Government Notices • Goewermentskennisgewings

DEPARTMENT OF FORESTRY, FISHERIES AND THE ENVIRONMENT

NO. 6818 **7 November 2025**

**NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998
(ACT NO. 107 OF 1998)**

CONSULTATION ON THE INTENTION TO PRESCRIBE ONSHORE WELL DECOMMISSIONING GUIDELINES PREPARED BY PETROLEUM AGENCY SA

I, Dion Travers George, Minister of Forestry, Fisheries and the Environment, hereby consult on the intention to publish the Onshore Well Decommissioning Guidelines Document Number: Agency – TC – 001 in terms of section 24J of the National Environmental Management Act, 1998 (Act No. 107 of 1998). The Decommissioning Guidelines support the proposed Regulations for the Exploration and Production of Onshore Petroleum Resources Using Fracturing Technology, 2025.

Any onshore petroleum wells that are decommissioned or temporary suspended, as contemplated in the proposed Regulations for the Exploration and Production of Onshore Petroleum Resources Using Fracturing Technology, 2014, must comply with the requirements of the Guidelines.

The Guidelines have been prepared through consultation of industry experts, international regulators, retired experienced engineers, academics, lawyers, and industry short courses service provider. Preparation of these Guidelines furthermore draw references to common industry practices including Regulations, guidelines and standards adopted in several countries globally, and standards adopted by major international operations companies.

Members of the public are invited to submit written comments or input, within 30 days from the date of the publication of this notice in the Government *Gazette*, or a notification in a newspaper, whichever occurs last, to any of the following addresses:

By post to: Department of Forestry, Fisheries and the Environment
The Director-General
Attention: Mr Simon Moganetsi
Private Bag X447
PRETORIA
0001

By hand at: Reception, Environment House, 473 Steve Biko Road, Arcadia, Pretoria.
By e-mail: Smoganetsi@dffe.gov.za.
Any enquiries in connection with the notice can be directed to Mr Simon Moganetsi at 012 399 9309 or by mail at Smoganetsi@dffe.gov.za.

A hard copy of any notice or document associated with this Government *Gazette* can be requested from Ms M Masondo at email: mmasondo@dffe.gov.za or collected at the Department's physical address as indicated above. The Onshore Well Decommissioning Guidelines can be downloaded from the Department's website at https://www.dffe.gov.za/projectprogrammes/environmental_management_instruments and the Government Notice can be downloaded from the Department's website at https://www.dffe.gov.za/legislation/gazetted_notices.

Comments or input received after the closing date may be disregarded.

The Department of Forestry, Fisheries and the Environment complies with the Protection of Personal Information Act, 2013 (Act No. 4 of 2013). Comments received and responses thereto are collated into a comments and response report which will be made available to the public as part of the consultation process. If a commenting party has any objection to his or her name, or the name of the represented company/ organisation, being made publicly available in the comments and responses report, such objection should be highlighted in bold as part of the comments submitted in response to this Government Notice.

DR DION TRAVERS GEORGE
MINISTER OF FORESTRY, FISHERIES AND THE ENVIRONMENT

Petroleum Agency SA

South African Agency for Promotion of Petroleum Exploration and Exploitatio SOC Ltd.

Registration No. 1999/015715/30

Document Number: **Agency – TC – 001**

Document Title: **Onshore Well Decommissioning Guidelines**

PROPRIETARY INFORMATION

01	30-09-2022	Draft			
REV	DATE	DESCRIPTION	BY	CHK	MGR

EXECUTIVE SUMMARY

This document present decommissioning guidelines developed to manage and facilitate closure of onshore wells at the end of their lifespan. Aspects considered in the developed of these guidelines focused mainly on managing and minimizing:

- Risk of loss of hydrocarbon containment from hydrocarbon bearing formations previously not in communication with the surface environment.
- Risk of transfer of fluids between formations (crossflow) resulting in unnatural pressurisation or contamination of formations, including freshwater aquifers.
- Risk of onshore wellheads and structures causing an obstruction or danger to other users of the land.

The document describes how such risks might be assessed and how they may generically be managed through well decommissioning design and execution.

The guidelines are to be used for the decommissioning of all onshore wells. They are prescriptive providing a “one-size-fits-all” template for onshore well decommissioning for simple wells with provision for a risk-based approach for complex situations and where quality of cement barriers is uncertain.

TABLE OF CONTENTS

EXECUTIVE SUMMARY.. 2

TABLE OF CONTENTS 3

REFERENCES.......... 5

1. BACKGROUND 6

1.1 GENERAL BACKGROUND TO WELL PLUGGING & ABANDONMENT (DECOMMISSIONING) 6

2. OBJECTIVES OF WELL DECOMMISSIONING 9

2.1. OVERVIEW OF OBJECTIVES.......... 9

2.2. OBJECTIVE OF PERMANENT ABANDONMENT 9

2.3. OBJECTIVE OF TEMPORARY ABANDONMENT (SUSPENSION) 9

2.4. LEGACY WELLS 9

3. DESIGNATED AGENCY ONSHORE WELL DECOMMISSIONING GUIDELINES.......... 11

4. APPENDICES 19

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS 19

APPENDIX B: SUMMARY OF LEGAL REQUIREMENTS FOR WELL DECOMMISSIONING 22

APPENDIX C: CONTENTS OF A WELL DECOMMISSIONG SUBMISSION TO THE DESIGNATED AGENCY 23

ANNEXURE D: WELL DECOMMISSIONING TECHNICAL CONSIDERATIONS & PRACTICES 26

D.1 ISOLATIONS.......... 26

D.2 BARRIERS 26

D.3 BARRIER LOCATION.......... 27

Open Hole 27

Cased Hole 27

D.4 INTERMEDIATE FORMATIONS.......... 28

D.5 TEMPORARY ABANDONMENT (SUSPENSION) 28

D.6 PERMANENT BARRIERS 29

D.7 TEMPORARY ABANDONMENT (SUSPENSION) BARRIERS.......... 30

D.8 LENGTH OF CEMENT PLUGS 30

D.9 POTENTIAL INSTALLATION TECHNIQUES 31

D.10 CEMENT PROGRAMME DESIGN AND EXECUTION 31

D.11 THROUGH TUBING OPERATIONS.......... 32

D.12 REMEDIAL CEMENTATION 32

D.13 BARRIER ELEMENT VERIFICATION 35

APPENDIX E: WELL DECOMMISSIONING ENVIRONMENTAL RISK CONSIDERATIONS 37

APPENDIX F: SPECIAL CONSIDERATIONS.......... 39

F.1 PARTIAL ABANDONMENT FOR SIDETRACKING 39
F.2 RADIOACTIVE SOURCES 39
F.3 HOLE ANGLE 39
F.4 MULTI-LATERAL WELLS 39
F.5 MULTIPLE RESERVOIRS 39
F.6 CEMENTED CASING LINER 39
F.7 CONTROL LINES, ELECTRICAL SUBMERSIBLE PUMP (ESP) CABLES AND GAUGE CABLES 40
F.8 HIGH PRESSURE HIGH TEMPERATURE (HPHT) WELLS 40
F.9 WELLS CONTAINING H2S 40
F.10 WELLS CONTAINING CO2 40
F.11 WELLS CONTAINING NORM AND/OR MERCURY 40
F.12 SEALING FORMATIONS 40
F.13 SURVEYS 41
F.14 DEVIATIONS FROM THE GUIDELINES 41
F.15 POST DECOMMISSIONING ACTIVITIES 41

REFERENCES

These guidelines have been prepared through the consultation of industry experts, international regulators, retired experienced engineers, academics, lawyers, and industry short courses service provider. With over 60 years experience of oil and gas drilling, and the abandancey of legacy wells abandoned in South Africa, it was agreed that these guidelines are sound and fit for future decommissioning (plugging and abandonment) of wells.

Preparation of these guidelines draw references to common industry practices including regulations, guidelines and standards adopted in several countries globally, and standards adopted in by major international operations companies which include;

- Guidelines for Suspension and Abandonment of Wells, Oil and Gas UK, issue 6 (2018).
- NORSOK Standard D-010, Well Integrity in Drilling and Well Operations (2021)
- USA Code of Federal Regulations, Title 30 (Mineral Resources), Chapter II (B.S.E.E.) Sub-Chapter B (Offshore), Part 250, Sub-part Q, §250.1715
- American Petroleum Institute, API Recommended Practice 65-3, First Edition, June 2021
- ISO 16530-1:2017 Petroleum and natural gas industries — Well integrity — Part 1: Life cycle governance

Thus, provide South Africa with first set of guidelines to manage and facilitate closure of wells at the end of their life span.

1. BACKGROUND

1.1 GENERAL BACKGROUND TO WELL PLUGGING & ABANDONMENT (DECOMMISSIONING)

At the end of their useful life, wells and facilities installed in oil and gas fields will be decommissioned to minimise the health, safety and environmental risks to other future users of the location, the wider general public, the local ecology and broader environment. This document addresses the decommissioning, sometimes referred to as Plugging and Abandonment ("P&A") of wells that were drilled either to explore, appraise or produce hydrocarbons and/or to inject water or other substances (for disposal or reservoir pressure maintenance).

Well decommissioning must address a suite of potential risks to the long-term safety to people and the environment. The two principal residual risks posed by abandoned oil and gas wells are the future loss of containment of subsurface hydrocarbons and other fluids and the resulting future liability to the state.

Oil and gas exploration and production operations are undertaken in a large number of countries and are governed by a wide range of regulatory environments and standards. There is clear historic evidence to indicate that these regulatory regimes have not been entirely successful in ensuring effective long term hydrocarbon containment.

Most regulatory regimes rely on a single standard "prescriptive" procedure to deliver all well decommissioning. These regulatory procedures rely on the concept of installing impermeable rock-to-rock equivalent 'barriers' (or Barrier Elements) across the wellbore to ensure hydrocarbon containment and hence replace nature's original containment mechanism, commonly referred to as 'a cap rock', which were penetrated by the wellbore during well construction. These barriers are expected to extend across the whole of the wellbore adjacent to a rock formation with sufficient integrity to be part of the containment mechanism. In most prescriptive well decommissioning regimes, it has been common practice to specify the use of a back-up, dual, barrier philosophy for hydrocarbon containment with a single barrier being acceptable for containment of water.

