

## Well integrity control measures and performance standards

### Core concepts

#### Control measures

- Control measures are the means by which a titleholder reduces the risks to well integrity associated with their well activities. Control measures also include contingency and emergency plans.
- Titleholders must be able to demonstrate that they have examined the existing control measures of a well and considered any alternative or additional control measures which take account of the current scale and complexity of a well and the risk profile of the well.
- Control measures include those physical features that make up a well and those elements of a titleholders management system which are utilised in the design, construction, operation, suspension and permanent abandonment of a well such that the measures combined eliminate, prevent, reduce, mitigate or otherwise ensure that risks to well integrity are reduced to a level that is as low as reasonably practicable (ALARP).
- Control measure identification, assessment and selection should involve those people who have a thorough knowledge and understanding of the use and possible failure modes of the identified control measures.
- Control measures must be clearly understood in terms of their effectiveness in reducing risk, including their functionality, reliability, independence, survivability, compatibility, maintainability and availability.
- The use of a range of different control measures generally provides a greater level of protection, particularly if using additional levels of independent protection.
- As with all risk reduction measures, preferential order should be considered when selecting control measures. Hierarchies of control measures are typically defined in order of priority as, eliminate; prevent; reduce; mitigate. Applying a hierarchy of control measures involves for example designing out or physically removing a hazard at source and controlling residual risks by engineering or organisational means.
- The titleholder's management system must provide for all activities that will occur, or have a reasonable possibility of occurring at a well. Control measures must be applied to all risks at a well that have the potential to cause harm to people as well as those risks associated with the integrity of a well.
- Control measures must be reviewed periodically to ensure well risks remain ALARP. This principal is also linked to lifecycle management, management of change and integrity assurance processes.

#### Performance standards

- A titleholder's management system for well construction, operation, suspension and permanent abandonment must specify the performance standards against which the control measures are to be assessed to ensure and demonstrate that the measures are reducing risk to ALARP on a continuous basis.
- A titleholder's management system should be comprehensive, integrated and able to describe within the WOMP the performance standards and control measures used and by so doing demonstrate competency of the larger integrated management framework.

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## Abbreviations/acronyms

MTBF	Mean time between failures
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
SMART	Specific, measurable, appropriate, realistic and timely
WOMP	Well operations management plan
ALARP	As low as reasonably practicable

## Key definitions for this guidance note

Old regulations	means the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 as in force immediately before 1 January 2016.
New regulations	means the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 as in force from 1 January 2016.
ALARP	a term used to identify a risk that has been reduced to a level that is 'As Low as Reasonably Practicable'. In practice this means a titleholder must demonstrate through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce risks further.
Control measure	any policy, procedure, process, system, device or other means of eliminating, preventing, reducing or mitigating the risk of a loss of well integrity. Control measures are the means by which risk is eliminated or minimised.
Hierarchy of control measures	a protocol used when deciding what kind of control measure should be applied to address a particular hazard. The rationale underlying a hierarchy of control measures is that organisations should look to employ the highest reasonably practical level of control (e.g. elimination) rather than a lower control (e.g. administrative controls).
Measurement criteria	a statement specifying a required level of performance and which provides evidence of competent performance.
Performance outcome	the anticipated result of an activity or process after employing accepted performance standards with appropriate control measures and monitored against effective measurement criteria.
Performance standard	a level of performance established by the titleholder against which, the performance of a policy, procedure, process, system or device is measured. Performance standards are used as a basis for measuring the effectiveness of the control of risks associated with a loss of well integrity.
Risk assessment	a process of estimating the likelihood of an undesirable event (a consequence) and its associated consequences of a given severity.
Source control	management response to well control planning/execution and recovery from a loss of well integrity.
Well	a hole in the seabed or subsoil made by drilling, boring or other means, in connection with: exploration of petroleum, petroleum production and



	injection into a geological formation of greenhouse gas substances, or other substances.
Integrity	in relation to a well; means the capacity of the well to contain petroleum, a greenhouse gas substance, or any other substance.
Well related equipment	means any plant or equipment or other thing for containing pressure or fluids in a well.

