
GENERAL NOTICE

NOTICE 1032 OF 2013**DEPARTMENT OF MINERAL RESOURCES****MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002****(ACT No. 28 OF 2002)****PROPOSED TECHNICAL REGULATIONS FOR PETROLEUM EXPLORATION AND EXPLOITATION**

I, Ms Susan Shabangu, MP, Minister of Mineral Resources, hereby give notice of my intention to make Technical Regulations for Petroleum Exploration and Exploitation under section 107(1) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), as set out in the Schedule hereto.

The purpose of the draft regulations is to augment gaps identified in the current regulatory framework governing exploration and exploitation of petroleum resources, particularly in relation to Hydraulic Fracturing and prescribe good international petroleum industry practices and standards that will enhance safe exploration and production of petroleum.

Members of the public and interested and affected parties are invited to submit written input and comments to the Minister within 30 days of publication of this notice. Comments must be addressed as follows;

By post to: The Director General: Mineral Resources
 Attention: Dr. Thibedi Ramontja
 Private Bag X 59
 Pretoria, Acardia, 0007

By E-mail to: Andre.Andreas@dmr.gov.za

Hand delivered at: 70 Mentjies streets,
 Trevena Office Campus, building 2B.

Comments received after the closing date may not be considered.



SUSAN SHABANGU, MP

MINISTER OF MINERAL RESOURCES

**TECHNICAL REGULATIONS FOR PETROLEUM EXPLORATION AND
EXPLOITATION**

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CHAPTER 1

GENERAL PROVISIONS

Short Title

These Regulations shall be called Technical Regulations for Petroleum Exploration and Exploitation.

Purpose

To augment the Mineral and Petroleum Resources Development Regulations so as to prescribe standards and practices that will ensure safe exploration and exploitation of petroleum.

Definitions

1. In this schedule any word or expression to which a meaning has been assigned in the Act shall have that meaning and, unless the context indicates otherwise –

“API” means American Petroleum Institute;

"aquifer" means an aquifer as defined in the National Water Act, 1998 (Act No.36 of 1998);

"base fluid" means the continuous phase fluid type, including, but not limited to water used in hydraulic fracturing operations;

“casing” means piping positioned in a wellbore and cemented in place to prevent soil or rock from caving and isolate fluids from the surrounding geological formations;

"chemical" means any element, chemical compound, or mixture of elements or compounds that has its own specific name or identity;

“competent persons” means competent persons as defined in the Mineral and Petroleum Resources Regulations published in Government Notice No.R.527 dated 23 April 2004;

“days” means calendar days;

“designated agency” means designated agency as defined in the Mineral and Petroleum Resources Regulations published in Government Notice No.R.527dated 23 April 2004;

“flare” means a thermal oxidation system using an open, enclosed, or semi-enclosed flame;

“fresh water” means surface and subsurface water in its natural state that is suitable for human consumption, domestic livestock, irrigation, industrial, municipal and recreational purposes and is capable of supporting aquatic life in line with South African water quality guidelines;

“gas” means all natural gas, including casinghead gas, coal bed methane and shale gas;

“groundwater” means any water below the land surface that is within the saturated zone or geologic materials where the fluid pressure in the pore space is equal to or greater than atmospheric pressure;

“holder” means a holder of an exploration or production right granted in terms of sections 80 or 84 of the Act or an applicant for such a right;

“horizontal well” means a well with a wellbore drilled laterally at an angle of at least 80 degrees to the vertical and with a horizontal projection exceeding 30 meters, measured from the initial point of penetration into the productive formation through the terminus of the lateral in the same common source of hydrocarbon supply;

“hydraulic fracturing” means injecting fracturing fluids into the target formation at a force exceeding the parting pressure of the rock to induce fractures through which petroleum can flow to the wellbore;

“hydraulic fracturing additive” means any chemical substance or combination of substances, including, but not limited to any chemical and proppant that is added to a base fluid for the purposes of preparing hydraulic fracturing fluid;

“hydraulic fracturing flowback” means all hydraulic fracturing fluid and other fluids that return to the surface after hydraulic fracturing operations have been completed and prior to the well being placed in production;

“hydraulic fracturing fluid” means the mixture of the base fluid and all the hydraulic fracturing additives used to perform hydraulic fracturing;

“hydraulic fracturing string” means any pipe or casing string used for the transport of hydraulic fracturing fluids;

“micro-seismic monitoring” means the monitoring of seismic activity less than or equal to magnitude 3 using a network of calibrated seismological

equipment in order to produce readings on magnitude, depth, location, error and time of each seismic event;

“naturally occurring radioactive material” means a low-level, radioactive material that naturally exists in natural materials;

“oil” means natural crude oil or petroleum and other hydrocarbons, regardless of gravity, which are produced at the well in liquid form which are not the result of condensation of gas after it leaves the underground reservoir;

“perennial stream” means a stream that has continuous flow in its stream bed during all of the calendar year;

“petroleum” means petroleum as defined in the Act;

“produced water” means water, regardless of chloride and total dissolved solids content, that is produced in conjunction with oil or natural gas production or natural gas storage operations, but does not include hydraulic fracturing flowback;

“proppant” means sand or any natural or man-made material that is used during hydraulic fracturing operations to prop open the artificially created or enhanced fractures;

“release” means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment;

“surface water” means all water that is open to the atmosphere and subject to surface runoff;

“the Act” means the Mineral and Petroleum Resources Development Act, 2002(Act No.28 of 2002)

“pollution” means pollution as defined in terms of the National Environmental Management Act, 1998 (Act No.107 of 1998);

“water resources” means water resource as defined in the National Water Act 1998 (Act No. 36 of 1998);

“well” means any drilled hole used for the purpose of exploration and production of petroleum resources;

“well site” means surface area, including a well, occupied by all equipment or facilities necessary for or incidental to drilling, hydraulic fracturing, production, or plugging a well.

