be appropriate for routine maintenance work or tasks where hazards and risks are well controlled with higher level controls (e.g. engineering, isolation, etc.).

Tips for Developing Good Quality Content

- Conduct a task analysis to determine how the work is actually done, rather than how a manager or engineer thinks it 'should' be done.
- Involve the people who do / will be doing the work, including people with varying levels of experience.
- Involve safety and risk professionals where instructions pertain to hazard control and risk mitigation.
- Ask workers to identify potential barriers to procedure compliance – such as why a particular step might not be followed – and to suggest alternatives or solutions.
- Resolve disagreements by developing a number of drafts with varying content. These can later be tested to determine optimal performance outcomes.
- For routine tasks, develop different versions of a procedure to be used by personnel at different job levels. As experience increases, the detail contained within the procedure can generally be reduced.
- For infrequent, unusual or highly complex tasks, detailed procedures should be used by all personnel.

2.2. Structure and layout

While the content of an instruction or procedure is vital to workforce perceptions of validity and usefulness, the structure and layout of such documents is equally important in reducing non-compliances. Procedures and instructions that are difficult to read or understand are not a useful resource for the workforce. Such documents, even if their content is good, are unlikely to be used, and when used are likely to contribute to error.

Procedures and instructions should follow a consistent format across the organisation. They should be written using simple language, avoiding jargon and acronyms, and using terminology that will be easily understood by those doing the work. They should provide a complete instruction in how to perform the task, not requiring the reader to refer to other procedures, standards, or reference documents.

Font and spacing should allow for easy reading rather than saving space on the page. Where the procedure or instruction is written in a step-by-step format, each step should ideally contain only one action. Steps should be numbered, and should proceed in logical order. Actions should be written in the present tense with sentences beginning with an action verb. For example, "close the valve" rather than "the valve should be closed". Where two or more workers are required to interact within the procedure, the use of a 'play-script' format can help to avoid misunderstandings. For example:

Mechanic: [perform action]

Electrician: [perform action]

Pictures, graphs, diagrams and tables should be used where possible to replace long sections of explanatory text. These should be located adjacent to corresponding text, in chronological order. Procedures and instructions should be designed to eliminate or simplify mental calculations. For example, rather than providing a target with error bands (e.g. 150 ± 10%), a range of values will convey the same information without requiring a mental calculation (e.g. 135-165).

Finally, warnings and cautions should be clearly distinguishable from other text. Different font style, size and colour should be employed to ensure warnings and cautions stand out. They should be located immediately before the step or information to which they apply, and should contain information about how to prevent and respond to the hazard or potential incident to which they refer.

Tips for User-Friendly Structure and Layout

- Develop a template for procedures and instructions to be applied across the organisation.
- Use language appropriate to an 8th grade reading level.
- Use present-tense language.
- Begin steps with action verbs.
- Use a 12-point serif style font and double spacing.
- Number each step using whole numbers, not decimals.
- Insert one blank line between each step.
- Use play-script format where interaction between two or more workers is required.
- Do not refer the reader to other documents for task-critical information or instruction.
- Avoid interrupting a sequence of steps with non-critical supporting information. Such information should be presented in a different section of the document.
- Ensure that steps do not contain any ambiguous information (i.e. instructions that are open to interpretation, such as "use appropriate tools" rather than "use tool x").
- Provide conversion tables, worksheets, graphs, and value ranges to eliminate mental calculations.
- Use diagrams and pictures instead of descriptive text where possible.
- Use a different font colour, style and size for warnings and cautions.

2.3. Implementation

Effective implementation of a procedure or instruction isn't as simple as publishing a document and informing the workforce that they must now use it. Before the document is finalised and published, it should be trialled by the workforce for their comments and feedback. Feedback should focus on people's understanding of the content, their ability to perform the steps as described in the document and any

potential barriers to compliance. Multiple trials with different teams or individuals should be conducted to ensure that all potential issues and weaknesses are identified before the final document is released. Questionnaires or rating scales may help to generate useful feedback; alternatively a health and safety representative or safety advisor may be able to facilitate this process through workshops and group discussions.

Workforce feedback should be incorporated into the next revision of the document. Revisions should be trialled again to determine whether changes appropriately address the feedback received, and also whether the changes introduce new issues or problems. Where possible, including members of the workforce in the drafting and revision process is likely to reduce the number and significance of revisions required.

Supervisor engagement is also important to minimise non-compliances. Supervisors who disagree with the content of procedures and instructions may deliberately or inadvertently discourage compliance within their crews. Therefore, supervisors should also be involved in the review and feedback process.