## 1 Introduction

### 1.1 Intent and purpose

This document provides guidance on the control measures and performance standards as part of the preparation of a well operation management plan (WOMP) for titleholders operating in Australian Commonwealth waters as required under the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 and the corresponding laws of each State and Territory.

The purpose of the guidance note is to assist titleholders through the process of identifying, assessing and selecting control measures and to identify, assess and select the relevant performance standards for those control measures in the context of preventing a potential loss of well integrity and to support the evidence that risks are reduced to a level that is as low as reasonably practicable (ALARP).

The guidance note will be of use to those responsible for developing a WOMP and those involved in its implementation and ongoing risk management.

The guidance note should be read in conjunction with other relevant guidance notes; the full set is available on the NOPSEMA website along with guidance on other relevant legislative requirements.

NOPSEMA acknowledges that what is considered good practice and what approaches are valid and viable will vary according to the nature of the differing risks associated with well integrity. While this guidance note puts forward possible approaches to address the risks to meet the compliance requirements of the regulations, the selection is not exhaustive and titleholders may choose to use other approaches not covered by this guidance note.

This guidance note is not a substitute for detailed advice on the regulations or the Act.

The guidance note is designed to assist titleholders to ensure that evidence is provided in the WOMP that provides a description of the control measures in place that ensure that risks to the integrity of the well will be reduced to as low as reasonably practicable (ALARP) throughout the life of the well, including periods when the well is suspended (e.g. not operational but not permanently abandoned), and that a description of the performance standards for those control measures are also described and appropriate. Additionally, a description of the planned performance outcomes and measurement criteria against which performance is to be measured should also be included.

Further, a description of the monitoring, audit and well integrity assurance processes that will be implemented to ensure the performance outcomes and performance standards are met throughout the life of the well, including periods when the well is not operational but has not yet been permanently abandoned, should also be included.

The titleholder is required to provide a description of the measures that will be used to ensure that contractors and service providers undertaking well activities as part of the titleholder's activities are aware of their responsibilities in relation to the maintenance of the integrity of the well. The titleholder should also describe the measures taken to assure appropriate contractor and service provider competency and training.

Suspension and abandonment assurance is a critical element of well integrity and a description of the arrangements in place for suspension and abandonment of wells should be included in the WOMP. This should describe how:

- during the process of suspending or abandoning a well, risks to the integrity of the well will be reduced and maintained to as low as reasonably practicable
- the actions taken to suspend or abandon a well will provide assurance that the integrity of the well will be maintained throughout its designated period of suspension or abandonment
- at the conclusion of suspension and abandonment activities, no unknown hindrance, obstruction or other impediment will be afforded to other users of the sea.

It is further anticipated that a full description of the measures and arrangements that will be used to regain control of a well if there is a loss of integrity will also be included.

*Further guidance is available in the NOPSEMA Well Integrity guidance notes:*

- ALARP in the context of well integrity – N-04600-GN1616
- Hazard Identification and Risk Assessment – N-04600-GN1613

## **1.2      The risk management process as applied to WOMP**

The requirements as to management of risk under the regulations are described in subregulations 5.05; 5.06; 5.09; 5.10 and 5.24 as below.

### **Requirement to undertake in accordance with well operations management plan**

- Reg 5.05(3)**      A titleholder may request, in writing, the consent of the regulator to the titleholder undertaking a well activity in a specified manner.
- Reg 5.05(4)**      The request must include sufficient information for the regulator to assess whether or not undertaking the well activity in that manner would result in the integrity of the well becoming subject to a significant new risk or a significantly increased risk.
- Reg 5.05(5)**      The regulator may give consent only if there are reasonable grounds for believing that undertaking the well activity in that manner will not result in the integrity of the well becoming subject to a significant new risk or a significantly increased risk.  
The consent must be in writing.

### **Application for acceptance of well operations management plan**

- Reg 5.06(1)**      A titleholder may apply to the regulator for acceptance by the regulator of a well operations management plan.
- Reg 5.06(3)(b)**    The plan may apply to more than one well if the integrity of each well is subject to similar risks.

