NOPSEMA
Australia's offshore energy regulator

INFORMATION PAPER

Human Factors – Personnel Resourcing

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Key Messages

- Appropriate personnel resourcing processes contribute to effective risk management.
- An understanding of the impact of time pressure and fatigue on human reliability should be applied to resourcing activities.
- Emergency response positions should be well resourced at all times.
- Maintenance activities should be designed and scheduled to reduce the likelihood of error, particularly in relation to interruptions and time pressure.
- Maintenance activities should be subject to independent checks to mitigate any errors that may have occurred prior to task closeout.
- Supervisors should develop a working knowledge of human error and performance shaping factors, and should apply that knowledge in their daily activities.
- Organisational systems and structures should be in place to support supervisors in managing relevant performance shaping factors.
- Supervisors should not be overburdened with administrative tasks; rather their priority should be to spend sufficient time coaching their employees.

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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.

Circadian Rhythm	*The pattern of sleepiness and alertness experienced during a 24 hour period.*
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.*

Abbreviations/Acronyms

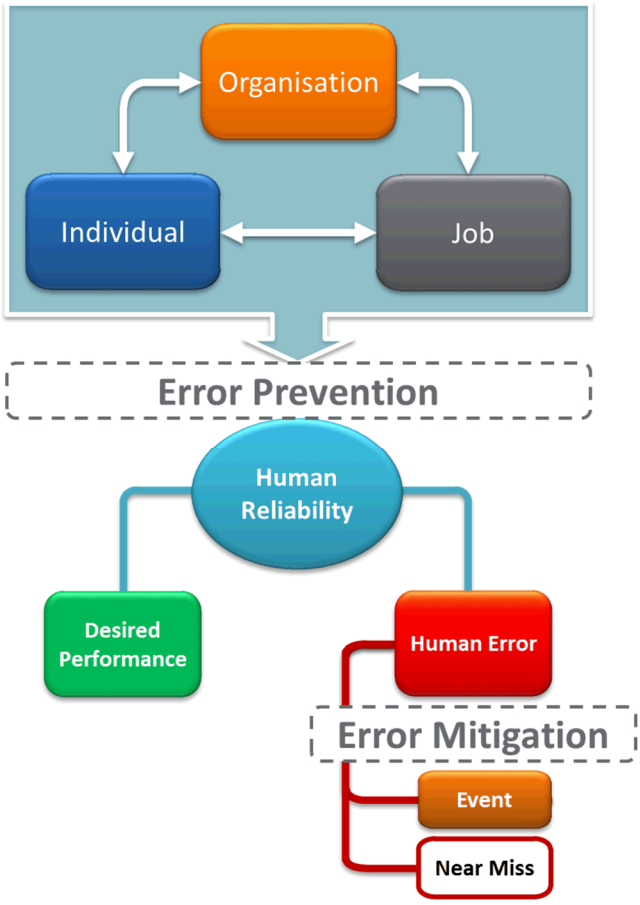
ER	*Emergency Response*
POB	*Persons-on-Board*
PSF	*Performance Shaping Factor*

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

Personnel resourcing practices can significantly impact human reliability both positively and negatively. Effective personnel resourcing activities and systems can contribute to the reduction of safety, integrity and environment risks to a level that is as low as reasonably practicable.

This information paper discusses personnel resourcing as a job-level factor within the human factors framework. Relevant performance shaping factors (PSFs) which are likely to influence performance are discussed in relation to a number of typical activities. Strategies to eliminate, minimise, mitigate or leverage the impact of such PSFs are identified.

This information paper is designed to foster continuous improvement in the area of personnel resourcing. It provides information that organisations may wish to consider within their personnel resourcing systems, procedures, and activities.

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. Personnel Resourcing

This section describes some of the ways in which appropriate personnel resourcing can assist in the reduction of risk to a level that is as low as reasonably practicable. Strategies are discussed for all activities in general, and then more specifically in relation to emergency response activities, maintenance activities, and supervision.

2.1. Matters Relevant to All Activities

Organisations should ensure that work is conducted in a manner that is safe and without health risk. An understanding of resourcing factors likely to diminish human reliability should be taken into account when planning activities. Resourcing should be conducted in such a way that minimises error and supports proactive risk management behaviour.

In particular, the effects of fatigue and time pressure should be recognised as factors that increase the likelihood of error and diminish proactive risk management behaviour. The SPAR-H Human Reliability Analysis Method (US NRC, 2005) identifies the multiplying effect that such PSFs have 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
Available time	Inadequate	100
	≈ 2/3 required time	10
	≥ 5x required time	0.1
	≥ 50x required time	0.01
Fitness for Duty (e.g. fatigue)	Unfit	100
	Degraded	5

This table indicates that, in ideal conditions a worker conducting a diagnosis task has a 1% likelihood of making an error. However, where available time to perform the task is inadequate, or where a worker is fatigued, error becomes 100% likely. By increasing the time available to complete the task, the likelihood of error can be significantly reduced.