Application of Regulations

2. (1) These Regulations apply to all onshore, and, to the extent applicable, offshore exploration and production operations and must be read with the Act, the Regulations thereto and any other relevant legislation.

CHAPTER 2

SITE ASSESSMENT, SELECTION AND PREPARATION

Environmental Impact Assessment

- 3.(1) Wherever exploration or production activities are being planned that could have an impact on natural resources, or sensitive areas, appropriate studies must be undertaken to assess the potential impacts of such activities on the environment over the full life cycle of the operations.
- (2) An appropriate impact prediction study must contain the following elements-
- (a) correct formulation of the key questions that need to be answered by the impact prediction study and agreement with the relevant authorities that these are the correct key questions;
 - (b) characterization and knowledge of the sources on the operations that give rise to the impact;
 - (c) characterization and knowledge of the environmental pathways along which the impact could migrate;
 - (d) characterization and knowledge of the receptors that experience the impacts and what constitutes an acceptable impact;
 - (e) an assessment of the capabilities and limitations of the various approaches and tools that can be used to make impact predictions and answer the key questions that have been agreed upon;
 - (f) understanding of the issues of risk and uncertainty inherent in the tools and the assessment procedure and how these combine to affect the confidence that can be placed in the impact prediction that is made;
 - (g) development of a conceptual model that describes the interactions between sources, pathways and receptors, describes and motivates assumptions that will be made and describes and motivates which prediction tools will be used to undertake the impact prediction;
 - (h) appointment of suitably qualified persons that have access to the various tools and that have proper training and experience in selecting the appropriate tools for the assessment being undertaken and in using the selected tools;

- (i) adequate and appropriate independent review of the prediction methodology and results;
 - (j) design and implementation of an appropriate post-prediction monitoring programme, to support the validation and calibration of the predictions;
 - (k) a conclusion and recommendation on the most appropriate management action to be implemented for the activity for which the impact prediction assessment was undertaken; and
 - (l) compilation of all the above into an impact assessment report.
- (3) In undertaking an impact assessment study, the applicant must interact with the authorities at appropriate points in the impact assessment study and reach agreement with them on the following points-
- (a) the key questions that need to be answered by the impact prediction;
 - (b) the identity of the critical receptors;
 - (c) the initial conceptual model and its underlying assumptions;
 - (d) the final conceptual model and its underlying assumptions and the tools to be used to undertake the impact prediction; and
 - (e) that identified alternative management options to manage any unacceptable impacts are appropriate.
- (4) The final impact assessment report together with the independent review report must be submitted to the designated agency and/ or relevant Departments as part of the application process for an exploration or production right as prescribed by relevant legislation.

Assessment of Conditions Below Ground

4. A holder must assess the geology and geohydrology of the affected area prior to well design using available data and submit a geological overview report at the designated agency which may include the following -
- (a) geological map of the area (that can encompass several hydraulic fracturing sites) at relevant scale and with details that will allow understanding of the potential structural problems;
 - (b) geophysical profiling (2D or 3D) to the depth of the target area and below;
 - (c) stratigraphic boreholes (could be the hydraulic fracturing hole or any other complementary hole) to understand the regional stratigraphy and possible structural complexity. Proposed depth(s) to the top and

the bottom of the formation into which well fracturing fluids are to be injected;

- (d) borehole analysis: core logging, downhole geophysics, camera, water strikes, water quality, injection tests in fractures or formations;
- (e) physical and chemical properties of the stratigraphic formations such as porosity, permeability, fracturing, total organic carbon, clay and mineralogy;
- (f) cross sections of the study area based on surface geology, exploration borehole and geophysical profiling showing the stratigraphy, including the presence and morphology of dolerite and kimberlite and tectonic structures;
- (g) a hydrogeological investigation report at depth of drilling and fracturing;
- (h) model of fluid migration in the geological formation; and
- (i) geohazards associated with geological formations and structures and the solutions to overcome them.

Water Resource Assessment

- 5.(1) A holder must appoint an independent specialist(s) to conduct a hydrocensus as well as identify priority water source areas and domestic aquifer supplies indicated on relevant geohydrological maps for consideration in the impact assessment.
- (2) A holder must, prior to conducting hydraulic fracturing operations, appoint an independent specialist approved by the designated agency to conduct baseline water quality assessment of all water resources within 1 kilometre of the vertical projection of the planned wellbore to surface.
- (3) Water samples collected as part of the baseline quality assessment contemplated in sub-regulation (2) must be analysed by an accredited laboratory and the holder must submit the results to the designated agency and the Department of Water Affairs within 7 days after receipt thereof.
- (4) The results must, at a minimum, include a detailed description of the sampling and testing conducted, including duplicate samples, the chain of custody of the samples and quality control of the testing.
- (5) After baseline water quality assessment is conducted, a holder must-
 - (a) as directed by the designated agency, have all water resources subjected to regular sampling, analysis and interpretation of water quality and changes in water levels by an independent specialist approved by the designated agency; and

- (b) submit the results of the analysis and interpretation to the designated agency and other relevant Departments within 7 days of the receipt of the analysis and interpretation.
- (6) The designated agency, Council for Geoscience or the Department of Water Affairs, may collect samples of any fluids encountered in the exploration or production area (water or hydrocarbons, at depth or at the surface) for their own analysis and interpretation.
- (7) Data collected as contemplated in this regulation may be published with the exception of where it may be shown to directly relate to the prospectivity of the holder's acreage.