Further, it is common to specify critical Barrier Element characteristics e.g., any plug forming an element of a Barrier to include a minimum length of cement, and a minimum level of Barrier Element verification, although the exact requirements differ from jurisdiction to jurisdiction, as shown in **Table 1.1.**

COMPARISON OF BARRIER CRITERIA BY REGULATORY LOCATION					
Requirements	**USA**	**NORSOK D-10 (Norway)**	**Oil & Gas UK (UK)**	**ANP (Brazil)**	**Proposed SA Guideline**
Format	Prescriptive regulation	Prescriptive Guideline	Prescriptive with risk-based deviation	Prescriptive	Prescriptive with elements of risk-based
Number of Barriers	One cement plug and one mechanical plug	Two	Two (or a single combination barrier) for isolation of hydrocarbon zones One for water-bearing	One	Two (or a single combination barrier) for isolation of hydrocarbon zones One for water-bearing Plus environmental plug
Length of Cement Barrier	50' (~15m) plug on top of fundament 200' (~60m) plug with at least 100' above perforations 200' (~60m) annular cement	50m annular cement or 30m if verified by CBL 50m cement plug set on a fundament, otherwise 100m	100' (~30m) good cement Up to (500' (~150m) were good cement has not been verified	60m	30m good cement Up to 150m where good cement has not been verified for the internal cement plug and/or the adjacent annuli
Material	Silent	Characteristics specified	Characteristics specified	API 10A or similar	Characteristics specified matching, as a minimum, API 10A
Cement Across Perforations / Reservoir	Yes (or similar)	Not specified	Not specified	Yes (or similar)	Reinstating the cap rock is the goal
Cement Across Open Casing Shoe	Yes (or similar)	Not specified	Not specified	Yes (or similar)	Not specified depends whether the casing shoe and the adjacent formation is required to act as a barrier
Control Line / Gauge Cable	Not specified	Remove	Remove	Not specified	Remove unless barrier integrity can be demonstrated
Barrier Plug Validation	* Weight test to 15klbs (~6.8T) or * Test to 1,000psi (~68 bar)	* Test to 70 bar above leak-off	* Tag * Weight test (Openhole) * Test to >500psi (~34 bar) above injection pressure or * Inflow test > potential differential	* Weight test to 7T or 7M Pa	* Tag * Weight test (Openhole) * Test to >500psi (~34 bar) above injection pressure or * Inflow test > potential differential

Table 1.1 Comparison of barrier criteria by regulatory regime with proposed South African Well Decommissioning Guidelines

From Table 1.1, it is evident that no one internationally accepted well decommissioning standard exists. However, the NORSOK standard (Norway) and the Oil & Gas UK standards are commonly referred to by other international jurisdictions.

Historically, there has been no formal application and approval process in South Africa for the decommissioning of a well. Therefore, the ensuing guidelines aim to define a suite of well decommissioning expectations aligned with international practice and over-arching South African regulatory requirements

Prescriptive procedures, whilst easy to administer and operate, cannot address every geological, technical or health, safety and environmental well decommissioning situation. To address such challenges, many regulators are replacing their earlier prescriptive decommissioning requirements with goal-oriented guidelines. Goal-oriented guidance provide latitude for well decommissioning that is designed to fit the specific hazards and characteristics of any particular well, while maintaining the overall objective of minimising the risk of a future incident.

As summarised in Table 1.1, these guidelines are a combination of prescriptive and goal orientated approach, providing recommendations for the nature, location, number, size, and verification of barriers required. The guidelines have, in the main, been distilled from the Well Decommissioning Guidelines, Issue 6, Oil & Gas UK, June 2018. These were developed in collaboration between operators and UK regulators and have undergone a number of iterations and are considered to be a suitable foundation for onshore South African circumstances.

Given the historical absence of a specified suite of South African well decommissioning requirements, there exist a considerable number of wells that were previously abandoned without any formal regulatory approval and sign-off at the time of operations. These new guidelines also serve to provide a framework for the risk-based analysis of any historically abandoned wells.

2. OBJECTIVES OF WELL DECOMMISSIONING

2.1. OVERVIEW OF OBJECTIVES

Wells present a number of potential risks to the environment and the wider community, most notably:

- A risk of loss of hydrocarbon containment from hydrocarbon bearing formations previously not in communication with the environment;
- A risk of transfer of fluids between formations (cross-flow) resulting in unnatural pressurisation or contamination of formations, including fresh water aquifers;
- A risk of onshore wellheads and structures causing an obstruction or danger to other users of the land.

Well abandonment can be defined as the actions taken to manage these risks to an acceptable level. Any abandonment design should, as a minimum, therefore, explicitly address these risks.

More broadly, abandonment should be managed as a continuation of a broader process of well integrity maintenance across the whole lifecycle of the well and as such should make reference to the underlying principles of good well integrity management, including maintaining dual barrier isolation of hydrocarbons and a competent method of barrier verification.

2.2. OBJECTIVE OF PERMANENT ABANDONMENT

The objective of permanent abandonment is to provide an eternal isolation of each and every formation with potential for flow penetrated during the drilling and construction of the well, in order to prevent any contamination of the environment with outflow of fluids and/or hydrocarbons from the well, and to prevent contamination of any fresh water bearing aquifer.

Furthermore, the well and the surrounding location must be configured such that they pose no danger to other legitimate users of the area e.g., farmers and the local population onshore.

2.3. OBJECTIVE OF TEMPORARY ABANDONMENT (SUSPENSION)

The objective of temporary abandonment (sometimes referred to as suspension), is to provide a combination or permanent and temporary barriers to prevent migration of fluids (hydrocarbons or water) between formations and into the environment, in such a way as to facilitate future well re-entry and future use, or subsequent permanent abandonment.

2.4. LEGACY WELLS

Wells abandoned prior to the introduction of this guideline, and not subjected to the reviews inherent within the Rights relinquishment process, constitute a special case.

It is acknowledged that it may not be appropriate for these wells to meet all the requirements of the good practices detailed within this guideline, and it is recognised that past abandonments may have been designed to comply with differing standards. Nevertheless, there remains the requirement to undertake a risk assessment of the current state of these wells.

It should be noted that, when undertaking this risk assessment, the potential risks associated with any option for re-intervention to improve the isolation barriers should be included. These, along with the anticipated costs, should be balanced against the likely reduction in risk of loss of containment to manage this risk to an acceptable level. Intervention risks should, as a minimum, include the additional health and safety exposure from the planned operations and the technical risk of failure for operations that may be made difficult by the current status of the well and the lack of complete and reliable documentation. Technical risks may include the anticipated deterioration of the casing and wellhead integrity, and the difficulty of milling out shallow cement plugs and bridge plugs. Documentation deficiencies include undefined tubing and casing sizes and setting depths, or unknown cement plug depths.

By following the required risk assessment process, it may therefore be determined that the residual risks posed by wells abandoned previously do not warrant re-intervention to reduce these risks.

3. DESIGNATED AGENCY ONSHORE WELL DECOMMISSIONING GUIDELINES

These guidelines provide recommended practices to aid the effective design and execution of abandonment work programmes, including the nature, number, location, installation and verification of isolation barriers required to temporarily and/or permanently abandon wells.

The guidelines are applicable to all onshore wells licensed through and constructed under the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (“MPRDA”); whether constructed with the objective of exploration, appraisal, production or injection. In addition, this document provides guidance for abandoned wells constructed before the date of this guideline, and which are now included in any application for Relinquishment of a Production or Exploration Right.

The guidelines are designed to provide practical guidance which can then be interpreted on a case-by-case basis taking into account the constraints applied by the well’s construction, the nature (fluid type, fluid composition, pressure, temperature, permeability etc.) of the formations to be isolated and any uncertainties in the well’s condition (unknown cement quality, top of cement, casing condition etc.). As such, they represent the **minimum requirements for onshore well decommissioning** for simple wells with provision for a risk-based design approach for complex situations and where quality of cement barriers is uncertain.

Abandonment design begins with an evaluation of the formations required to be isolated. Once these have been identified, the form, number, location, materials, and placement method for any additional isolation barriers must be established. The typical information to be included in any well decommissioning design and application to the Designated agency is included in Appendix C. Background explanatory information to be read in conjunction with the guidelines, is presented in **Appendix D.**

In order to minimise the risk of environmental damage through the loss of containment from hydrocarbon and water bearing formations, it is necessary to abandon wells after the end of their useful life by introducing permanent barriers to flow to surface and between subsurface zones. The guidelines also provide guidance on the evaluation of the potential risks of each well to be decommissioned as prescribed in legislation such as the MPRDA and the NEMA, as detailed in Appendix E to the guidelines.

The guidelines aim to offer guidance to the Regulator in exercising its powers in respect of the decommissioning of onshore wells. However, it should be noted that compliance with the details contained within this guideline will not absolve the rights holder or operator from accountability for designing and implementing effective abandonment, nor from any future liability as provided for in terms of the NEMA or in terms of any other South African law.

In applying the guidelines:

- The words “**must**” or “**shall**” indicates a requirement to be complied with;
- The word “**should**” indicates a recommendation to be complied with unless another course of action can be reasonably justified;
- The words “**may**” or “**can**” indicate a permitted course of action that should be considered as an option;
- **Regulator** refers to as the designated agency.

The Well Decommissioning Guidelines requirements are laid out in the table below.

3.1 GENERAL
The objective of these guidelines is to provide a structured framework for the decision-making process which forms an integral part of any well decommissioning activity. Well plugging material shall be produced in accordance with the recognised international standards, for example API Spec10, Specifications for Materials and Testing for Well Cements", etc. In advance of any well abandonment operations, appropriate drilling or completion fluids must be pumped into the well in order to provide hydrostatic pressure control and stabilisation of the wellbore. Well decommissioning (plugging and abandonment) operations should incorporate judicious methods and processes in order to ensure acceptable well control from start to finish.
3.2 ZONES WITH FLOW POTENTIAL
The design of the well barriers requires the Operator to undertake a detailed engineering appraisal of the flow potential (including cross flow between formations) within every formation which a well may pass through. An ALARP approach should include a full range of measures to mitigate possible consequences of flow potential. Such assessments should be explained in the well decommissioning application submitted to the designated agency. The evaluation of flow potential should include all possible scenarios. Examples include re-charging of reservoirs, zones that become charged during the life of the well, movement of fluids post-decommissioning, and potential re-development for hydrocarbon extraction. The fundamental principle on which these guidelines are based is the restoration of a cap rock. Following well decommissioning, a specific risk assessment of the potential harm to people and/or damage to the environment is required to demonstrate the degree of flow potential is acceptable.
3.3 WELL DECOMMISSIONING DESIGN
Good practice is that well decommissioning should be considered during well design and construction. The detailed planning for well decommissioning should commence, as a minimum, five years ahead of the well P&A operation to allow sufficient time to gather information regarding changes to the well status and ensure adequate clarity on the scope of work to be undertaken. Typical inputs to the well decommissioning design include well configuration, stratigraphic sequences of each wellbore, cement logs and cementing operation data and documents, formations with suitable barrier properties, and specific well conditions. All supporting data used in the well decommissioning design must accompany the well decommissioning application to designated agency (Appendix C). For wells that have been in production for longer than 10 years or have undergone remedial cement jobs during their lifecycle, cement logging shall be undertaken as part of the well decommissioning design planning to verify the casing cement quality.
3.4 PERMANENT BARRIERS

3.4.1 Material Requirements

The primary characteristics of positioned barrier materials (not limited to cement) should be as follows:

- *Compatibility* - barrier material must be compatible with all of the adjacent formation geologies.
- *Downhole fluids resistance* - materials must be resistant to fluids such as CO_2, H_2S, hydrocarbons, brine, etc. at anticipated pressures and temperatures.
- *Immovable* - remain at the intended position and depth in the well.
- *Impermeable* - to stop flow of fluids through the bulk material.
- *Load capacity* - mechanical properties suitable to accommodate loads at foreseeable temperatures and pressures. If applicable, consider changes in service over the entire life cycle of the well (e.g., due to conversion of producers to water injectors, steam injection, gas storage, unconsolidated formations etc.).
- *Permanent integrity* - long-term isolation characteristics of the material, not deteriorating over time; risks of cracks and de-bonding over time, are to be considered.
- *Provide an interface seal* - to prevent lateral flow of fluids around the barrier; the material provides a seal along the interface with adjacent materials such as steel pipe or rock; risks of shrinkage and de-coupling should be considered.