### **Contents of well operations management plan**

- Reg 5.09(1)**      The matters that must be included in a well operations management plan are the following:
- (b)**      a description of the risk management process used to identify and assess risks to the integrity of the well;
  - (c)**      a description and explanation of the design, construction, operation and management of the well, and conduct of well activities, showing how risks to the integrity of the well will be reduced to as low as reasonably practicable;
  - (e)**      a description of the control measures that will be in place to ensure that risks to the integrity of the well will be reduced to as low as reasonably practicable throughout the life of the well, including periods when the well is not operational but has not been permanently abandoned;
  - (i)**      a description of the arrangements that will be in place for suspension and abandonment of the well, showing:
    - (i)**      how, during the process of suspending or abandoning the well, risks to the integrity of the well will be reduced to as low as reasonably practicable.

**Revision based on circumstances**

**Reg 5.10(2)** A titleholder must (except when the regulator has consented under sub-regulation 5.05(5)) submit to the regulator a proposed revision of a well operations management plan that is in force for a well in the title area, before making a significant change to the manner in which risks to the integrity of the well are reduced to as low as reasonably practicable.

**Reg 5.10(3)** A titleholder must submit to the regulator a proposed revision of a well operations management plan that is in force for a well in the title area:

(a) as soon as practicable after the integrity of the well becomes subject to a significant new risk or a significantly increased risk.

**Notice of change in activity or circumstances**
**Reg 5.24(2)**

- (1) If the information in a notice about a well activity given to the regulator is no longer accurate, the titleholder must provide the Regulator with updated information as soon as practicable.
- (2) Subregulation (1) does not apply if the reason why the information is no longer accurate is because the integrity of the well is subject to a significant new risk or a significantly increased risk.

Note: A significant new risk or a significantly increased risk requires a revision of the well operations management plan for the well—see subregulation 5.10(3).

### 1.3 Control measure identification, assessment and selection

The aim of control measure identification, assessment and selection is to:

- understand the effectiveness of adopted control measures and their impact on risk
- provide the basis for justifying the selection or rejection of control measures
- show clear linkages between the control measures and the potential loss of well integrity or other hazards they are intended to control
- demonstrate within the WOMP that the risks have been reduced to a level that is ALARP
- provide a means of monitoring the ongoing effectiveness of the control measures.

### 1.4 Features of control measure identification and assessment

The risk assessment, control measure identification and assessment philosophy should be reflected in the titleholder's WOMP. For example:

- If the titleholder intends to base the WOMP largely on compliance with specific international guidance and standards, the risk assessment and control measure selection should address corresponding issues, their applicability to the well, and the risks associated with compliance.
- Conversely, if the titleholder intends to base the WOMP on fundamental engineering and/or management systems, the risk assessment and control measure selection should be structured accordingly.

In particular, if the titleholder intends to diverge from established international guidance or standards, or if the international guidance and standards are not fully applicable to the well, the risk assessment should address these issues. Titleholders should use the risk assessment as a way of identifying alternative and more effective/efficient means of managing risk and so use risk assessment to establish the most appropriate controls for the well.

The approach taken will depend on the nature of the activities and the risk management decisions of the titleholder. In all cases the WOMP should show that the risk assessment and control measure identification and selection is based good risk management decisions which are appropriate to what the well may face.

Finally, if communicated appropriately the risk assessment process creates knowledge, awareness and preparedness within the organisation. Knowledge of risks and their implications are necessary to prevent well integrity incidents and is in itself an important control measure.

## 1.5 Understanding control measures in relation to the risks

Understanding the linkage between control measures and the hazards which may give rise to a potential loss of well integrity is critical in assessing the control measures that prevent or mitigate each consequence. The nature, scale, range of risks and potential outcomes that each control measure is designed to address and the relationship of the control measure to the risk needs to be clearly understood, i.e. the mechanism by which the control measure would work to prevent or manage the risk associated with a potential loss of well integrity.

The mechanism for each control measure for the range of operating conditions that may exist at the well (normal, abnormal or emergency conditions) needs to be clearly understood. It is also necessary to determine whether there are sufficient control measures for all the possible risks and outcomes and that they are robust enough to reduce the risk associated with the potential loss of well integrity to ALARP.