Assessment of Related Seismicity

6. (1) A holder must, prior to conducting hydraulic fracturing, assess the risk of any potential hydraulic fracturing related seismicity and submit a risk assessment report and mitigation measures to the designated agency for approval and recommendation by the Council for Geoscience.
- (2) A holder must carry out site-specific surveys prior to hydraulic fracturing to characterize local stresses and identify nearby faults and such site characterizations must include-
- (a) desktop studies of existing geological maps;
 - (b) seismic reflection data;
 - (c) all available background seismicity data; and
 - (d) stress data from nearby boreholes where available.
- (3) A holder must make use of other techniques to detect potential presence of faults given the limits of remote sensing techniques.
- (4) The assessment of the orientation and slip tendency of faults and bedding planes can be done once faults have been identified and geological stresses characterized.
- (5) Risks of fault movement must be mitigated by the identification of stressed faults and where practicable, by preventing fracturing fluids from entering stressed faults.
- (6) Fracture behaviour of a targeted formation in a given well must be tested using small pre-fracturing injection tests with micro-seismic monitoring and subsequent hydraulic fracturing operations must then be modified.

- (7) A reasonable period of time must be allowed to elapse following a pre-fracturing injection test to ensure that no seismic activity occurs as the injected fluid diffuses away from the well and pressure changes in surrounding rock formations are redistributed.
- (8) A holder must adopt conservative assessments and controls at the exploration and production phase.
- (9) Micro-seismic monitoring should continue after hydraulic fracturing at the site has ceased for a period of at least 3 years.
- (10) Micro-seismic monitoring must occur at the waste sites should the disposal include similar procedures as hydraulic fracturing.

Site Preparation

7. All topsoil stripped to facilitate the construction of the well pad and access roads must be stockpiled, stabilized and remain on site for use in either partial or final rehabilitation.

Site Containment

8. (1) A holder must at all times, prevent the contamination of the environment by providing a suitably designed impermeable site underlay system and site drainage arrangements.
- (2) Sites must be designed and constructed to prevent spills to the ground surface and containment measures must be-
 - (a) instituted on the well-site during both drilling and hydraulic fracturing operations;
 - (b) sufficiently impervious and able to contain spilled material or waste until it can be removed or treated; and
 - (c) compatible with the waste material or waste stored or used within the containment.
- (3) A holder must submit a plan to the designated agency describing the containment practices, including equipment to be utilised on site.
- (4) Containment systems must be used wherever drilling mud, hydraulic oil, diesel fuel, drilling mud additives, hydraulic fracturing additives and flowback substances are stored.

Protection of Astronomy Activities

Radio Astronomy

9. (1) A holder must comply with all declarations and regulations, promulgated in terms of the Astronomy Geographic Advantage Act, 2007 (Act. No. 21 of 2007) for the protection of astronomy advantage areas declared for radio astronomy purposes.
- (2) The Minister of Mineral Resources must, prior to issuing an exploration or production right within a distance to be determined as contemplated in sub-regulation (3) of any Square Kilometre Array station in the Northern Cape Province, consult with the Minister of Science and Technology.
- (3) A distance contemplated in sub-regulation (2) will be determined by the Ministers of Science and Technology and Mineral Resources and published in the *Gazette*.
- (4) A holder must, for purposes of enabling effective consultation between the Ministers of Mineral Resources and Science and Technology as contemplated in sub-regulation (2), submit the following information to the Minister of Mineral Resources –
 - (a) inventory of electrical or electronic equipment and relevant technical reports describing the radiated electromagnetic emissions to be expected from each piece of equipment under normal operating conditions; and
 - (b) relevant standard operating procedure for usage of the equipment as described in the inventory.
- (5) If the outcome of consultation between the Ministers of Science and Technology and Mineral Resources as contemplated in sub-regulation (2) identifies a requirement for the holder to take the necessary actions to mitigate the risk of radio frequency and electromagnetic interference to the Square Kilometre Array radio astronomy facility, such a requirement will form part of the terms and conditions of the exploration or production right.

Optical Astronomy

10. (1) A holder must comply with all declarations and regulations promulgated in terms of the Astronomy Geographic Advantage Act, 2007 (Act. No. 21 of 2007) for the protection of astronomy advantage areas declared for optical astronomy purposes.
- (2) The Minister of Mineral Resources must, prior to issuing an exploration or production right within a distance to be determined as contemplated in sub-

regulation (3) from the South African Large Telescope near Sutherland, consult with the Minister of Science and Technology.

- (3) A distance contemplated in sub-regulation (2) will be determined by the Ministers of Science and Technology and Mineral Resources and published in the *Gazette*.
- (4) A holder must, for purposes of enabling effective consultation between the Ministers of Mineral Resources and Science and Technology as contemplated in sub-regulation (2), submit the following information to the Minister of Mineral Resources –
 - (a) inventory of relevant lighting, and relevant technical reports that describe the lighting to be expected from each piece of equipment under normal operating conditions; and
 - (b) relevant standard operating procedure for usage of the equipment as described in the inventory.
- (5) If the outcome of a consultation between the Ministers of Science and Technology and Mineral Resources as contemplated in sub-regulation (2) identifies a requirement for the holder to take the necessary actions to mitigate the risk of optical interference to the South African Large Telescope facility, such a requirement will form part of the terms and conditions of the exploration or production right.

CHAPTER 3

WELL DESIGN AND CONSTRUCTION

Well Design

- 11.(1) A holder must ensure that a well is designed such that it is constructed, equipped, commissioned, operated, modified, maintained, suspended and abandoned in a manner that will provide for control of the well at all times and prevent-
 - (a) migration of petroleum and other fluids into any other formation except the targeted formation;
 - (b) pollution of useable groundwater (water containing 10 000 mg/l Total Dissolved Solids); and
 - (c) risks to health and safety of persons from it or anything in it, or in strata to which it is connected.

- (2) Final well abandonment design must be considered at the well planning stage and the following factors must be considered-
 - (a) height of cement in annulus outside casing;
 - (b) any permeable formations outside casing that must be covered by cement;
 - (c) cementing casing overlaps;
 - (d) the need for abandonment plugs to cover the full diameter of the hole, with only casing within the cement;
 - (e) type of fluid in annuli above cement; and
 - (f) difficulties of injecting cement into the annulus.