The following strategies may assist in minimising the effects of fatigue and time pressure:

- Include hazard identification and control activities in man-hour estimates for tasks and activities.
- Where practicable, schedule tasks and activities with an understanding of the impact of circadian rhythm within a shift, and that of fatigue over the course of a swing.
- Provide education, tools and training for personnel in recognising the signs of fatigue, in themselves and in others.
- Develop practical procedures for managing personnel experiencing fatigue. Note that a 'self-reporting' approach is unlikely to work if fatigue management strategies are ineffective, or if they are likely to increase the workload of team members.

- Implement an evidence-based best practice approach to night-shift rostering.
- Plan for workforce involvement activities (e.g. in risk assessments, permissioning document development, etc.) and ensure that robust involvement is not impeded by production requirements.
- In the case of turnover, re-assess activity plans to account for a diminished workforce. Even where a replacement is immediately sourced, allowances should be made for reduced productivity as the replacement becomes familiar with the role as well as the facility and its people, systems and culture.

Example – Resourcing for Circadian Rhythm

Adults are likely to feel the strongest need for sleep between the morning hours of 2:00 and 4:00am, and also between the afternoon hours of 1:00 and 3:00pm. To reduce fatigue-induced error, use these time periods for morning and afternoon tea breaks and low-risk tasks that not critical to safety, integrity or environmental management.

Further information regarding fatigue management can be found in the following publications:

UK HSE 2008: ***Guidance for managing shift work and fatigue offshore***

IPIECA-OGP 2013: ***Performance indicators for fatigue risk management systems***

2.2. Emergency Response Activities

Effective emergency response (ER) is highly dependent on the availability of personnel who are competent to perform key roles. In the event of an emergency, it is critical that each person on a facility understands their role. From mustering through to coxswain duties or overall command, each role contributes to a successful ER outcome.

Organisations should ensure that their persons-on-board (POB) profile will facilitate effective emergency response. All positions identified as necessary for ER should be present on a facility at all times. Risks to the maintenance of adequate ER personnel resourcing should be identified, with mitigations implemented to ensure that required ER roles will always be filled.

Emergency response role requirements should be built into planning and resourcing processes. Systems should be capable of identifying gaps in ER capability within forward plans, including the identification of competency expiry dates where relevant. Strategies should be developed for unplanned situations where gaps in ER capability occur, for example, where a person with a designated ER role is demobilised due to illness.

The following strategies may assist in maintaining appropriate personnel resources for emergency response:

- Incorporate ER capability requirements into planning processes and POB profiles. Ensure that systems flag gaps in ER capability rather than relying on individuals to 'eyeball' lists or spread sheets.
- Ensure a level of redundancy for all ER roles. That is, more than one person per swing should be competent to perform each ER role.
- Allocate each ER role to a specific individual during each swing, to avoid confusion in the event of an emergency. ER role allocations should be clearly displayed in the muster areas.

- Conduct regular ER drills and exercises followed by debriefing to identify gaps in the system, with corresponding improvement actions developed where necessary.
- Develop clear protocols in the event that an ER role on a facility becomes unexpectedly vacant and cannot be filled with existing POB.

Example – Emergency Response Drills and Resourcing

After each emergency response drill, hold a debriefing session with personnel allocated to ER roles. Seek to identify gaps or potential weaknesses in the ER process, and develop solutions as a team. Potential debriefing questions relevant to personnel resourcing include:

- Were all ER roles filled with competent personnel?
- Were surplus personnel available for each ER role?
- Did everyone know which role they were responsible for?
- Did anything unexpected happen?
- Was anyone required to perform a function outside of their designated role?
- What factors impeded time-efficiency?

2.3. Maintenance Activities

Maintenance of offshore facilities is a critical aspect of risk reduction. Errors during maintenance activities can create latent hazards which may contribute to hazardous event causation. For example, when changing a valve in the blowdown system, a maintenance technician could install the wrong gasket. This error may go undetected until the blowdown system is required for use, with potentially disastrous consequences.