One way to represent the relationships between risks, outcomes, control measures and potential loss of well integrity may be through the use of bowtie analysis (cause-consequence diagrams). The relationship between the proactive control measures, the event, the reactive control measures and the outcomes for each hazard is demonstrated below (Figure 1). Proactive controls are also referred to as preventative controls and reactive controls referred to as mitigation controls.

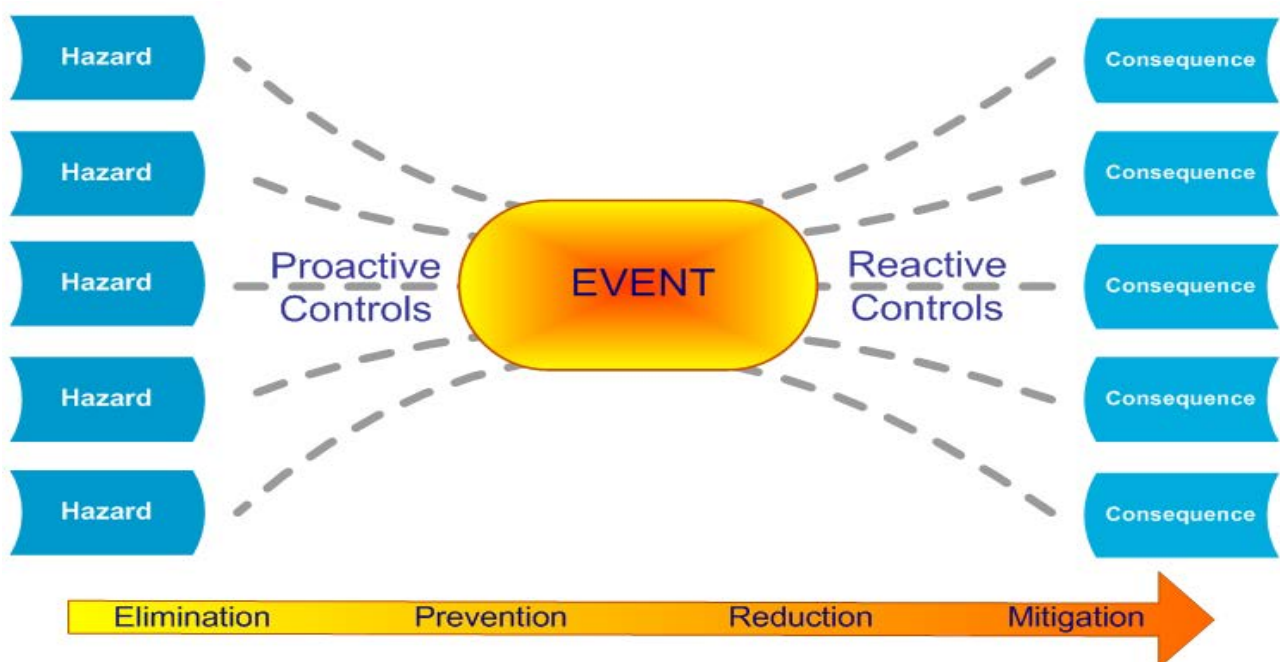


Figure 1 – Schematic representation of a bowtie diagram





The benefit of using a bowtie diagram is that it is a transparent and easily accessible method of documenting and presenting information for stakeholders. However, this information or parts of this information can also be represented in other formats such as risk registers, fault trees and event trees, or other formats which are designed to show critical linkages.

## 2 Planning and preparation

### 2.1 Organisation requirements for control measure identification

The purpose of control measure identification is to identify the existing and potential control measures, for each potential well integrity risk and its associated potential outcome. To prepare a WOMP requires a commitment by onshore management and well integrity personnel during all stages of the identification, assessment and selection of control measures.

When conducting control measure identification, selection and assessment, it is recommended to consult widely amongst the available technical expertise in each specific area. It may also be helpful to employ a third party to provide facilitation. A drill well on paper (DWOP) or peer review is a common method of gaining accurate information developing from a diversity of viewpoints and which helps to generate ownership in the WOMP process.

There are a range of options that may be exercised when developing and assembling the control measures, performance measurement criteria and performance outcomes necessary for inclusion in a WOMP.