3.4.2 Number of Barriers

All penetrated zones in the well with flow potential which have been identified as necessitating isolation should be isolated from the surface by a minimum of one permanent barrier, or two as appropriate.

Where there is an unacceptable risk of crossflow, zones should be isolated from each other.

The actual number of barriers required should be determined by an individual well risk assessment. Note that the numbers below are a general recommendation and for a particular well may be different due to the specific scenario and conditions.

Operators should consider enhancing this requirement based on, but not limited to, considerations such as the following:

- Robustness of the barrier placement and subsequent authentication of integrity;
- Differential pressure across the barrier;
- Impact of a single point failure.

Generally:

- One permanent barrier from surface may be considered if a zone requiring isolation is water-bearing.
- Two permanent barriers from surface are recommended if a zone requiring isolation is

hydrocarbon-bearing OR water-bearing and significantly over-pressured.

- Two permanent barriers may be combined into a single large permanent barrier (or Combination Barrier) on the condition that the objective is not compromised in any way i.e., such a barrier should be as reliable and effective as two barriers and is an apt method to achieve the purposes that two separate barriers would have provided.

- In addition to the permanent barriers described above, an environmental plug shall also be placed to disconnect the open annuli from the external environment (see Section 3.7).

3.4.3 Barrier Plug Length Requirements

Refer also to "Positions Requirements" below.

The minimum requirements for plugging the *open hole* portion of a wellbore are the placement of a permanent cement plug comprising Good Cement set across Good Cement in the adjacent annuli such that the full cross section of the wellbore is plugged with a Competent Barrier:

- 30m (MD) above hydrocarbon-bearing strata

- 30m (MD) above zones with flow potential

- 30m (MD) above zones with any abnormal geo-pressured strata. Cement should be placed across a competent formation which can withstand migration of formation fluids

- 30m (MD) above the top of all fresh water zones

Plugging of a well shall segregate the *uncased and cased* portions of the wellbore to prevent vertical movement of reservoir fluids from below the casing into the cased portions of the wellbore.

The minimum requirement for plugging to segregate uncased and cased portions of wellbore with Good Cement is one of following:

- A continuous cement plug must be placed from 30m (MD) below to 30m (MD) above the casing shoe

- Via setting a mechanical bridge plug 15-150m (MD) above the casing shoe and minimum of 30m (MD) of cement placed on top of plug

- By the top-down squeeze method using a cement retainer set 15-150m (MD) above the casing shoe, a volume of cement sufficient to fill the wellbore from the retainer to 30m (MD) below the casing shoe must be pumped through the retainer and cement must be pumped above the retainer to cap it with a minimum of 15m (MD) of cement plug;

Plugging of *cased* portions of a wellbore shall be performed in manner that ensures that all hydrocarbons are confined to their respective indigenous strata and are prevented from migration into other strata or to the surface. The minimum requirement for plugging a cased portion of a wellbore with Good Cement are as follows.

If the perforations are isolated from the hole below, the following plugging methods can be used;

- A mechanical bridge plug set no more than 30m (MD) above the top of the perforated interval, and a minimum of 30m (MD) of cement placed on top of the plug

- By the top-down squeeze method using a cement retainer set 15-30m (MD) above the perforated interval, a sufficient volume of cement pumped through retainer or packer to fill the wellbore from the base of the perforated interval and cement must be pumped above the retainer or packer to cap it with a minimum of 15m (MD) cement plug

- By the displacement method or bull heading, a cement plug at least 30m (MD) in length, with the bottom of the plug no more than 30m (MD) above the perforated interval

- A through-tubing basket plug set no more than 30m (MD) above the perforated interval with at a minimum of 30m (MD) of cement on top of the basket plug; or

- By displacement or bull-heading method, a sufficient volume of cement so as to extend at least 30m (MD) above the uppermost packer in the wellbore and minimum of 30m (MD) of cement in the casing annulus immediately above packer when mechanical bridge plug is used to temporarily isolate the perforations.

- In cases where a "fish" is present in the hole across the perforations and/or above the perforations, preventing the above methods from being achieved, the cement plug should be set as close as possible to those described above.

Casing Stubs / Tubing Stubs / Balanced Cement Plugs within outer casing must be plugged with Good Cement by one of the following;

- A cement plug placed from 30m (MD) below the stub to 30m above the stub

- By the down squeeze method using retainer set no more than 15m (MD) above the stub, a volume of cement pumped below the retainer sufficient to fill the casing stub with 30m of cement unless no injectivity, and cement pumped above the retainer to cap it with a minimum of 30m (MD) cement plug;

- If the casing stub annulus is cemented, a mechanical bridge plug set nor more than 15m (MD) above the casing stub, and cement pumped above the bridge plug to cap it with a minimum of 30m (MD) cement plug;

- By the displacement method, a minimum of 30m (MD) cement plug placed with the bottom of the plug set no more than 15m (MD) above the stub end.

Note: Where distinct zones with flow potential are less than 30m (MD) apart, then the maximum practical column of Good Cement should be placed between the zones.

When a single Combination Barrier is chosen to replace two permanent barriers, it should have:

- A cement column of typically a minimum 60m (MD) of Good Cement, which is considered to constitute such a permanent barrier

- Typically, 60m (MD) of Good Cement above the zone with flow potential

- The internal cement plug adjacent to the annular Good Cement over a cumulative distance of 60m (MD) of overlap

Note: If Good Cement has not been verified for the internal cement plug and/or the adjacent annuli (if present) the isolation barrier lengths should be increased from the minimum 30m to up to 150m.

Note: The use of plugging materials or techniques other than cement are acceptable if the performance of the plug can be demonstrated to match or exceed that of API cement. For ease of reference, the term cement is used in this guideline.

3.4.4 Sealing Formations

Certain formations (e.g. specific shales or some salts) are renowned to deform on account of subsurface geomechanical stresses. To be considered for use as an open hole annular casing barrier, the sealing formation should be impermeable and have sufficient strength; these properties should be durable at the prevalent conditions.

If it can be demonstrated that the cumulative length of the resulting seal of the formation against the casing is adequate to prevent flow of the existing fluids at the maximum anticipated pressure differentials, then such a seal is acceptable as a replacement for good annular cement.

The internal barrier material should be adjacent to the annular isolation providing sufficient cumulative length above the zone with flow potential.

3.4.5 Existing Annular Materials

Similarly, for existing annular materials, if it can be demonstrated that the cumulative length of the resulting seal of the formation and against the casing is adequate to prevent flow of the present fluids at the maximum anticipated pressures, then such a seal is acceptable as a replacement for good annular cement, provided that the materials and fluids are not corrosive to the casing.

The internal barrier material should be adjacent to the annular isolation providing sufficient cumulative length above the zone with flow potential.

Note that annular sealing materials will be well-specific and the following should be taken into consideration:

- age of the well;
- annular clearance;
- density of the mud;
- mud fluid properties;
- inclination of the well;
- pressure and fluid composition of the zone to be isolated;
- weighting agent.

3.4.6 Alternative Materials and Technologies

A range of alternative barrier materials and technologies have recently been developed or are in development which will offer plugging solutions other than cement. Such solutions require thorough certification and testing, including field trials to be qualified for use as permanent barriers and this may necessitate different barrier lengths to those for cement.

If it can be demonstrated that the cumulative length of the resulting seal of the formation against the casing is adequate to prevent flow of the present fluids at the maximum anticipated pressures, then such a seal is acceptable as a replacement for a good annular cement, provided that the materials and fluids are not corrosive to the casing where present.

The internal barrier material should be adjacent to the annular isolation providing sufficient cumulative length above the zone with flow potential, where the casing remains intact.

3.4.7 Position Requirements - General

The first Barrier above the zone with flow potential is referred to as the Primary Barrier.

The subsequent Barrier above the zone with flow potential, where required, is referred to as the Secondary Barrier.

A permanent Barrier should:

- Be set above the zone with flow potential across a suitable cap rock;
- Extend across the full cross section of the well including all annuli;
- Have formation fracture pressure at the base of the barrier in excess of the maximum anticipated pressure from the zone being isolated.

A suitable cap rock is impermeable, laterally continuous and has adequate strength and thickness to contain the maximum anticipated pressure from the zone being isolated.

3.4.8 Position Requirements – Open Hole

See also "Length Requirements", above.

This section covers barrier position where the zone with flow potential is not behind the casing (or in open-hole).

For open hole isolations, it is recommended to set a permanent barrier in the cased hole or to extend sufficiently into the cased hole. The barrier across the cased hole is to fully isolate the open hole and allow for a pressure test.

Zones with flow potential that belong to different pressure regimes should be separated by one permanent barrier unless cross-flow is acceptable.

Where the pressure from a zone with flow potential is anticipated to exceed the formation fracture pressure anywhere in the open hole, it should be isolated by two permanent barriers or a combination barrier (as described earlier).

3.4.9 Position Requirements – Cased Hole

See also "Length Requirements", above.

A full lateral barrier in cased hole consists of annulus isolation and overlapping internal casing isolation.

Cemented casing alone is not considered to constitute a permanent barrier to flow which may occur laterally into or out of the wellbore.

Inside the cased hole, a permanent barrier requires both a cement plug or equivalent inside the casing, and overlapping good annular cement or equivalent. The internal barrier should be attempted whether the casing is perforated or not.

3.4.10 Placement - General

In order to achieve the required cement barrier length, allowances will have to be made on volumes to cater for uncertainties during mixing and placement. As examples, it may be necessary to place up to:

- 150m (MD) of cement to achieve approximately 30m (MD) of Good Cement.
- 240m (MD) of cement to achieve 60m (MD) Good Cement.

Furthermore, optimisation of the barrier placement and verification of a Competent Barrier will allow reduction of length from the values noted above.