There are a number of engineering and design solutions that can eliminate or minimise the potential for maintenance error. Further, maintenance procedures should be developed with a focus on practicality, readability, simplicity, and useability. From a personnel resourcing perspective, the following strategies may also assist in minimising and mitigating maintenance error:

- Allow more than the average time requirements for maintenance task completion. This will facilitate effective diagnosis and problem-solving, and reduce the likelihood of corner-cutting or memory lapses.
- Eliminate mid-task interruptions for maintenance technicians. Maintenance tasks typically require the completion of a specific sequence of steps. Mid-task interruptions can cause maintenance technicians to forget their location in the sequence, and consequently to miss critical steps.
- Avoid 'bumping' maintenance personnel in favour of production-related project personnel. Increased maintenance backlog is likely to lead to real or perceived time pressure, increasing the likelihood of error. Further, this practice may lead to a workforce perception of an overriding production priority, which may then negatively influence workforce risk management behaviour.

- Develop quality assurance processes to be implemented for all maintenance tasks with the potential to contribute to or exacerbate hazardous events. These processes should include detailed checking of all work completed within the maintenance task, including steps completed, equipment used/installed, and checks conducted by the original technician.
- Assign such quality assurance tasks to more experienced technicians, and prioritise these tasks over others. Additionally, allow excess time for these tasks to promote thorough and detailed inspections.

Example – Reducing maintenance error

Create a priority rule for maintenance tasks whereby once a maintenance task is commenced it cannot be interrupted. Inform all employees and contractors of this rule, and educate them on the error mechanisms that this rule will help to minimise. The rule should also apply to lunch, morning and afternoon tea breaks – a new task should only be started if there is sufficient time to complete it before the next break. Larger maintenance activities should be broken into discrete tasks with key milestones or deliverables that can be achieved within a smaller timeframe. This approach facilitates a more effective handover and reduces the likelihood that a step will be missed.

2.4. Supervision

Supervisors perform a vital role in the prevention and mitigation of hazardous events. For employees, a supervisor is the face of the organisation, representing the organisation's values, priorities and expectations. Employees look to their supervisors' actions to identify those behaviours which are likely to be viewed favourably or otherwise by the organisation. Employees are more likely to demonstrate behaviours that align with perceived organisational priorities. As such, supervisor language and behaviour has a direct impact on employee behaviour. From a risk management perspective, effective supervision requires time spent coaching employees in identifying, understanding and mitigating risk. This approach to supervision not only educates employees in the how and why of risk management, but also demonstrates that it is a priority for the organisation. Further, feedback is one of the most effective tools that supervisors can use to improve employee performance.

There are a broad variety of strategies that can and should be used to improve supervisor performance in promoting and reinforcing risk management behaviour. From a personnel resourcing perspective, the following strategies may be beneficial:

- Maintain a low employee to supervisor ratio for teams where risk management is a critical part of their function.
- Provide supervisors with training and coaching in understanding human error mechanisms and PSFs, particularly in relation to fatigue and time pressure. Develop procedures and organisational structures to support supervisors in implementing this knowledge.
- Encourage supervisors to provide feedback to planners in relation to actual vs. planned time for task completion, and build this feedback into future man-hour estimates.
- Provide supervisors with an opportunity to challenge or question plans and schedules in relation to the effect of PSFs on performance.

- Exercise caution when adding to the workload or responsibilities of supervisors. Research shows that, as their workload increases, supervisors spend less time engaged in one-on-one coaching with their employees. This is one of the most effective leadership tools used by supervisors, particularly in relation to promoting and encouraging risk management behaviour.

Example – Helping supervisors to manage employee fatigue

Develop guidelines and tools to assist supervisors in identifying fatigue in their crews, and supporting procedures for managing the risk. Focus should be paid to potential (formal or informal) disincentives to reporting fatigue. For example, if a supervisor's response to reported fatigue is "harden up" (whether said seriously or with humour) this will adversely impact the effectiveness of any attempts to improve fatigue management. Similarly, if a report of fatigue will result in an increased workload for the rest of the team, individuals may feel discouraged from reporting. It is therefore critical that any approach to improved fatigue management includes appropriate supervisory training and systems support such as capability for modification of task completion targets.

3. Critical Success Factors for Personnel Resourcing

- When developing schedules for tasks that are critical to safety, integrity and environment, allow excess time for completion.
- Take an evidence-based approach to fatigue management and night-shift rostering.
- Develop procedures and protocols to ensure that all emergency response positions required for a facility are filled at all times.
- Design maintenance tasks to minimise the potential for error, particularly in relation to time pressure and interruptions.
- Ensure that all maintenance activities critical to safety, integrity and environment are independently checked by an experienced technician prior to closeout.
- Provide supervisors with sufficient training, coaching, time and resources to prevent and mitigate the effects of fatigue and time pressure on their employees.
- Where possible, delegate administrative tasks away from supervisors, allowing them more time to spend coaching their employees.

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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