Alternatively, selected personnel may prepare the control measure assessment and then run workshops to validate their work. Internal independent peer-reviews may be conducted. The best approach will depend on the size and type of well and the resources available.

#### Range of operating circumstances

Operating circumstances should not be automatically applied to generically similar wells. Wells are rarely identical and therefore some may have potential failure modes that others do not have.

Control measures may vary for different stages of the **well's lifecycle**. For example, design and construction standards are important for new wells, but as a well matures more focus is required in connection with well integrity management over the lifecycle of the well. Control measures may themselves have lifecycles that may require consideration.

To determine control measure suitability, it is important to have an understanding of the circumstances in which these controls will be effective.

It should be noted that hazardous events often occur during non-routine operations such as start-up, shut-down and simultaneous operations, when activity levels are high and titleholders may be dealing with a complex array of interrelated activities. Therefore, it is important that appropriate attention be given to control measures relevant to these **phases of operation**. The types of control measures in place, or being considered, must be appropriate to the **activities** undertaken at the well and the risks that have been identified.

## 2.2 Reasonably practicable

In order to comply with new regulations, for WOMP and WOMP revision compliance, the titleholder must be able to demonstrate the control measures that are necessary to reduce the risks to the integrity of the well to a level that is ALARP.

A titleholder's demonstration that risk has been reduced to a level that is ALARP would likely contain elements of the following process:

- identification and consideration of a range of potential measures for further risk reduction
- systematic analysis of each of the identified measures and a view formed on the integrity benefit associated with each of them
- evaluation of the reasonable practicability of the identified measures and the implementation (or planned implementation) of the identified reasonably practicable measures
- recording of the process and results summarised in the WOMP.

Clearly, the balance between benefits in terms of reduced risk and the costs of further control measures will play a part in achieving and justifying ALARP. For example, if an option has a benefit that greatly outweighs the cost, this option would almost always have to be implemented, or very good reasons provided for not doing so. In contrast, if the cost greatly outweighs the benefit, demonstrating that the option is not appropriate may be grounds for not implementing a perceived benefit as other options are likely to exist that would be able to achieve a similar level of risk reduction at lower cost. If benefits and costs are both high, or are both low, careful consideration will be required before selecting or rejecting any control measure.

## 3 Assurance of control measures

The regulations require the titleholder to ensure that control measures will be in place so that risks to the integrity of the well will be reduced to ALARP throughout the life of the well, including periods when the well is not operational but has not yet been permanently abandoned. Possible methods of assurances are described in the sections that follow.

### 3.1 Approaches to demonstrating ALARP

There is no prescribed method for demonstrating the adequacy of control measures however there are several basic approaches which may be used to support a titleholder's provision of evidence and justification within the WOMP. Titleholders might consider using one or more of these approaches but should also be prepared to consider developing specific approaches appropriate to their wells. In practice, it is likely that most wells would require a combination of approaches.

**Comparison with international guidance and standards** – compare the management system framework and operational procedures against national or industry standards, codes of practice, guides etc. as they are revised.

**Audit against good practice** – audit the basis and implementation of the management system against standard industry practice for offshore wells.

**Technical analysis** – evaluate control measures in technical terms and assess strengths and weaknesses, for example, effectiveness, functionality, availability, reliability, technical feasibility, compatibility, survivability, suitability of control measures to hazards and risks and appropriateness of performance standards, etc.

**Performance data** – evaluate performance data as evidence of adequacy or satisfactory levels of performance, for example, data on the operational effectiveness or reliability of a control measure may support the demonstration of its appropriateness for that service.

**Improvement approach** – demonstrate the extent of relative improvements in performance for the well based on past, present and planned modifications and enhancements.



**Benchmarking and judgement** – present considered judgements as to the suitability of control measures as described within the management system or the perceptions of a cross-section of stakeholders, e.g. senior management, peer groups, technical experts, key members of the workforce, independent observers.

**Practical tests** – demonstrate that the management system and/or control measures function effectively.

### 3.2 Assurance processes for control measures

Titleholders' integrated management framework should be able to support the reasoning for the choice of performance standard for a defined control measure.