3.4.11 Placement – Through Tubing

In situations when well completion tubulars are left in-hole and permanent barriers are then installed both within and around the completion tubulars, and potentially below the completion string, reliable procedures and appropriate techniques to install such barriers should be established.

3.4.12 Placement – Penetrations through Permanent Barriers

Cables and control lines can be included in permanent barriers as long as the isolations mandated in these guidelines are attained. Appraisal of potential leak paths through the cement plug and subsequent plugging of such paths should be conducted, documented and included in the well decommissioning submission for approval by the Regulator.

3.4.13 Placement – Bull-Heading

Bull-Heading of cement into perforations can be used for placement of a permanent barrier, provided the over-arching principle of cap rock restoration still applies.

Considerations for bull-headed isolation barriers include:

- Ability to verify plug placement by tagging (e.g., wireline access depth in high angle wells);
- Cement slumping;
- Cement channelling;
- Cement contamination;
- Fluid losses into the perforated formation;
- Reservoir injection capability;
- Formation fracturing;
- Small volume/capacities;
- Tubing and casing integrity;
- Tubing debris, such as scale and wax deposits.

3.4.14 High Angle / Horizontal Wells

Decommissioning highly deviated or horizontal wells is in principle similar to that of a standard vertical well. The notable difference is in the methodology of ensuring a satisfactory isolation, which typically is considerably more difficult to realise and verify in high angle or horizontal wells.

3.5 VERIFICATION OF BARRIERS

3.5.1 Wellbore Barriers

It is critical that any permanent barrier should be verified to ensure the barrier is positioned at the required depth and will have the required sealing capability.

A cement barrier should be verified by an appropriate combination of the following:

- The barrier installation should be documented, including records from the cementing operation (cement density, pump rate, volumes pumped, returns during cementing, water-wetting pills, spacers etc).
- The strength development of the cement slurry should be confirmed. This is primarily done using pre-job testing with representative component samples cured at simulated downhole temperature and pressure conditions.
- The position of a barrier should be verified by tagging, or calculation and measurement of pumped volumes and pressures to confirm the depth end length of the cement plug.
    - Tagging with drill-pipe this is typically 10 to 15 klbs with a drill bit;
    - Tagging with wireline, coiled tubing or stinger; the weight will be limited by tools and geometry.
- A pressure test should:
    - Be a minimum of 500 psi above the leak off pressure below the cement barrier (e.g. leak off pressure into perforations or open formation below the casing shoe); but
    - Not exceed the casing strength minus wear allowance or damage the primary casing cement, whichever is lower.
- Inflow test should consider the maximum pressure differential to be experienced by the barrier.

In cased hole, if a pressure tested and tagged mechanical plug or previous cement plug is used as a foundation for the barrier, then

- Pressure-testing of the cement barrier may not be meaningful;
- Tagging may not be necessary if the cement job is executed as planned and fully documented. However, if a decision is made not to tag a cement plug then the rationale should be documented, and risk assessed. This should consider well conditions, plug length and volume, job trends and execution performance, other verification methods and consequence of failure. If circumstances exist that increase the risk (e.g. shortened cement plug, high pressure and temperature, well integrity concerns, method of placement, execution anomalies) then tagging is advisable.

3.5.2 Annular Barriers – General

The annular barrier should be verified by an appropriate combination of:

- Pressure testing (e.g., perforate and test, cased hole annulus test);
- Inflow testing;
- Records from cementing operations (e.g., slurry density, volumes pumped, returns during cementing, differential pressure, fluid losses, centralisation etc);
- Sufficient annular isolation through the original cement job. If the quantity of annular cement (the estimate of TOC) is to be based on differential pressure or monitored volumes during the original cement job (rather than logs for instance), then a longer cement column

may be required to allow for uncertainty. In this case, a 305m MD column may be considered adequate for the equivalent of two barriers or a combination barrier based on the assumption that sealing has occurred somewhere in the annulus cement. This may be increased, or decreased, on a well-by-well basis depending on the confidence level of the original cementation.;

- Casing annulus pressure history during the life cycle of the well;
- Well-integrity reporting;
- The leak-off test when the casing shoe was drilled out;
- Field experience;
- Modelling of well lifecycle loading;
- Modelling of cement job;
- Logs (e.g., cement bond, temperature, sonic);
- Sampling of annular fluids.

3.5.3 Annular Barriers – Verifying Sealing Formations

In addition to the above, the verification of a formation seal requires:

- Evidence that the formation has the required fracture strength to withstand the maximum anticipated pressures;
- The length of the resulting seal of the formation against the casing is adequate to prevent flow of the present fluids at the maximum anticipated future pressures, for example differential pressure testing across a suitable length;

And/or

- Validation that the bond log response can be interpreted as adequate for the maximum anticipated future pressures. This can be achieved by means of a combination of logging and differential testing experience. Log interpretation should be performed by a senior onshore qualified and trained cement log specialist and documented.

3.5.4 Annular Barriers – Verifying Through-Tubing & Bull-Headed Barriers

In addition, there can be less accurate methods of determining cement quality and quantity in both tubing and annulus after through-tubing or bull-headed barriers are placed. No single verification method should be relied on exclusively. Additional considerations for verification of bull-headed or through-tubing barriers could include:

- Pressure responses during pumping and displacement;
- Reservoir injection characteristics before, during and after placement;
- Cables and control lines outside the tubing;
- The use and effectiveness of cement wiper plugs;
- Accuracy of TOC measurement inside tubing or through-tubing.

3.5.5 Annular Barriers – Liner Laps

Annular cement across a liner lap should not be part of a permanent barrier unless it has been verified (e.g. by pressure testing, inflow testing and/or logging). If the cement quality in the liner lap is uncertain, a verifiable cement barrier should be placed above and/or below the liner lap.

3.6 SPECIAL CONSIDERATIONS

Additional guidance is provided in Appendix F for the following situations which should each be the subject of a risk assessment:

- Partial Abandonment for Sidetracking;
- Radioactive Sources;
- Hole Angle;
- Multi-Lateral Wells;
- Multi Reservoir Wells;
- Cemented Casing Liner;
- Control Lines, Electrical Submersible Pump Cables and Gauge Cables;
- High Pressure High Temperature (HPHT) Wells;
- Wells Containing H_2S;
- Wells Containing CO_2;
- Wells Containing Mercury and /or NORM;
- Sealing Formations;
- Surveys;
- Deviations from the Guidelines;
- Post Abandonment Operations.

3.7 ADDITIONAL CONSIDERATIONS

Fluids that are positioned above the uppermost barrier in a well and cannot be legally discharged should be removed or contained before wellhead removal. This is the part of the well which will be exposed to the environment after wellhead removal.

Decommissioned wells, and redundant surface equipment, should not present a hazard to other users of the land.

The wellhead equipment and all casing strings to a depth of 1.5-5m below ground should be retrieved and a surface cement plug (or environmental plug) placed across the casing stubs. This environmental plug should not considered a competent barrier.

A well marker plate should be tack welded to the casing stub with the following information recorded.

- Well name;
- Date drilled;
- Date abandoned;
- Total depth in mBGL.

In case of temporary well abandonment longer than 90 days, the guidelines provided above must be followed except that a permanent barrier such as cement is not mandatory for the secondary barrier. A verified temporary barrier such as a pressure tested bridge plug and/or suspension cap may be used. If temporary well abandonment is planned to exceed 90 days duration, a risk assessment shall be conducted and approved by the Regulator.

4. APPENDICES

APPENDIX A: GLOSSARY OF TERMS AND ABBREVIATIONS

Term / Abbreviation	Explanation
Abandonment Report	Document detailing the planned and actual abandonment activities carried out on a well, including confirmation of the abandoned status of the well.
ALARP	As Low as Reasonably Practicable. A measure of the residual risk associated with an existing or proposed condition or status of a facility.
API	American Petroleum Institute, which has developed more than 700 standards to enhance operational and environmental safety, efficiency and sustainability.
Barrier	An isolation constructed between formations, or between a formation and the environment.
Barrier Element	One part (of two or more) of a Barrier, such as the annular cement opposite an internal abandonment cement plug.
BHA	Bottom Hole Assembly, a set of tools made up together and run on the bottom of a work string.
BOP	Blow Out Preventor, an assembly of valves routinely deployed during well operations and designed to provide emergency pressure control to prevent loss of hydrocarbon containment from the wellbore.
Cap Rock	An impermeable formation, with a sufficiently high fracture strength to withstand the hydraulic pressure potentially applied from another formation and thus act as a sealing element for that formation.
CBL	Cement Bond Log, an acoustic measurement of the quality of cement bonding between the outer surface of casing or other tubular, and the formation. It is primarily used to confirm zonal isolation by assessing the likelihood of a leak path or channel behind casing. Note that other acronyms exist depending on the service provider and era of the electric wireline tool design e.g., SBT = Segmented Bond Tool.
Closure Certificate	Closure Certificate granted in terms of section 43 of the MPRDA.
Closure Plan	A document required under legislation detailing the facilities proposed to be left in place at the point of License or Right relinquishment.
CO_2	Carbon Dioxide.
Combination Barrier	Where primary and secondary permanent barriers are combined into a single large permanent barrier
Competent Barrier	An isolation barrier comprising all the necessary elements in the wellbore and the adjoining formation, and that complies with all requirements in order to be effective.

Fish	A tool, piece of equipment or debris in the wellbore which is typically creating a blockage and/or preventing an operation.
Fluid(s)	Liquids and/or gases in the formation and the wellbore.
Formation with Flow Potential	A strata (or layer) of rock intersected by the wellbore and containing the capacity to deliver hydraulic pressure via the flow of fluids.
Formation Strength	The hydraulic pressure required to induce fracture and/or integrity failure in the formation.
Gas Gradient	The hydraulic head created by a column of gas in the wellbore.
Good Cement	Cement that has been pumped and confirmed to meet these guidelines with respect to both quantity and quality.
Good Practice	Methods and techniques utilised internationally in the upstream oil and gas industry and commonly accepted as appropriate by experienced and competent industry professionals.
GOR	Gas Oil Ratio
H_2S	Hydrogen Sulphide
HPHT	High Pressure High Temperature
Impermeable	A formation or material that does not permit passage of a fluid (impervious or impenetrable)
Maximum Anticipated Pressure	Post well decommissioning, the maximum pressure expected in the wellbore or formation taking into account potential recharging of the reservoir or other associated developments
MD	Measured depth. The length of the wellbore, as if determined by a measuring along a wellbore. This measurement differs from the true vertical depth (TVD) of the well in all but completely vertical wells.
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)

NORM	Naturally Occurring Radioactive Material
NPT	Non-Productive Time
Operator's Competent Technical Authority	The Operator's appointed engineer with sufficient experience and knowledge to oversee the design and execution of well abandonment operations. This individual must be responsible for ensuring all abandonment operations are designed and carried out in an effective way, compliant with this guideline, and any other Operator internal standards, procedures and policies, and must have the authority to control and approve well operations plans and activities.
P&A	Plug and abandon = Well Decommissioning
Permanent Barrier	A confirmed barrier that will uphold a seal permanently. A Permanent Barrier must extend laterally across the full cross-section of the well including all annuli. In respect of isolation from surface, the first barrier above the point of potential influx is called the ***Primary Barrier***, and the subsequent barrier above the point of potential influx is called the ***Secondary Barrier***.
Permanent Well Decommissioning	The perpetual isolation from surface, as well as from lower pressurised zones, of any penetrated zones which have flow potential in a well which will not be re-entered at any time in the future.
Swarf	Steel fragments, often thin and curly in nature, produced by milling casing or other tubulars
TOC	Top of cement.
USIT	Ultrasonic Imager Tool, an electronic tool used to confirm the density and homogeneity of cement behind casing. Note that other acronyms exist depending on the service provider and era of the electric wireline tool design.
Well	A well is a single wellbore or accumulation of wellbores from a single well origin at surface, including the original wellbore and any side-tracks.
Xmas Tree	Christmas Tree: An Assembly of valves, seals and external connections installed on a wellhead to provide shut-in and pressure control capability on a completed well on a permanent basis.
Zone with Flow Potential	One or more formations with flow potential that due to, either being in communication with one another or displaying similar pressure characteristics, are treated as a single formation for abandonment purposes.