- (3) Where technically appropriate and environmentally safe, multi-well pads and horizontal drilling technologies must be considered to maximise the spacing between neighbouring wells and minimise the cumulative surface impact of operations.

Casing Standards

12. (1) All wells must be cased according to current industry standards published by the API in "5CT Specification for Casing and Tubing" and the casing thread compound and its use must conform to the current API RP 5A3.
- (2) All casing installed must have a minimum yield pressure designed to withstand at least 1.2 times the maximum pressure to which the casing may be subjected during drilling, production or hydraulic fracturing operations and the minimum yield pressure shall be based upon engineering calculations as listed in the API "TR 5C-3 Technical Report on Equations and Calculations for Casings, Tubing and Line Pipe used as Casing and Tubing, and Performance Properties Tables for Casing and Tubing".
- (3) A holder must not use casing that is pitted, patched, bent, corroded, crimped, or if the threads are worn or damaged, or reconditioned casing that has not passed the approved hydrostatic pressure and drift test pursuant to API "5CT Specification for Testing and Tubing".
- (4) A holder must contact the designated agency at least 2 days prior to setting any casing to enable an authorized person to be present when the test is done.

Conductor Casing

13. When conductor casing is used, it must be set and cemented to surface to –
- (a) stabilize unconsolidated sediments;
 - (b) isolate shallow aquifers that provide or are capable of providing groundwater for water wells and springs in the vicinity of the well; and
 - (c) provide a base for equipment to divert shallow natural gas.

Surface Casing

14. Surface casing must be set to a depth of 60m below the base of the deepest fresh water or to the top of any petroleum bearing zones, whichever comes first and cemented to surface.

Intermediate Casing

15. (1) Intermediate casing must be set to protect unexpected fresh water found below the surface casing shoe.
- (2) Intermediate casing used to isolate fresh water must not be used as the production string in the well in which it is installed and must not be perforated for purposes of conducting a hydraulic fracture treatment through it.
 - (3) When intermediate casing is installed to protect fresh water, it must be set at least 30 meters below the base of the unexpected deepest fresh water and must be cemented to the surface.
 - (4) In instances where intermediate casing is set solely to protect fresh water encountered below the surface casing shoe and cementing to the surface is technically infeasible, would result in lost circulation, or both, cement must be brought to a minimum of 180 meters above the shallowest fresh water zone encountered below the surface casing shoe.
 - (5) The location and depths of any petroleum-bearing zones or fresh water zones that are open to the wellbore above the casing shoe must be confirmed by coring, electric logs, or testing and must be reported to the designated agency.

Production Casing

16. (1) In cases where intermediate casing is not installed, production casing must be run and fully cemented to the surface.
- (2) If intermediate casing is in place, production casing must be set and fully cemented to 150 meters above the top perforated zone.

Centralisers

- 17.(1) Casing must be centralized in each segment of the wellbore to provide sufficient casing standoff and foster effective circulation of cement to isolate critical zones including aquifers, flow-zones, voids, lost circulation zones and hydrocarbon production zones.
- (2) Surface casing must be centralized at the shoe, above and below a stage collar or diverting tool, and through usable-quality water zones.
- (3) In non-deviated holes, a pipe centralizer must be placed every fourth joint from the cellar cement shoe to the ground surface or to the bottom of the cellar.
- (4) All centralizers must be in accordance with the standards of -
 - (a) API "10 D, Specification for Bow-Spring Casing Centralizers and all rigid centralizers";
 - (b) API "10 TR 4 Considerations Regarding Selection of Centralizers for Primary Cementing Operations"; and
 - (c) API RP 10D-2, Recommended Practice for Centralizer Placement and Stop Collar Testing.
- (5) The designated agency may require additional centralization as necessary to ensure the integrity of the well design is adequate.

Cement Requirements and Compressive Tests

- 18.(1) A holder must notify the designated agency at least 2 days before commencing with casing cementing operations to enable an authorized person to be present during cementation of all casing.
- (2) Cementation of all casing must be done by the pump and plug method with a minimum of 25% excess cement and appropriate loss circulation material, unless another amount of excess cement is approved by the designated agency.

- (3) All cement placed into the well bore must be cement that is manufactured to meet the standards of API "10 A Specification for cements and material for well cementing" or ASTM "C150/C150M Standard Specification for Portland Cement" and the cement slurry must be prepared to minimize its free water content in accordance with the current API RP 10B-4.
- (4) A holder must conduct tests for cement mixtures for which published performance data are not available on representative samples of the basic mixture of cement and additives used, using distilled water or potable tap water for preparing the slurry.
- (5) Tests contemplated in sub-regulation (4) must be conducted using the equipment and procedures established in the current API "RP 10 B-2 Recommended Practice for Testing Well Cements"
- (6) Test data showing competency of a proposed cement mixture to meet the requirements of the current API "API RP 10 B-2 Recommended Practice for Testing Well cements" must be submitted to the designated agency for approval prior to the cementing operation.
- (7) A holder must perform cement compressive strength tests on all casing strings and if it does not conform to standards it must be redone.
- (8) After the cement is placed behind the casing, a holder must wait for the cement to set until the cement achieves a calculated compressive strength of at least 500 psi (3447.38 kPa) and for a minimum of 8 hours before the casing is disturbed in any way including installation of a blow-out preventer.
- (9) The cement must have a 72-hour compressive strength of at least 1,200 psi (8273.71 kPa), and the free water separation must be no more than 6 millilitres per 250 millilitres of cement, tested in accordance with the current API TR 10TR3.
- (10) A holder must ensure that there is isolation of hydraulic fracturing operations from freshwater and other permeable horizons by ensuring complete cement isolation in each casing annulus.
- (11) A holder must, in co-operation with specialist contractors, prepare suitable programmes for cement placement operations, including monitoring of the effectiveness of placement as part of the operations planning, contingency plans and procedures to cover the possibility of a failure to meet the cementation design objectives.