A periodic assessment of control measure effectiveness should form an important part of the adequacy assurance process. For WOMP purposes, the rationale for deciding the adequacy of the measures employed should be supported and accompanied by all assumptions made and conclusions drawn. Where appropriate, the results of supporting studies that have been performed should also be described.

Performance standards should be clearly linked to their associated control measures. Performance standards should reference any strategy, procedure, work instruction and other assurance related documentation that would enable titleholders to measure, monitor and test the effectiveness of each control measure.

### 3.3 Contingency measures for control measure failure

As part of the development of performance standards, the titleholder should consider possible failure modes associated with the control measures and develop contingency measures to apply if performance standards are not met.

A control measure can fail in several different ways:

- complete failure or absence of the control
- chronic failure or decline of performance over time
- marginal ability of the control to perform as intended due to inadequate design.

The titleholder's well management system should address what action should be taken if a control measure is deemed to be impaired or compromised, and is unable to meet its performance standard(s). Contingency measures could range from applying additional alternative control measures to ceasing operation at the well until the ability of the control measures to meet the performance standards is restored.

It is up to the titleholder to establish appropriate contingency measures for their well and operations, based on assessment of the risks created by the failure or deviation of the control measure.

Measures should be established as part of the development of the WOMP to avoid the situation where the titleholder needs to submit a revised WOMP for each deviation from a specified performance standard. It also avoids the titleholder seeking consent to operate outside the WOMP in these circumstances.

NOPSEMA policy is to avoid issuing consent to operate outside the WOMP in such circumstances as these types of consent are reserved for emergency situations which are considered to be not reasonably foreseeable.

### 3.4 Control measure identification, selection and assessment outputs

At the end of the process of control measure identification, selection and assessment, the following information should be available:

- a list of the existing and potential control measures and an understanding of their relationship to a potential loss of well integrity
- the identification of new control measures to be implemented



- an 'effectiveness' assessment for existing controls and any new controls which are to be implemented
- a list of improvement actions recommended for existing control measures
- a list of risks where additional control measures may be desirable
- the performance standards for loss of well integrity control measures.

These outputs should be documented with clear links between the risk assessment and the outcomes from the control measure assessment. Good documentation at this stage will significantly help to demonstrate that risks are reduced to a level that is ALARP. A description of the process should be adequately reflected in the WOMP.

## 4 Identifying and selecting control measures for source control

### Identifying control measures

The regulations require the titleholder to identify control measures that are suitable for the well and are adequate to reduce risks to a level that is ALARP. A potential loss of well integrity risk analysis and control measure identification shouldn't simply concentrate on mitigation measures, but should also consider elimination, prevention and protection measures, wherever possible, in line with a hierarchy of controls. Additionally, a potential loss of well integrity risk analysis should not simply assume that industry guidance and standards will always be suitable by default. Justification for application of these guidelines and standards should be considered for the specific situation and must assess whether reasonably practicable alternative measures might be more effective.

Performance standards will also be required for any identified control measures relating to source control.

As previously noted the purpose of control measure identification is to identify the existing and potential control measures for each hazard and associated consequence. A source control relief well plan must be treated as a mitigating control measure. A range of relief well planning provisions should be considered for a potential loss of well containment and reasons for selecting certain provisions and rejecting others should be documented. The titleholder would conduct the analysis and determine a suitable response plan appropriate to recovering and securing a well.

Relief well planning should be an integral part of the WOMP development. Several factors will determine the level of planning adopted, including but not limited to, type of reservoir, type of well and water depth, distance of well from shore, accessibility to onshore support, prevailing meteorological conditions at location and season in which activities may take place.

## 5 Performance standards

Regulations 5.08 and 5.09 describe the requirements for performance standards to be included as part of a WOMP submission. Performance standards are the parameters against which the control measures are assessed to ensure the measures are reducing the risk of a loss of well integrity to ALARP. Performance standards facilitate the transition from the theoretical to the practical in the well integrity risk management process. In developing the performance standards for well integrity, titleholders should consider what level of performance it is reasonable to expect or achieve from each control measure considering:

- functionality
- availability
- reliability
- survivability
- dependency
- compatibility

Performance standards enable the titleholder to measure, monitor and test the effectiveness of each control measure and take corrective action based on deviations or trends.