APPENDIX B: SUMMARY OF LEGAL REQUIREMENTS FOR WELL DECOMMISSIONING

There were no approved regulations relating to decommissioning of onshore wells in the past, and these current guidelines initiate some form of standards to provide guidance and support to decommissioning of wells in South Africa.

These guidelines are referred to, on section 20 (2) in the Proposed Regulations Pertaining to the Exploration and Production of Onshore Oil and Gas Requiring Hydraulic Fracturing were published in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

APPENDIX C: CONTENTS OF A WELL DECOMMISSIONG SUBMISSION TO THE DESIGNATED AGENCY

In considering all well decommissioning plans, the designated agency must balance the following issues:

- Ensure economic recovery is maximised from a reservoir;
- Promote safe and technically feasible decommissioning solutions;
- Minimise adverse effects on the subsurface, surface and atmospheric environment; and
- Minimise adverse impact on other users of the location.

To allow the designated agency to verify that these issues are being appropriately addressed in the submitted well decommissioning plan, the submission should contain the following minimum requirements:

1. Executive Summary with Abandonment Form (example provided in Figure C-1, below).
2. Abandonment Summary

   2.1 Reason For Abandonment (including an assessment of any remaining recoverable petroleum volumes);

   2.2 Summary of Well Engineering History;

   2.3 Abandonment Programme (including the proposed well abandonment procedure and details of any proposed barriers e.g., location, capacity, length and volume of any cement plugs);

   2.4 Bottom Hole Pressure & Temperature Data.
3. Summary Risk Analysis & Mitigations – including an assessment of potential short-term Operational Risks and potential long-term Abandoned Well Integrity Risks and how they have been mitigated by the proposed programme.
4. Enclosures (as appropriate to the well being abandoned):

   Encl.1 Well Location Map.

   Encl.2 Structural Map & Geological Cross Section (showing the well path) including any aquifers.

   Encl.3 Petrophysical Analysis of the well (incl. details of all hydrocarbon-bearing intervals).

   Encl.4 Current Completion Schematic.

   Encl.5 Perforation Chart.

   Encl.6 Well Test Record.

   Encl.7 Tabulation of Annular Pressure History.

   Encl.8 Cement Verification Evidence.

   Encl.9 Production History Tabulation & Plot. This should state Initially In Place Petroleum Volumes accessed by the well and provide details of the cumulative production of oil, gas and water and give an estimate of the current Recovery Factor for each reservoir zone.

   Encl.10 Decline Curve Analysis (including an analysis of any remaining petroleum volumes).

   Encl.11 Blowdown Report (including, Time of Test, Choke Size, Tubing Pressure, Casing Pressure, Samples of petroleum and water, any pertinent remarks).

   Encl.12 Volumetric & Economic Analysis of any Hydrocarbon-bearing zones including undeveloped intervals.

   Encl.13 Proposed Abandonment Schematic.

   Encl.14 Breakdown of Well Decommissioning Duration and Estimated Cost (AACE Class 3).

Encl.15 Analysis of Potential Risks to the Environment

Enclosures 9, 10, 11 and 12 aim to allow designated agency to verify that economic recovery has been maximised from any well.

	FIGURE C-1 **WELL ABANDONMENT SUMMARY**	Ref. No. : Issued Date : Issued By : PASA Approval Date:

FIELD NAME		WELL NAME		SLOT NAME	
WELL TYPE :	e.g. Development Well (Deviated well)		PLATFORM LINE PRESSURE		

REASON FOR ABANDONMENT	ATTACHMENT CHECKLIST
☐ Completely Depleted ☐ Production Sub-Economic ☐ Technical Problems – Specify ☐ Other, Specify	☐ Well Location Map ☐ Structural Map & Geological Cross Section ☐ Petrophysical Analysis ☐ Completion Schematic ☐ Perforation Chart ☐ Well Test Record ☐ Tabulation of Annular Pressure ☐ Production History Tabulation & Plot ☐ Decline Curve Analysis & Blowdown report ☐ Volumetric & Economic Analysis of any Unperforated Sands ☐ Abandonment Schematic ☐ Breakdown of Well Decommissioning Duration & Cost ☐ Analysis of Potential Risks to the Environment
CASING TO BE PULLED	**ARTIFICIAL RECOVERY**
☐ No ☐ Yes Detail:	☐ No ☐ Yes Detail:
FISH IN HOLE	**UNCEMENTED CASING LEAKS**
☐ No ☐ Yes Detail:	☐ No ☐ Yes Detail:

WELL STATUS		CUMULATIVE PRODUCTION		
☐ Shut-in	Last Shut-in date :	Gas	???	bscf
☐ Periodical Production	Rate :	Condensate	???	mbbl
☐ Producing	Daily Rate :	Oil	???	mbbl
		Water	???	mbbl

WELL DATA

Initial Rate			Most Recent Test (Before well die)			Initial Static Pressure (Psi)			Current Static Pressure (Psi)		
Gas:	???	mmscfd	Gas:	???	mmscfd	Wellhead Tubing:	???	psi	Wellhead Tubing:	???	psi
Condensate:	???	bpd	Condensate:	???	bpd	Production Casing:	???	psi	Production Casing:	???	psi
Oil :	???	bpd	Oil :	???	bpd						
Water:	???	bpd	Water:	???	bpd						
Flow Pressure:	???	psi	Flow Pressure:	???	psi						
Duration:	???	hrs	Duration:	???	hrs	Duration:	???	hrs	Duration:	???	hrs
Date:			Date:			Date:			Date:		

CURRENT AND PREVIOUS ABANDONED ZONE

Sand Name	Perforation (m MD)		Date of Abandonment	Method of Isolation	Plug Depth
	Top	*Bottom*			

CASING HISTORY

Casing String	Casing Size	Casing Depth	Cement Top	Stage Cement Top
Surface Casing	*9 5/8"*	*??? mBRT*	*??? mBRT*	*??? mBRT*
Intermediate Casing	*7"*	*??? MBRT*	*??? MBRT*	*??? MBRT*
Production Casing	*3 ½"*	*??? mBRT*	*??? mBRT*	*??? mBRT*

I hereby certify that the statements made in this form are, to the best of my knowledge, true, correct and complete.

Name: Title:

Signature: Date:

ANNEXURE D: WELL DECOMMISSIONING TECHNICAL CONSIDERATIONS & PRACTICES

D.1 ISOLATIONS

Each formation penetrated during the drilling and construction of the well, and which exhibits a flow potential, should be isolated as part of the abandonment.

Multiple formations that are in natural hydraulic communication or are demonstrably at similar hydraulic pressures can be treated as a single zone.

Water bearing zones require a single barrier isolation from the environment.

Hydrocarbon bearing zones require dual barrier isolation from the environment. This may be simplified to a single barrier, in certain circumstances, provided this can be demonstrated to be as, or more, effective and reliable than the dual barrier alternative.

In addition, a single barrier isolation should be applied between each zone within the wellbore. See **Figure D.1**

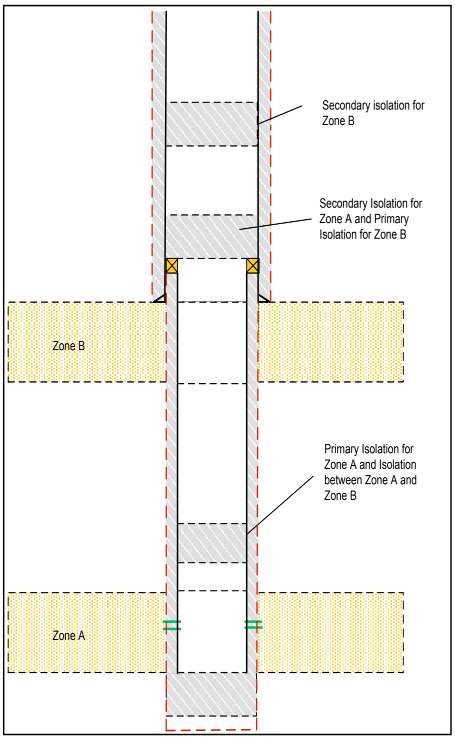
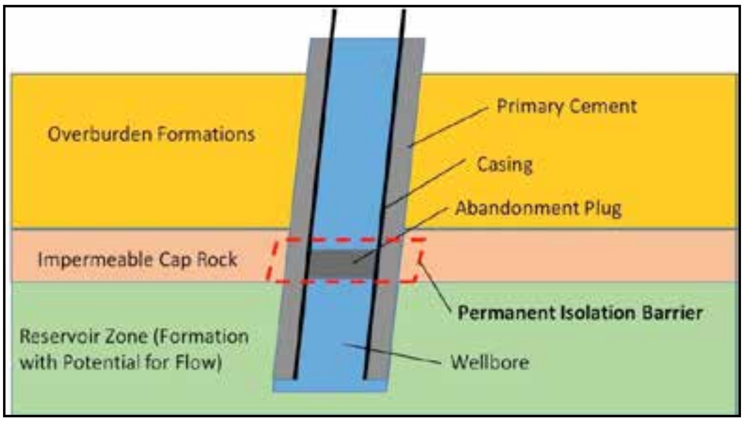


Figure D.1 Isolation of Multiple Zones

D.2 BARRIERS

The aim of a primary permanent isolation barrier is to reinstate the containment or 'Cap Rock' originally in place for the formation or zone. To be considered as a Competent Barrier it must be:

- Contiguous across the whole of the wellbore
- Of sufficient length along the wellbore
- Located at such a depth that the adjacent formation is impermeable and is of sufficient strength to withstand the potential wellbore pressure it may be required to isolate in the future i.e. a Cap Rock - see **Figure D.2**.
- Each Barrier may be made up of a number of Barrier Elements. See **Figure D.3**



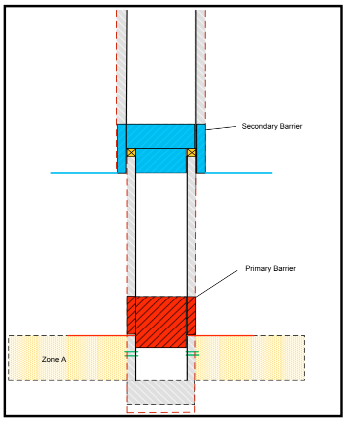


Figure D.2: Reinstatement of the Cap Rock **Figure D.3: Multiple Barrier Elements**

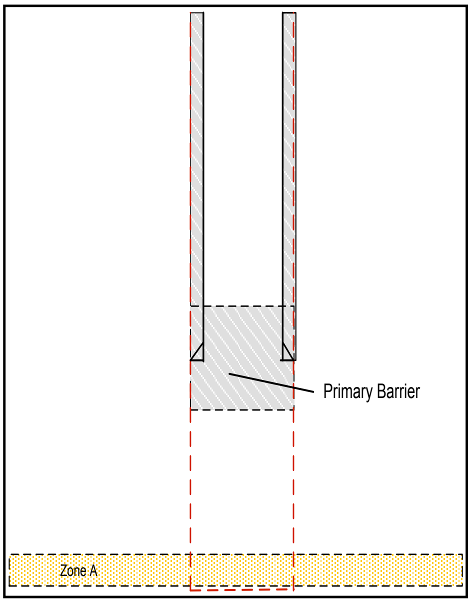
D.3 BARRIER LOCATION

An isolation plug, forming a Barrier Element, should be set as close as practicable to the uppermost point of potential inflow from a formation or zone, taking due regard for all other considerations within this guideline.

Note that the Secondary Barrier for one formation may contain Barrier Elements that are also part of the Primary Barrier for a shallower formation.

Open Hole

In addition to the requirements above, a Barrier is required in cased hole, or extending a minimum of 30m (100’) into cased hole. See **Figure D.4**. This Barrier is to fully isolate the open hole.



``**Figure D.4: Open Hole Isolation**

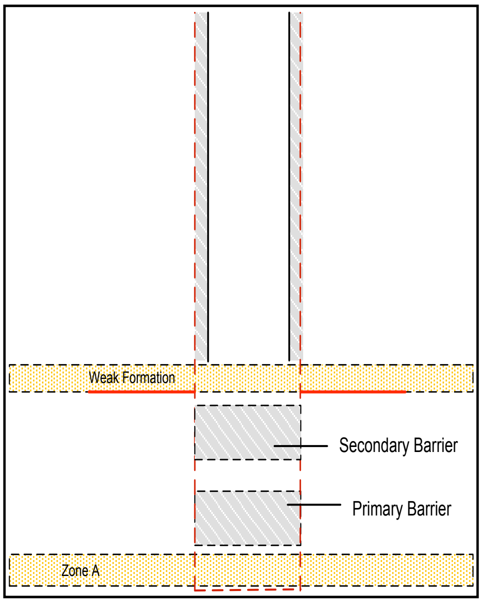


Figure D.5: Open Hole Isolation of Weak Formation

Where the pressure from a formation in open hole is anticipated to exceed the formation fracture pressure anywhere in the open hole, the weaker zone should be isolated from the higher-pressure Zone A by 2 barriers. A further open hole barrier will be required above the weak formation as described in **Figure D.5**.

Cased Hole

Cemented casing is not considered a permanent barrier to lateral flow within the wellbore, due to the potential degradation of the steel casing over time. However, casing cement can be considered as a barrier to vertical flow if there is sufficient evidence regarding its quality and extent, as illustrated in **Figure D.6.**

Top of Cement (TOC) and cement bond quality can be confirmed by cement bond logging, or by recording operational parameters during casing cementation. If the TOC is estimated based on cementing reports, then a longer cement column shall be required to allow for TOC uncertainty.

If the cement quality and annular TOC (or top of good cement) is verified by cement bond logging, then the depth of the top of (good) cement can be assumed to be as recorded. If the annular TOC is estimated from cementing reports, then a specified minimum cement plug length above the base of the internal Primary Barrier cement plug is required, as illustrated in **Figure D.7.**

Problems during casing cementation should be investigated, and if doubt remains regarding the quality and/or quantity (height) of annular cement then remedial cementation, such should be considered.

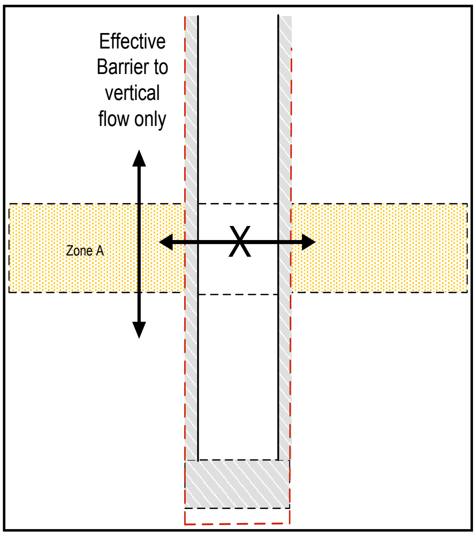


Figure D.6: Cemented Casing as a Barrier

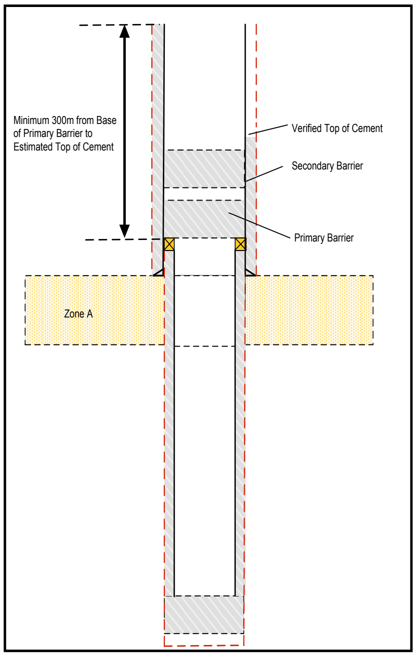


Figure D.7: Annular Cement Requirements

D.4 INTERMEDIATE FORMATIONS

Hydrocarbon bearing formations intersected by the well, but not necessarily viewed as production formations, should be treated similarly to hydrocarbon production zones. However, multiple formations with similar pressure regimes can be treated as a single zone as there is no pressure differential to drive cross-flow. Often, only a single isolation barrier will be required, at or close to the surface/seabed, in order to isolate multiple water bearing formations with potential to flow encountered relatively high up in the wellbore.

It must be noted that care should be taken to isolate any fresh water zone, with potential to be used as a water source, from the other formations including saline aquifers, in order to ensure no future contamination of water resources.

D.5 TEMPORARY ABANDONMENT (SUSPENSION)

Wells may be shut-in or suspended for a short duration, to allow BOP maintenance, Xmas tree change-out etc. In such cases, good well integrity maintenance and well control procedures should apply.

Well suspension for longer periods (referred to as Temporary Abandonment), where a well is typically not monitored frequently, should provide competent, verified, isolation of formations as per these guidelines.

The same minimum number of barriers are required as for permanent abandonment; however, these may include suitably designed and pressure tested (or otherwise verified) mechanical devices, including bridge plugs, wellhead seals, pressure containing suspension caps etc.

Kill weight fluid only constitutes an acceptable Barrier Element when it can be monitored and maintained and is therefore not usually applicable for Temporary Abandonment.

A cemented shoe track is only an acceptable Barrier Element when it is specially designed, and suitably tested, to be one. Similarly, cemented liner is only considered a barrier element when suitably tested, see below.

Shoe track valves, run as an aid to cementing, do not qualify as a Barrier Element.

The Temporary Abandonment should be designed to facilitate both well re-entry for reuse, and future permanent well abandonment.

The setting of any plugging system or device as part of a Secondary Barrier is of particular importance, ensuring it can be easily removed without compromising safety or well control, even when the primary barrier below has failed.

D.6 PERMANENT BARRIERS

Permanent plugging materials employed as Barrier Elements must be made of cement, or a material with similar functional properties. Critical properties are:

- Very low permeability, resulting in a release rate of <1m3 gas/year
- Long lasting, with characteristics that do not deteriorate over time
- Ability to withstand the maximum differential pressure anticipated at the barrier location
- Non-shrinking
- Ability to bond to casing and formation
- Resistance to reaction with, or degradation by, all elements of the wellbore contents including critically H_2S and CO_2 if potentially present.

In designing the specific recipe of the cement, care should be taken to ensure that each of these factors is addressed.

When considering an alternative material to cement, care must be taken to consider whether it has a proven track record in applicable circumstances, and this choice should be subject to specific review and acceptance by the Regulator. In principle, an alternative material should provide a performance equal, or in excess, of cement.

A support, commonly referred to as a fundament, such as a bridge plug or viscous pill, to prevent slumping of the cement slurry is recommended for all cement plugs.

It should be noted that mechanical plugs and viscous pills do not constitute permanent Barrier Elements.

Casing and tubing do not constitute permanent Barrier Elements either, although it is permissible for these to be present across the Barrier Element length, as in the case of balanced plugs circulated behind perforated tubing or original primary cement behind casing.

It should be noted that control line and/or instrument cable and/or power cable is not generally advisable across the full length of Barrier Element, as, due to the nature of their design and/or material and method of fastening to the host tubular, they provide a potential leak path either now or in the future.

D.7 TEMPORARY ABANDONMENT (SUSPENSION) BARRIERS

Temporary Abandonment Barrier Elements may be made of metal and/or elastomers, including suitably designed tools such as bridge plugs, wellhead seals and pressure containing suspension caps. See **Figure D.8**.