- (12) The designated agency may, as necessary, require-
- (a) a specific cement mixture to be used in any well or any area if evidence of local conditions indicates that specific cement is necessary; or
 - (b) installation of an additional cemented casing string or strings in the well.
- (13) A holder must run a radial cement bond evaluation log to verify the cement bond on all casing strings and must carry out remedial cementing if the cement bond is not adequate for drilling ahead.
- (14) A copy of the cement job log for any cemented casing string in the well must be maintained in the well file and be submitted to the designated agency.
- (15) Any proposed changes to the cementation programme must be reported to the designated agency for approval before such changes are implemented except in case of a need to prevent possible catastrophic consequence.

Casing String Tests

19. (1) After the setting and cementing of a casing string, except the conductor casing, and prior to further drilling, the casing string must be tested with fresh water, mud, or brine to at least the maximum anticipated treatment pressure but no less than 0.22 psi per foot (1.512 kPa per 0.3048 meter) of casing string length or 1,500 psi (10 342.12 kPa), whichever is greater, for at least 30 minutes with less than a 5% pressure loss.
- (2) The pressure test must not exceed 70% of the minimum internal yield and if the pressure declines more than 5% or if there are other indications of a leak, corrective action must be taken before conducting further drilling and hydraulic fracturing operations.
- (3) A holder must contact the designated agency at least 2 days prior to conducting a pressure test to enable an authorized person to be present when the test is done.
- (4) A record of the pressure test must be maintained by a holder and submitted to the designated agency prior to conducting hydraulic fracturing operations.
- (5) The actual pressure must not exceed the test pressure at any time during hydraulic fracturing operations.
- (6) Any hydraulic fracturing string used in the operations must be either strung into a production liner or run with a packer set at least 30 meters below the deepest cement top and must be tested to not less than the maximum

anticipated treating pressure minus the annulus pressure applied between the fracturing string and the production or immediate casing.

- (7) The pressure test shall be considered successful if the pressure applied has been held for at least 30 minutes with no more than 5% pressure loss.
- (8) The annulus between the hydraulic fracturing string and casing must be pressurized to at least 250 psi (1723.69 kPa) and monitored.

Formation Pressure Integrity Test

- 20.(1) A holder must, after a successful casing string test contemplated in regulation 19, conduct a formation pressure integrity test below the surface casing and below all intermediate casing.
 - (2) A holder must notify the designated agency at least 2 days prior to conducting a formation pressure integrity test to enable an authorised person to be present when the test is done.
 - (3) A record of the pressure test must be maintained by the holder and submitted to the designated agency prior to conducting hydraulic fracturing operations.
 - (4) The actual hydraulic fracturing treatment pressure must not exceed the test pressure at any time during hydraulic fracturing operations.

Blowout Prevention

- 21.(1) A holder must install blowout prevention equipment that meets the current API Std 53 for blowout equipment after setting casing to shutoff a wellhead which must be supported and secured to prevent stresses on all connections.
 - (2) Blowout prevention equipment installed at wells that will be subject to hydraulic fracturing must include a remote blowout prevention actuator-
 - (a) that is powered by a source other than rig hydraulics;
 - (b) located at least 20 meters from the well head; and
 - (c) that has an appropriate rated pressure equal to or greater than the induced hydraulic fracture pressure.
 - (3) All lines, valves and fittings between the blowout preventer and the remote actuator must be flame resistant and have a working pressure rating higher than the maximum anticipated well heads surface pressure.

- (4) Blowout prevention equipment must be in good working condition at all times.
- (5) When blowout prevention equipment is installed, tested, or in use, a competent person as contemplated in regulation 25 must be present at the well site and that person must have a current well control certification from an accredited training program that is acceptable to the designated agency.
- (6) The certification referred to in sub-regulation 5 must be available at the well site and provided to the designated agency upon request.

Pressure Testing of the Blowout Prevention Equipment

- 22.(1) The blowout prevention equipment must be tested to 100% of rated working pressure and the annular-type blowout preventer must be tested to 1,000 psi (6894.76 kPa) at the time of installation in accordance with current API std 53 for blowout equipment.
- (2) Testing of blowout prevention equipment for any drilling or completion operation must take place prior to drilling below the last cemented casing seat and a record of the pressure tests must be maintained by a holder and submitted to the designated agency.
- (3) A holder must notify the designated agency at least 2 days prior to conducting a blowout integrity test to enable an authorised person to be present when the test is done.
- (4) Blowout prevention equipment that has failed any pressure test must not be used until it is repaired and passes the pressure test.

Well Examination

23. (1) A holder must include in their well examination scheme the following aspects of well design and operations, including abandonment and hydraulic fracturing operations-
 - (a) groundwater and aquifer isolation;
 - (b) fracture containment;
 - (c) related seismicity risks;
 - (d) fracturing and flow-back/testing programmes and operations; and
 - (e) Independent well examination.
- (2) The designated agency may, at the cost of the holder, appoint an independent and competent person to undertake well examination.

CHAPTER 4

OPERATIONS AND MANAGEMENT

Management of Operations

24. A holder must appoint competent persons to be responsible for day to day management of the operations in accordance with relevant legislation.

Drilling Fluids

25. A holder must ensure that drilling operations through shallow soils and local aquifers are always undertaken using water or water-based mud systems the details of which must be declared to the designated agency prior to commencement of drilling operations.