## **5.1 Contents of a performance standard**

The following sections explore aspects of control measures which titleholders may choose to measure and set performance standards.

### **5.1.1 Aim or objective**

It is beneficial when developing performance standards to state an overall goal or objective for the performance standard to achieve. A well-defined aim statement will focus the elements of the performance standard on the important aspects to be addressed by the standard. It is also essential to understand if the performance standard is to apply to grouped elements as in an entire system or discrete elements within a system.

### **5.1.2 Functionality**

The functional performance of a control measure is what it is required to do e.g. the way the control performs in order to achieve the required risk reduction. Functionality may include applicable standards to be met including a wide range of performance characteristics.

### **5.1.3 Availability**

The availability of a control measure is typically a measure of the percentage of time that the control measure is in place and capable of performing its designed function. It is the considered probability or likelihood that the control will not fail or degrade in its required period of service.

### **5.1.4 Reliability**

The reliability of a control measure is the probability that at any point in time it will operate correctly for a further specified length of time. Reliability is to do with the probability that the system will function correctly and is usually measured by the mean time between failures.

Function testing should be sufficiently frequent to detect failures, and detected failures should be rectified promptly through maintenance or replacement.

### **5.1.5 Survivability**

This is a measure of a control measures ability to survive a potentially damaging event and is relevant for control measures that are required to function after an incident has occurred. Survivability performance should be considered particularly for critical systems.

### **5.1.6 Dependency**

The dependency of a control measure is its degree of reliance on other systems in order for it to be able to perform its intended function. If several control measures can be disabled by a single failure mechanism (common mode failure/single point of failure) or the failure of one control measure could cause the failure of others, then the control measures are not independent.

Adopting a diverse range of control measures such as a combination of inherently safe features, hardware and procedural controls will assist in improving independence.

### **5.1.7 Compatibility**

Whether or not a control measure is compatible depends upon how it interacts with other controls and the rest of the well. Compatibility considerations should be applied to new or changed control measures to ensure compatibility with the well and any other control measure already in use.

## 5.2 Defining parameters of a performance standard

A performance standard should state the key requirements (indicators) that the control measure has to achieve in order to meet its intended functionality, availability, reliability, survivability and its dependencies. If a performance standard is based on industry standards and guidelines for the control measure to meet, then the performance standard should include the key requirements (some of which may be contained within the guidance and standards) that the control measure will be measured against during its life and not simply list the guidance and standards that apply.

It is important that the parameters set in the performance standard are specific, measurable, appropriate, realistic and timely (SMART).

**Specific** – performance standards should be well defined and not open to broad interpretation

**Measurable** – whenever possible, performance standards should be based on quantitative measures

**Appropriate** – the performance standard should align with the overall goal of the control measure

**Realistic** – performance standards should be achievable

**Timely** – performance standards should be developed in a timely manner

## 5.3 Utilising findings from the risk assessment

Risk assessment should generate information useful to the establishment of performance standards for each control measure. Typical considerations that might come from the risk assessment include:

- control measures associated with a high risk of loss of well integrity are likely to require rigorous performance standards
- the required reliability or number of control measures should reflect the likelihood and consequence of the corresponding loss of well integrity
- the interdependence of control measures should be specifically noted and accounted for.

## 5.4 Performance standards lifecycle and continual development

There are a number of ways of establishing performance standards. Titleholders may choose to have one single performance standard for a control measure throughout the lifecycle of a well or may choose to use different performance standards for control measures for the various lifecycle stages of the well. It is critical that whatever performance standards are chosen they remain relevant and effective during all lifecycle stages where the control measure is required to be in place and where the control measure continues to ensure risk is being managed to a level that is ALARP. As the appropriateness of individual performance standards may change over the lifecycle of the well, titleholder should consider means of assessing the suitability of their performance standards over a wells lifecycle to ensure compliance with regulations 5.08 and 5.09. Options may include:

- conducting annual reviews incorporating feedback from process/integrity monitoring
- conducting gap analyses and evaluating performance requirements for control measures
- introducing control measures as necessary
- amending assurance tasks to incorporate changes
- applying a continuous monitoring and feedback loop.