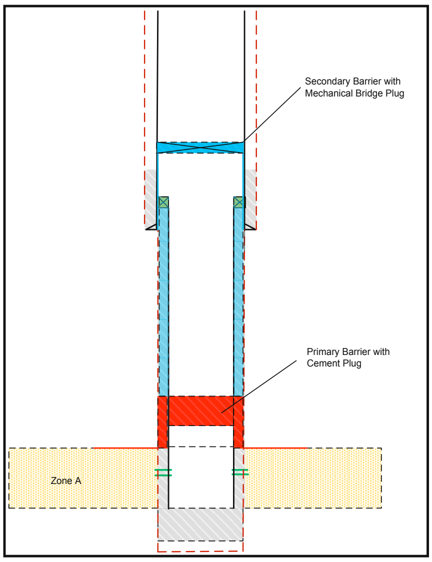


Figure D.8: Temporary Suspension Barriers

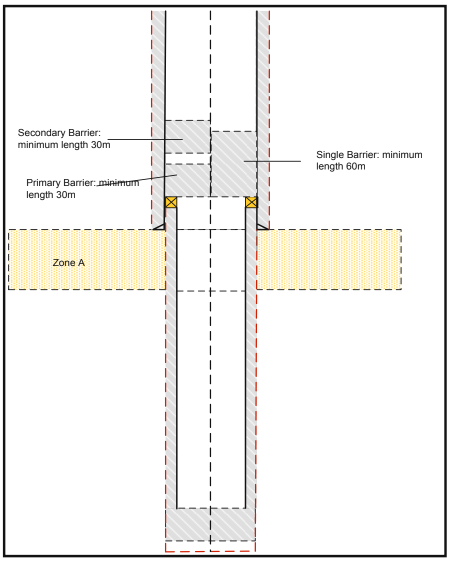


Figure D.9: Cement Plug Lengths

D.8 LENGTH OF CEMENT PLUGS

It is considered 'good practice' for an isolation cement plug to have a minimum 'along hole' length of 30m of 'Good Cement'. However, the installation method for the plug should be considered, and where there is an increased risk of contamination, and/or the cement quality has not been verified, the volume should be increased to provide up to 150m of cement. Increased risk of contamination may be due to:

- Small cement volumes,
- Minimal spacer volume,
- Difficulty cleaning the wellbore,
- Directional or horizontal well trajectory,
- Large bore circulation (through tubing or casing for example), or
- Setting a balanced plug behind casing or tubing

In addition, hole inclination may also raise concerns regarding the actual length of cement achieved. In the instance of the barrier location being at inclinations of more than about 65°, the cement plug length 'Along Hole' should be calculated in order to provide a specified minimum 'thickness' where appropriate.

In instances where a single Combination Barrier is used to isolate a hydrocarbon Zone from surface, the Barrier Element length should be doubled. See **Figure D.9**

Where primary cement behind casing is employed as a Barrier Element, this element should extend for at least the same length as the internal plug. Where there is a lack of confidence in the quality of the annular cement, the Barrier Element length inside and outside the tubular should be increased to 150m or more. Where there is doubt about the actual top of cement in the annulus, the theoretical top of cement in the annulus should extend above the base of the barrier plug by a minimum specified amount 'Along Hole'.

D.9 POTENTIAL INSTALLATION TECHNIQUES

To maximise the likelihood of achieving a successful barrier, cement plug installation methods should be carefully chosen.

The wellbore at the barrier depth should be suitably prepared with surfaces cleaned of contamination and in a water-wet condition.

Cement plug volumes should be chosen to take account of contamination and any shrinkage, and to take account of inner string eccentricity.

Wherever practicable, a fundament should be installed at the base of the cement plug location, in order to prevent or minimise the risk of slumping. This fundament may be a bridge plug, a viscous gel pill or some other device or material. It should be noted that these fundaments do not constitute a Competent Barrier Element.

D.10 CEMENT PROGRAMME DESIGN AND EXECUTION

Effective cementing is critical to successful well abandonment, and both the design and execution phases must be considered with care.

Cement plugs can fail to achieve their objectives in a variety of ways, but the failure modes can be grouped under the following headings:

- Incorrect cement design or failure to mix the cement in accordance with the approved design, resulting in excessive solids settling, free water and/or shrinkage.
- Contamination of the cement slurry with other fluids to the point where the cement fails to set, or fails to achieve the required compressive strength. Note: Contamination at the top of the plug should be expected and planned for.
- Failure to achieve complete circumferential coverage across the wellbore or around an annulus, commonly known as boycotting.
- Failure to prevent fluid connectivity from below the plug to above due to 'roping' or 'slumping' with the wellbore contents.

The principal root causes of failure can be listed as follows:

<u>Design</u>

- Poor well evaluation.
- Poor written procedures.
- Incorrect design temperatures.
- Incorrect mix water composition.
- No firm base for cement plug.
- Directional wells
- Eccentric tubulars

Execution

- Contamination (as little as 10% by volume Oil Based Mud contamination may significantly impact the compressive strength).
- Poor mud and hole conditioning.
- Inappropriate chemical wash and spacer fluid design or failure to execute the design.
- Sub-optimal pump rates.
- Insufficient slurry volume.
- Execution delays.
- Impatience to set and tag the plug.
- Over-displacement (take into account the tubulars' actual dimensions to accurately calculate displacement volumes).

All these factors should be addressed in any cement plug programme, with particular attention to:

- Compatibility of recipe with hole contents and anticipated temperature,
- Sufficient plug volume to allow for contamination potential,
- Proper hole cleaning and water wetting of the casing/tubulars,
- Use of a fundament below the plug (viscous gel or bridge plug for example) to prevent slumping,
- Choice of circulation rates to minimise mixing with the wellbore fluid,
- Use of spacers before and after the cement slurry to minimise contamination,
- Avoidance of over-displacement to minimise mixing and contamination,
- Rotation of the delivery pipe (if possible) whilst pumping cement to maximise circumferential coverage, but without reciprocation which encourages mixing and contamination.

D.11 THROUGH TUBING OPERATIONS

There must be high confidence regarding the presence and quality of the cement behind the casing at the barrier depth. Care must be taken to ensure that the formation strength at the barrier depth is sufficient, particularly if the barrier plug is set above the production packer.

Allowance should be made, and/or mitigation measures (such as a viscous pill as annulus plug fundament) taken for potential slumping or fingering in the annulus of any balanced plug. The use of the tubing as a circulating conduit should also be properly assessed, as the diameter may increase the risk of mixing and contamination.

Allowance should also be made for hole inclination, tubing eccentricity and small radial clearances such that there is good confidence that full radial coverage of the annulus will be achieved.

Care must be taken to verify the location and depth of the cement plug in both the tubing and annulus as there is no single reliable measurement technique to confirm this. Tagging cement inside the tubing combined with operations quality control and pressure testing should be used in combination. No single method should be relied upon.

D.12 REMEDIAL CEMENTATION

Poor quality of primary cementation, or a lack of knowledge or confidence regarding the quality or presence of Good Cement behind casing, may lead to a requirement to take remedial action during the well abandonment operations.

There are a number of methods which can be considered from section milling the casing and back-reaming to the formation, or cutting and pulling the casing to expose the annulus at the necessary depth, to 'perforate-and-squeeze' techniques. Each technique has advantages and disadvantages, see **Table D.1** below:

Method	Advantages	Disadvantages
Casing section milling	Clear evidence of 'rock-to-rock' barrier placement.	Casing milling can be straightforward, but there is a significant risk of operational performance problems, particularly when the casing is un-cemented. Milling multiple casing sections can also be problematic, particularly in deviated and/or un-centralised sections. Swarf handling at surface, build-up in the BOP ram cavities and balling around the BHA are all cited as concerns associated with this technique. Finally, this technique is often viewed as both time consuming and costly.
Cut and pull inner casing(s) and set cement plug across or above the resultant stump	When successful, this provides an unequivocal barrier across the complete wellbore which can be both pressure tested and tagged/weight tested.	Pulling casing can be extremely difficult, or even infeasible if there is barite fallout or residual (poor) cement behind the casing, or if corrosion has weakened the string to such an extent it parts under the tensile load imparted during pulling operations. It also requires significant pulling and large diameter pipe handling capacity at surface, and significant laydown area and large volumes of backload of recovered pipe from location. This can be time consuming and thus expensive, particularly if multiple casings are to be removed.
Perforate and squeeze cement into the annulus below a cement retainer/squeeze packer	This is a relatively swift and simple operation, which limits expense.	The volumes of cement effectively squeezed into the annulus are highly dependent on the state of the annulus contents, with channels potentially packing off after only small volumes have been squeezed. With such small volumes there is significant residual uncertainty with regard to the length and effectiveness of the annular barrier created, and poor verification of the barrier. The annular Barrier Element can only be pressure tested or logged if the cement plug inside the casing is drilled out. The location of cement is largely unknown if more

		than one casing annulus is to be cemented.
Perforate, wash and cement using proprietary tooling	This tooling has been shown to be successful in a number of applications and the technique demonstrates that reasonable circulation and subsequently large volumes of cement are being obtained behind the casing.	There remains some uncertainty as to the cleanliness of the annulus after the washing process, and thus it is not clear where the cement is going and how long or effective the annular Barrier Element is. The annular Barrier Element can only be pressure tested or logged if the cement plug inside the casing is drilled out. The results of the operation become less certain when multiple annuli are to be cemented.
Inject cement into the annulus from surface	This is a relatively swift and simple operation, which limits expense.	Relies on injectivity below the casing shoe. The quality of the annular cement barrier is uncertain due to potential debris and contamination in the annulus, slumping of the cement and or fluid channelling, eccentricity of the casing etc. Difficult to verify the top of Good Cement but pressure testing the annulus is possible.

Table D.1: Comparison of Remedial Cementation Techniques

In evaluating the options, care should be taken to understand both the likelihood of a successful barrier and the method of verification. The unknowns in relation to the well condition, the potential for deviations from the planned operation (such as casing parting or becoming stuck), and the impact these may have on both the likely cost and barrier effectiveness should also be understood.

In addition to remedial cementing, other materials and techniques for remediation of poor annular cement are available including resins, bismuth or thermite. These novel methods may offer the opportunity for rig-less remediation but are typically reserved for situations where the use of cement is not applicable or has been unsuccessful.