Management of Hydraulic Fracturing

General

26. A holder must not commence with hydraulic fracturing operations before obtaining all the necessary authorizations and permits for any activities associated with hydraulic fracturing which include but are not limited to a water use licence in terms of the National Water Act 1998 (Act No 36 of 1998) and must submit the following to the designated agency and the Department of Water Affairs-
- (a) a plan for the handling, storage, transportation, and disposal or reuse of hydraulic fracturing fluids and hydraulic fracturing flowback ;
 - (b) waste management plan which must address the following-
 - i. type of waste to be generated by a specific operation to be performed;
 - ii. the proposed methods and locations of waste treatment, reuse, recovery or disposal; and
 - iii. waste management requirements in terms of National Environmental Management Waste Act, 2008 (Act No. 59 of 2008) and water use requirements in terms of the National Water Act, 1998 (Act No. 36 of 1998)

- (c) a well engineering design which must include but is not limited to the following-
- i. type of rig to be used;
 - ii. method of drilling;
 - iii. type and estimated amount of drilling fluids;
 - iv. different stages of drilling and the size of drill bits;
 - v. casing programme;
 - vi. cementation programme; and
 - vii. perforation design.
- (d) A hydraulic fracturing programme and procedures that must include-
- i. pre-fracturing simulation and modelling;
 - ii. the proposed depth(s) to the top and the bottom of the formation into which well fracturing fluids are to be injected;
 - iii. authorised source and volume of water to be used
 - iv. re-use and disposal of flowback;
 - v. fracturing fluid compositions, concentrations and estimated total volume to be used;
 - vi. anticipated surface and downhole treating pressure range;
 - vii. maximum injection treating pressure;
 - viii. annuli and offset well pressure monitoring programme to be performed;
 - ix. testing and flowback plan;
 - x. equipment rig up and testing, including testing of all high pressure equipment;
 - xi. a design of the fracture geometry including fracturing target zones, sealing mechanisms and aquifers;
 - xii. monitoring of pressure on the production string and well annuli during rig up and testing; and
 - xiii. monitoring of any adjacent or offset wells for pressure on the production string and other well annuli as required.

Hydraulic Fracturing Equipment

27. (1) Equipment used in hydraulic fracturing operations must be fit for purpose and must meet relevant API standards as prescribed in these Regulations.
- (2) Water transfer systems must be designed to site-specific conditions and must be tested and monitored in accordance with a schedule approved by the designated agency.

Mechanical Integrity Tests and Monitoring

28. (1) Before the commencement of hydraulic fracturing operations, all mechanical integrity tests required under these Regulations must be successfully completed.
- (2) Prior to commencing with hydraulic fracturing operations, the injection lines and manifold, associated valves, fracture head or tree and any other wellhead component or connection not previously tested must be tested with fresh water, mud, or brine to at least the maximum anticipated treatment pressure for at least 30 minutes with less than a 5% pressure loss.
- (3) A holder must notify the designated agency at least 2 days before commencing with tests contemplated in sub-regulation (2) to enable an authorized person to be present during testing operations.
- (4) A record of the pressure test must be maintained by a holder and made available to the designated agency.
- (5) The pressure exerted on treating equipment including valves, lines, manifolds, hydraulic fracturing head or tree, casing and hydraulic fracturing string, if used, must not exceed 95% of the working pressure rating of the weakest component.
- (6) A function-tested relief valve and diversion line must be installed and used to divert flow from the hydraulic fracturing string-casing annulus to a covered watertight steel tank in case of hydraulic fracturing string failure.
- (7) The relief valve must be set to limit the annular pressure to no more than 95% of the working pressure rating of the casings forming the annulus.
- (8) The hydraulic fracturing treatment pressure must not exceed the test pressure of any given component at any time during hydraulic fracturing operations.
- (9) During hydraulic fracturing operations, annulus pressure, injection pressure and the rate of injection must be continuously monitored and recorded.
- (10) The records of the monitoring must be maintained by a holder and must be provided to the designated agency at any time during the period up to and including 5 years after the well is permanently plugged or abandoned.
- (11) Hydraulic fracturing operations must be immediately suspended if any anomalous pressure or flow condition or any other anticipated pressure or flow condition is occurring in a way that indicates mechanical integrity of the well has been compromised and continued operations pose risk to the environment.

- (12) A holder must notify the designated agency and the Department of Water Affairs within 1 hour of suspending hydraulic fracturing operations as a result of any matters relating to the mechanical integrity of the well or risk to the environment.
- (13) Remedial action must be undertaken immediately and the designated agency must be satisfied with such remedial actions prior to issuing a written consent for the recommencement of operations.

Hydraulic Fracturing Fluid Disclosure

29. (1) A holder must, as part of the impact assessment, submit the following information to the designated agency-
 - (a) fluids and their status as hazardous/non-hazardous substances;
 - (b) material safety data sheet information;
 - (c) volumes of fracturing fluid, including proppant, base carrier fluid and each chemical additive;
 - (d) the trade name of each additive and its general purpose in the fracturing process;
 - (e) each chemical intentionally added to the base fluid, including for each chemical, the Chemical Abstracts Service number, if applicable; and the actual concentration, in percent by mass;
 - (f) possible risk of the above on the environment and water resources; and
 - (g) remediation required if a pollution incident were to occur.

Fracture and Fracturing Fluid Containment

30. (1) A holder must conduct a risk assessment that describes the control and mitigation measures for fracture containment and submit the risk assessment report to the designated agency.
- (2) Performance standards must be documented to characterize the basis for the sealing mechanism and to demonstrate that adequate control measures will be implemented.
- (3) Faults and igneous intrusions that might impact the hydraulic fracturing seal mechanism must be researched and the assessment documented and referenced in the Hydraulic Fracturing Programme to demonstrate that fracturing fluids cannot migrate via faults and intrusions beyond the designated fracture zone(s).