## 5.5 Monitoring compliance with performance standards

Management system procedural controls should ensure that once implemented, control measures continue to be fit for purpose on an ongoing basis. Well management system procedural controls should therefore be subject to regular monitoring, audit and review.

**Monitoring** comprises the routine checking that activities conducted under well management system procedures are actually being conducted; it also measures the performance of the well management system elements and compares the performance of those elements against the defined performance standard or target.

**Auditing** is the process of checking that the established well management system is understood and is being used and that the management framework (in particular the monitoring and corrective action processes) is being implemented and is effective. It can also include evaluation of the degree of compliance against the defined standards. Both quality control and quality assurance are necessary and; checks are required that activities occur, that the activities are being performed to a suitable standard and that the systems, procedures, controls etc. are achieving the desired results.

**Reviewing** is the regular but less frequent process of stepping back and asking if the entire system and the standards within it remain adequate, fit-for-purpose, and in-line with current good practice. A view should be taken as to whether or not the performance standards are appropriate once practical experience has been gained.

A combination of monitoring, audit and review is necessary to ensure the ongoing effectiveness of a well management system, and to drive continual improvement.

## 6 Quality assurance

At the completion of the control measure assessment phase it is important that checks for quality assurance are conducted. The following table outlines the key activities and checks that should be undertaken to ensure quality in the control measure selection and assessment process. These checks will also assist to ensure that all control measures relevant to loss of well integrity have been identified, selected and assessed.

**Table 1 – Key activities and checks for quality assurance**

Activity	Check
Verify all control measures have been identified	Use a checklist to confirm that all types of control measures have been identified.
	Have those personnel who were not present when control measures were identified review the risk identification documentation and the bow-tie diagrams.
	Review previous risk assessments and controls.
	Review other documents that may identify additional control measures. For example: <ul style="list-style-type: none"> <li>• Internal management standards, procedures and processes</li> <li>• Internationally recognised standards, guidelines and practices</li> <li>• Equipment manufacturer manuals and data.</li> </ul>
Verify accuracy of information	There is a need to confirm that control measures are in place. Experience shows that this is not always the case. Periodic checks should be developed to verify any control measure is in place and that it continues to meet the description provided in the risk register.
	Periodic checks will identify whether a control measure has been changed over the lifecycle of the well or process. Frequently it is found that a control measure has been modified over the lifecycle and the documentation not updated to reflect the change.

Activity	Check
	A review process should be included to verify the output of control monitoring (e.g. adequacy assessments, criticality assessments).
	Where adequacy assessment includes verifying the functionality of the control measure, is there documentary evidence of the verification? Is this process described in the WOMP?
Verify that the outcomes (assessment, performance indicators, critical operating parameters) have been communicated	Have contingency measures been identified in the event of a control measures failure to meet the performance standard?
	Is there a communication plan in place?
	Is there a requirement for this communication to be recorded?
	Are procedures periodically reviewed and current procedures in use? How are procedural changes communicated?
	Are procedures periodically reviewed and current procedures in use? How are changes communicated?

## 7 Common weaknesses in control measures and performance standards

### 7.1 Control measures

The following are common weaknesses associated with consideration of control measures in the context of well integrity:

- when only a single control measure has been considered rather than a range of control measures
- concentrating effort on reactive (mitigation) measures rather than proactive (elimination, prevention or reduction) measures
- assuming that industry guidelines and standards are suitable by default, without justification of their application to the specific situation
- there is no obvious direct link to clearly established performance standards for control measures
- critical information is no longer available.

### 7.2 Performance standards

The following are common weaknesses associated with performance standards:

- the performance standard has no defined performance parameters to facilitate assurance and verification
- the performance standard is not linked to interdependencies
- the performance standards fail to make reference to source information
- performance standards provide no direction to what actions or processes should be followed if the performance standard is not met
- a failure to conduct ongoing review of performance standards against actual data
- the performance standard fails to address degradation and lifecycle asset management issues.





## 8 References, acknowledgements and notes

All regulatory references contained within this guidance note are from the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011.

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