Training may be required when implementing new or modified procedures. The type and intensity of training will depend on the significance of the behavioural or cognitive changes required of the workforce. Training should not be treated as a box-ticking exercise to demonstrate that the workforce has been 'trained' in the procedure or instruction. While accurate records management is important, if training is ineffective, then it is essentially a waste of time and money. Training should focus on facilitating the learning process, and should provide the workforce with an understanding of why the procedure or instruction contains certain steps. This type of systems-based knowledge is likely to assist members of the workforce in understanding the rules behind the procedures, which is likely to reduce occurrences of rule-based mistakes.

Finally, procedures and instructions should be easily accessible to the workforce in their current revision. If hard copies are to be kept on site, management of change processes should ensure that all hard copies are replaced when documents are revised. If electronic versions are preferred, then members of the workforce should have easy access to a networked computer and printer.

Tips for Effective Implementation

- Conduct workplace trials of all draft procedures and instructions critical to safety, integrity and environment.
- Generate structured and specific post-trial feedback from the workforce.
- Incorporate workforce feedback into new drafts and trial these again.
- Engage supervisors in trials and feedback.
- Deliver learning-focused training in conjunction with the release of new or revised procedures and instructions.
- Ensure that procedures and instructions can be easily accessed and printed at the worksite.

2.4. Modifications

To maintain the relevance and validity of procedures and instructions, it is vital that mechanisms are in place to facilitate fast and efficient in-field modifications. A robust review and approvals process is absolutely necessary; however this must occur in a timely manner. When the workforce identifies a task or situation to which the procedure does not apply or is incorrect, or if they believe there is a better way to do it, non-compliances become more likely. In these situations, for compliance to be maintained it is critical that members of the workforce are able to recommend modifications or alternatives and have these approved in a timely manner before the job continues. This may take the form of a temporary deviation or similar, which is approved by site-based experts for use within a specified time period. If further approvals are necessary for a permanent modification, these should occur within the time period listed on the deviation. Alternatively, the deviation may only apply for a unique situation, such as an unexpected breakdown of equipment, and so there may not be a need to permanently modify the procedure or instruction.

Outside of field-based modifications, procedures should also be reviewed following changes to the facility or the organisation, to ensure that they continue to reflect the best way to complete the task. Such changes may include reporting lines, roles and responsibilities, organisational priorities, or the introduction of new plant and equipment. For example, on Piper Alpha, evacuation procedures were not revised following significant changes to the platform. As a result, during the platform fire and explosions, personnel who followed the muster procedure could not access the life boats and were unable to evacuate.

Finally, as with all organisational documentation, procedures and instructions should be reviewed regularly to ensure that they remain appropriate. Reviews should be scheduled according to risk; therefore review periods are likely to vary between documents. Reviewers should be allocated a sufficient amount of uninterrupted time to perform the review – simply allocating the task without appropriate resourcing will result in delays or poor quality reviews. For procedures and instructions relating to high-risk tasks, workplace observations may assist the reviewer in identifying whether the procedure reflects current practice, whether improvements can be made, or whether relevant crew members require a 'refresher' to improve compliance.

Tips for Timely Modification Management

- Allocate responsibility for in-field procedure deviation approvals to appropriate on-site discipline leaders or experts.
- Prioritise procedure deviation approvals, or set a time limit by which any applications for deviation must be approved or rejected.
- Where deviation requests are rejected, the reviewer should discuss reasons with the crew or individual involved, and work with them to develop an appropriate deviation that will meet the needs of all parties whilst managing risk effectively.
- Include procedure and instruction reviews in formal Management of Change processes.
- Conduct regular reviews of procedures and instructions to ensure that they continue to reflect current and best practice.

3. Critical success factors for procedures and instructions

- Ensure that procedures and instructions contain accurate and up-to-date information.
- Format procedures and instructions to facilitate readability.
- Involve the workforce in the development of procedures and instructions.
- Engage supervisors to promote compliance with procedures and instructions.
- Conduct workplace trials of new and modified draft procedures and instructions, and use feedback to improve the documents prior to publishing.
- Implement mechanisms to allow for timely in-field approval of temporary deviations to procedures and instructions.
- Incorporate procedure and instruction reviews into formal management of change processes.
- Conduct regular risk-based reviews of procedures and instructions.
- In cases of non-compliance, explore reasons (antecedents and consequences), and develop solutions to remove the perceived or actual need for non-compliance rather than automatic disciplinary action or 'retraining'.

4. References, acknowledgments & notes

U.S. Nuclear Regulatory Commission (2005). *The SPAR-H Human Reliability Analysis Method.* Retrieved from: **http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr6883/cr6883.pdf**

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