- (4) Hydraulic fracturing operations must be monitored and recorded against the Hydraulic Fracturing Programme design performance standards as contemplated in regulation 26(d) to ensure that wellbore integrity during hydraulic fracturing operation is maintained.
- (5) Hydraulic fracturing fluid must be confined to the targeted zone and if the monitoring system indicates that hydraulic fracturing fluid or hydraulic fracturing flowback are migrating into the freshwater zone or to the surface from the well in question or from other wells, the holder must immediately notify the designated agency and suspend hydraulic fracturing operations until remedial action that prevents the fluid migration is completed.
- (6) A holder must obtain the approval of the designated agency prior to resuming hydraulic fracturing operations suspended as contemplated in sub-regulation (5).

Fracturing Fluids Management

- 31.(1) A holder must minimize environmental, safety and health risks associated with fracturing fluids and additives, assess potential risks and develop a risk management plan for each well to be fractured addressing the following aspects-
 - (a) identification of chemical ingredients and characteristics of each additive;
 - (b) identification of volume and concentration of the substances in the fracturing fluid;
 - (c) assessment of potential environmental and health risks of fracturing fluids and additives; and
 - (d) definition of operational practices and controls for the identified risk.
- (2) A risk management plan as contemplated in sub-regulation (1) must be submitted to the designated agency before commencing with hydraulic fracturing operations.
- (3) A holder must-
 - (a) maximize the use of environmentally friendly additives and minimize the amount and number of additives; and
 - (b) train and develop relevant employees on appropriate procedures in handling hydraulic fracturing chemicals.

Management of Flowback and Produced Fluids

32. A holder must disclose to the designated agency the following information regarding management and handling of flowback or produced fluids-
- (a) estimated and actual volume of fluids to be recovered during flow-back;
 - (b) the expected rates, pressures and temperatures of fluids recovered and produced;
 - (c) water compositional analysis;
 - (d) any identified contamination issues;
 - (e) any radioactive contaminated fluids;
 - (f) proposed methods of handling recovered fluids, including but not limited to tank requirements, pipeline requirements, flaring, flow-back and storage periods, recycling and re-usage for other activities;
 - (g) proposed disposal methods of the recovered fluids up to the end location; and
 - (h) proposed volume of flow-back fluids to be recycled and re-used.

Transportation of Fluids

33. (1) A holder must ensure-
- (a) planning to minimize fluid transport movements and distances;
 - (b) implementation of management procedures to address the risks associated with fluid transport;
 - (c) natural gas is removed from fluids prior to fluids being transported and a system for checking and recording is implemented;
 - (d) fluids are transported to and from the hydraulic fracturing treatment site in accordance with relevant legislation and national standards in a manner designed to prevent spillage; and
 - (e) general workforce, including drivers, receive appropriate training and are equipped to respond to emergencies and to implement clean up measures.
- (2) Transportation of hazardous fluids or materials must be carried out in accordance with applicable South African National Standards and relevant legislation.
- (3) A quarterly report on the transportation of hydraulic fracturing fluids, produced water and hydraulic fracturing flowback must be submitted to the designated agency and the report must include-
- (a) the amount of fluids transported;
 - (b) identification of the company that transported the fluids; and
 - (c) the destination of the fluids.

Fluids Storage

- 34.(1) Areas where any additives, chemicals, oils, fuels are to be stored must have sufficient containment capacity to hold the volume of the largest container stored on site +110% to allow for precipitation, unless the container is equipped with individual secondary containment.
- (2) For the purposes of storage at the well site, hydraulic fracturing additives, hydraulic fracturing fluids, hydraulic fracturing flowback, and produced water must be stored in above-ground tanks during all phases of drilling, hydraulic fracturing and production operations until removed for proper disposal.
- (3) For the purposes of centralized storage off site for potential reuse prior to disposal, hydraulic fracturing additives, hydraulic fracturing fluids, hydraulic fracturing flowback, and produced water must be stored in above-ground tanks with bund walls.
- (4) The use of a reserve pit is only allowed for the temporary storage of hydraulic fracturing flowback and must be used only in the event of a lack of capacity of tank storage due to higher than expected volume or rate of hydraulic fracturing flowback, or other unanticipated flowback occurrence.
- (5) Any reserve pit must comply with the following construction standards and liner specifications-
- (a) the synthetic liner material must have a minimum thickness of 24 millimetres with high puncture and tear strength and be impervious and resistant to deterioration;
 - (b) the pit lining system must be designed to have a capacity of at least equivalent to 110% of the maximum volume of hydraulic fracturing flowback anticipated to be recovered;
 - (c) the lined pit must be constructed, installed, and maintained in accordance with the manufacturers' specifications and good engineering practices to prevent overflow during any use;
 - (d) the liner must have sufficient elongation to cover the bottom and interior sides of the pit with the edges secured with at least a 30 centimetres deep anchor trench around the pit perimeter to prevent any slippage or destruction of the liner materials; and
 - (e) the foundation for the liner must be free of rock and constructed with soil having a minimum thickness of 30 centimetres after compaction covering the entire bottom and interior sides of the pit.

- (6) Hydraulic fracturing fluids and hydraulic fracturing flowback must be removed from the well site within 60 days after the completion of hydraulic fracturing operations, except for any excess hydraulic fracturing flowback captured for temporary storage in a reserve pit which must be removed from the well site within 7 days.
- (7) Tanks, piping, and conveyances, including valves of sufficient pressure rating, must be constructed and be able to resist corrosion and be maintained in a leak-free condition.
- (8) Fluids transfer operations from tanks to tanker trucks must be supervised at both ends and along interconnecting piping.
- (9) Hydraulic fracturing flowback must be tested for volatile organic chemicals, semi-volatile organic chemicals, inorganic chemicals, heavy metals, and naturally occurring radioactive material prior to removal from the site and the results must be submitted to the waste transportation and disposal operators and the designated agency.
- (10) The ground adjacent to the storage tanks and any hydraulic fracturing flowback reserve pit must be measured for radioactivity prior to site restoration.
- (11) Discharge of hydraulic fracturing fluids, hydraulic fracturing flowback, and produced water into any surface water or water drainage way is prohibited.
- (12) A holder must make use of tanks to store and treat flow-back fluids on site.
- (13) Storage tanks must comply with applicable corrosion control requirements in accordance with applicable South African National Standards.
- (14) Storage site locations must be secured at all times.
- (15) The following information must be submitted to the designated agency-
 - (a) tank maintenance records; and
 - (b) tank cleaning records and off-take waste disposal records.