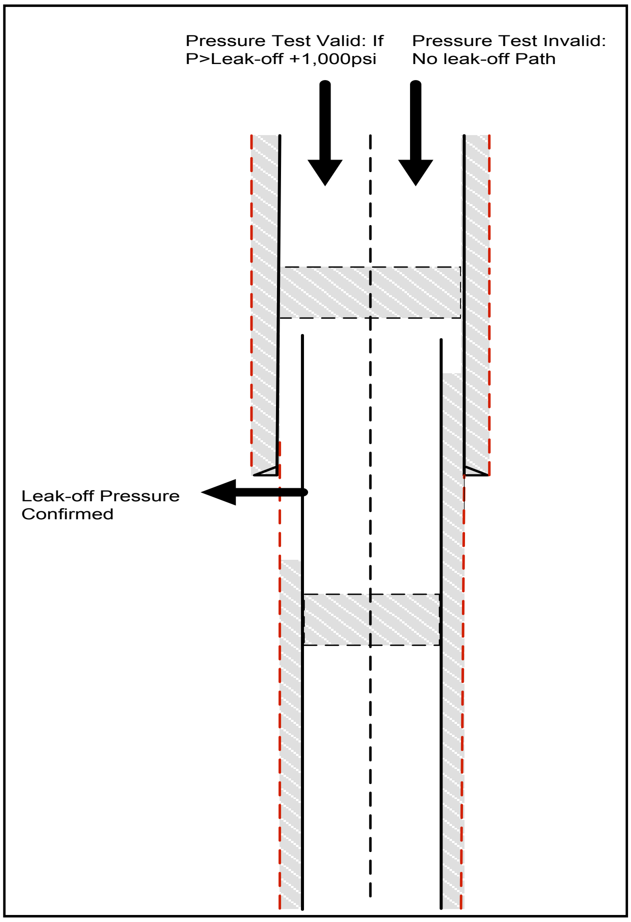


Figure D.11: Leak-off Path for Pressure Test

D.13 BARRIER ELEMENT VERIFICATION

Each element of a Barrier requires some form of verification. Where possible, a pressure test of each element of the Barrier should be performed. This can be by inflow test or a positive test from above. As a minimum, this should be with a differential pressure of a specified amount above the expected leak-off below the element for a specified period of time. A positive pressure test without a known leak path downstream of the Barrier Element is not valid unless specific measures are implemented to confirm that the test pressure is actually being applied to the Barrier Element being verified. See **Figure D.11**

In addition, where the Barrier Element is placed inside the wellbore, a tag and weight test may be performed to confirm that i) the plug is at the planned location and ii) that the cement has set correctly. A minimum weight of a specified amount should be set down on the top of the plug to confirm rigidity.

When cement from the original well construction forms a Barrier Element, the efficacy of this cement should be established beyond reasonable doubt. Ideally this is provided by a combination of a pressure test of the annulus (if possible) and a CBL or USIT-type log across the relevant depth forming the barrier. In the absence of such a log, the drilling and cementing reports should provide good evidence that Good Cement is present at the desired depth. The analysis of the reports should include confirmation of hole gauge, spacer fluid and cement volumes pumped, ‘bumping’ of wiper plugs, full returns through the cement job and/or an estimated top of cement a specified distance or percentage of the volume pumped above the top of the Barrier Element depth. In cases where the cement cannot be, and/or has not been pressure tested, such as a liner cementation where the pressure test was undertaken after the liner hanger/packer had been set, this cement should not form a Barrier Element unless verified by some other means.

APPENDIX E: WELL DECOMMISSIONING ENVIRONMENTAL RISK CONSIDERATIONS

An Environmental Risk Assessment must be carried out at the time of relinquishment or expiry of a production right or an exploration right granted in terms of the MPRDA, and a closure plan, environmental risk report and final performance assessment report must be prepared in support of an application to the Regulator for a Closure Certificate.

The risk assessment aims to assist in establishing what actions must be undertaken in order to return it 'to its natural or predetermined state, or to a land use which conforms to the generally accepted principle of sustainable development' in line with Section 38(1)(d) of the MPRDA.

At a minimum, the environmental risk assessment report must identify the risks associated with any infrastructure (including wells) and evaluate the significance of these risks by assessing the potential impact and the likelihood of occurrence.

This guideline describes a goal orientated approach which conforms to this requirement in terms of both abandonment design and assessment of residual risk. The process includes a screening qualitative step to categorise risk as insignificant, significant or of uncertain significance. These categories are defined as follows:

- Insignificant Risks are risks which have been calculated to have a low residual risk, i.e., both the residual impacts and likelihood of all unwanted events are shown to be insignificant in nature. Wells with risks categorised as 'insignificant' can be considered suitably abandoned and could form part of the application for a Closure Certificate without the need for further work to reduce the level of risk;

- Uncertain Risks are risks that have been calculated to have a moderate residual risk i.e., both the residual impacts and likelihood of all unwanted events are shown to be moderate in nature. The residual likelihood may be significant whilst the impact may be of a moderate to insignificant nature. Wells categorised as 'uncertain' should be assessed to determine if the risk level can be reduced by further gathering of data or evidence of Barrier effectiveness. These wells may also require other interventions to reduce the level of risk; and

- Significant Risks are risks which have been calculated to have a high residual risk i.e. both the residual impacts and likelihood of all unwanted events are shown to be significant in nature. Wells categorised as 'significant' should be considered as requiring further risk reduction (e.g. such as well intervention) to achieve abandoned status.

For the risks to be considered acceptable, it must be demonstrated that there are no further risk reduction measures that are 'reasonably practicable' to implement to further reduce the residual risk. In order to determine whether there are any additional risk reduction measures which could be implemented, a formalised assessment should be undertaken where the cost of further risk reduction should be balanced against any benefit that may be received. Where the costs of a measure are shown to be grossly disproportionate to any benefit that may be gained as result of its implementation, the measure may then be discarded. All other measures should be considered for implementation. All wells falling into the Uncertain or Significant categories may require quantitative assessment to demonstrate that the actions taken reduce the level of risk to an acceptable state.

This process must be recorded, subjected to external review, and presented to the Regulator as part of an application for Closure Certificate and/or as part of a justification for deviation. The Regulator has the discretion to subject the risk assessment to further external review.

The practices embodied within this guideline can be utilised to demonstrate that suitable measures have been taken to reduce the risk of future loss of containment.

The risk assessment process may be used to inform deviation from the guidelines contained in this document.

APPENDIX F: SPECIAL CONSIDERATIONS

F.1 PARTIAL ABANDONMENT FOR SIDETRACKING

The cement plug(s) to abandon the original mother wellbore should be designed, installed and verified in order that it can form part of the subsequent future permanent abandonment. If the plug is used as a kick-off plug, after kick-off, it should conform to the requirements as part of the eventual abandonment.

Note: the final abandonment for all boreholes of the well should comply with these guidelines.

F.2 RADIOACTIVE SOURCES

Ideally, radioactive sources should be retrieved prior to final abandonment. However, it is appreciated that this may not always be possible. If retrieval is not possible, local regulations should apply, including encapsulation registration and location marking as required. The presence of radio-active material should be noted within any reports or plans submitted to the Regulator for the purposes of obtaining a Closure Certificate.

F.3 HOLE ANGLE

Where cement barriers are to be installed at hole inclinations greater than about 65°, care should be taken with the design of the installation method(s) to ensure that good cement coverage can be expected to be obtained over the required length and the complete circumference of the wellbore. This should also be verifiable.

Where appropriate, plug lengths should be treated as true vertical heights rather than ‘along hole’ lengths.

F.4 MULTI-LATERAL WELLS

The added complexity of these wells should be fully considered at the time of well construction and abandonment design. Key issues to consider will include:

- Future abandonment issues where access to the original or previous wellbore(s)will be difficult.
- Isolation of annuli above the wellbore intersections.
- Potential for differential pressures between wellbores during abandonment operations and/or longer term.

F.5 MULTIPLE RESERVOIRS

Multiple reservoir zones that are not in natural hydraulic communication or are not demonstrably at similar hydraulic pressures cannot be treated as a single zone and should be isolated from each other.

F.6 CEMENTED CASING LINER

Where a liner hanger has been set inside and previous casing or liner, it is common practice to set the liner top packer prior to pressure testing the liner top. In this case, the cement behind the liner (the liner lap) has not been pressure tested and cannot be considered as a competent Barrier Element unless other barrier verification methods are acceptable.

F.7 CONTROL LINES, ELECTRICAL SUBMERSIBLE PUMP (ESP) CABLES AND GAUGE CABLES

Due to their design and/or material of construction, these items present a potential leak path over time and therefore must not form part of any Permanent Barrier unless specific measures are adopted to overcome this issue.

F.8 HIGH PRESSURE HIGH TEMPERATURE (HPHT) WELLS

These wells bring additional complexity and increased performance requirements from the abandonment barriers to be installed. Special attention should be given to the following during all aspects of abandonment design:

- Recharging of reservoir pressure.
- Casing deformation.
- Temperature cycling during the well's operational life.
- The impact of high temperature on Barrier Element performance including cement degradation and elastomeric seal degradation.
- Reservoir compaction and overburden subsidence.

F.9 WELLS CONTAINING H2S

For wells containing H_2S, or anticipated to contain H_2S in the future, barrier materials must be chosen to withstand the impact of chemical degradation, corrosion and embrittlement.

F.10 WELLS CONTAINING CO2

For wells containing CO_2, the corrosive impact of CO_2, when in contact with water, on cement and metals must be included in the choice of materials.

In addition, CO_2 can alter the permeability and strength of formations and cement due chemical interactions with these materials.

F.11 WELLS CONTAINING NORM AND/OR MERCURY

For wells containing NORM and/or Mercury will require specific waste management and safety management considerations during decommissioning.

F.12 SEALING FORMATIONS

Some formations, such as some shales and salts, are known to be able to close annular spaces in open-hole annuli.

If the formation is impermeable and of sufficient strength, and it can be demonstrated that a formation seal against the cement or casing is adequate to prevent flow at the anticipated future pressures, then this can replace Good Cement as an annular Barrier Element.

Verification of a sealing formation requires:

- Proof of adequate fracture strength
- A leak test demonstrating a seal between perforations at 30m (100') spacing.
- Verification of sufficient seal length (see section 8) through two (2) independent bond logs indicating bond strength as good as, or better than, cement.

Subject to Regulator approval, such verification may be conducted for the formation across a field or region, rather than for every well to be abandoned.

F.13 SURVEYS

All permanently abandoned well locations should be visually surveyed and monitored using a 4-gas hand-held monitor or FLIR. The monitoring should start at most one year and repeated at five years after the abandonment to demonstrate that abandonment has been effective.

Surveys should continue periodically on a 5-yearly cycle until no longer required in terms of applicable legislation.

F.14 DEVIATIONS FROM THE GUIDELINES

During the design and planning phase, all proposed deviations from the guidelines should be reviewed and approved by the Operator's Competent Person, and be discussed and accepted by the Regulator.

As a minimum, a documented risk assessment process should form part of such a motivation.

During operations, a management of change process should be implemented to ensure all changes to the programme of work that may affect the final abandonment status are properly reviewed and approved prior to execution. As a minimum, changes with this potential impact should be reviewed and approved by the Operator's Competent Technical Authority, and be discussed and accepted by the Regulator.

F.15 POST DECOMMISSIONING ACTIVITIES

On completion of the abandonment work programme, a Well Decommissioning Report should be compiled containing, as a minimum:

- Details of the work programme actually carried out;
- Detailed reports of wireline, logging, fluid mixing and sampling, cementing, pumping, pressure testing, tubing, casing, wellhead and conductor removal, location surveys;
- Details of all deviations from these guidelines;
- Confirmation of all correspondence and approvals from the operator;
- A wellbore status diagram showing the as-left status of the well.

This report should be submitted to the Regulator for review and acceptance no later than 3 months after completion of the final operations.

Detailed reports of all surveys of temporary abandoned (suspended) wells should be copied to the Regulator no less than 3 months after completion of the survey.