Hydraulic Fracturing Operations

- 35 (1) A holder may only proceed with hydraulic fracturing operations after the designated agency has approved the plans and well engineering design contemplated in regulation 26 and all other requirements prescribed by these Regulations have been fully satisfied.
- (2) A holder must notify the designated agency in writing at least 5 days prior to the commencement of hydraulic fracturing operations.

- (3) During all phases of hydraulic fracturing operations, a holder must-
- (a) comply with all terms and conditions of the exploration and production right; as well as any other authorisations;
 - (b) conduct operations in a manner that does not pose risk to public health, life, property and the environment;
 - (c) ensure that arrangements to deal with emergencies are in place and are disclosed to the designated agency;
 - (d) ensure that audits by independent and competent persons are made available to the designated agency;
 - (e) ensure that a sufficient number of people who are adequately trained and experienced to operate fracturing/flow-back/testing equipment, emergency shut-down systems and any spill containment equipment are available; and
 - (f) ensure that systems acceptable to the designated agency are in place to monitor the extent of the induced fracture network.
- (4) A holder must ensure that risk assessments to eliminate or reduce the risks from dangerous substances being released and their impact on the environment is carried out, recorded and the necessary control and mitigation measures are implemented.

Post Hydraulic Fracturing Report

36. A holder must compile and submit to the designated agency for review and recommendations a detailed post hydraulic fracturing operation report, including but not limited to-
- (a) location of a well, position in co-ordinates and well number;
 - (b) actual total volume of fluids used;
 - (c) actual surface and downhole treating pressure range;
 - (d) maximum injection treating pressure;
 - (e) the actual or calculated fracture geometry;
 - (f) annuli and offset well pressure monitoring results;
 - (g) confirmation that wellbore integrity was maintained throughout the operation;
 - (h) testing and flow-back results;
 - (i) any operational variations to the pre-job design;
 - (j) any data and information concerning any related seismic events, in internationally accepted formats, that have been recorded including any steps taken as a result of such events;
 - (k) plans to continue micro-seismic monitoring; and
 - (l) induced seismic events that have been recorded including any steps taken as a result of such events.

Management of Water

Water Balances

37. (1) A holder in control of any operations must compile a water balance that-

- (a) is based on data collected from installed flow measurement devices to measure the amount of water abstracted, received, consumed, transported and/or discharged as required in order to ensure that the flow of at least 90% of the total water in use is measured, with the remaining 10% or less being calculated;
- (b) incorporates accurate values determined from suitable measurement or modelling for rainfall, runoff, seepage and evaporation from all facilities where these components of the water balance may potentially come into play;
- (c) accounts for seasonal changes for all flow values affected by rainfall and/or evaporation;
- (d) is computerised in order that it can be updated at least monthly with measured and modelled data;
- (e) accounts for and reflects all possible interconnections between the operations and the surface and ground water resource and how these will be avoided, mitigated;
- (f) is used by the operations to generate water management reports to assist in the management of the impact of the operations on the water resource; and
- (g) is submitted to the authorities on a bi-annual basis together with the monitoring data, unless stipulated otherwise in a water use licence.

(2) A holder in control of any operations must ensure that all measuring devices used to develop the water balance are easily accessible, properly maintained and in good working order based on a verifiable programme of checking, calibration, and/or renewal of measuring devices.

Protection of Water Resources

38. (1) A holder must take into cognizance the following, prior to and during all phases of hydraulic fracturing operations-
- (a) the operation must not pollute a water resource or reduce such a resource and where such an incident occurs, a holder must implement the necessary remedial measures;
 - (b) the operation must not cause adverse impact to water quality in the water catchment area; and
 - (c) designated and existing uses of water resources are protected and maintained.
- (2) No well site where hydraulic fracturing operations are proposed, planned, or occurring may be located-
- (a) within 1 kilometre measured horizontally from the surface location of any existing water well or developed water resource; and
 - (b) within 1 kilometre measured horizontally from the centre of a perennial stream or within 1:100 year flood-line.
- (3) The edge of the disturbed site associated with a well must maintain a setback of 500 metres from the edge of any water resource or the 1:100 year flood line.
- (4) No well must be drilled within 1 kilometre of any wetland and the edge of the disturbed area of any well site must maintain a 500 metres setback from the boundary of the wetland.

Storm Water Management and Control

39. (1) A holder must implement measures to manage and control storm water runoff in order to prevent transportation of contaminants to water resources.
- (2) Construction design must consider natural drainage patterns in order to eliminate possible transportation of contaminants to the water resources.

Water Use

40. (1) A holder must prepare an integrated water and waste management plan for approval with the following components-
- (a) flowcharts and data derived from a dynamic, computerised water balance;
 - (b) pollution prevention and impact minimisation plan;
 - (c) stormwater management plan;

- (d) water conservation and demand management strategy;
 - (e) post closure water management; and
 - (f) water monitoring and reporting.
- (2) A holder must, prior to commencement of hydraulic fracturing, obtain the necessary authorisation(s) for the water uses as required indicating the supply source and location for the base fluid for each stage of the operation and the water usage volume.
- (3) A holder must consider re-using hydraulic fracturing fluids and produced water to reduce competing with freshwater uses.

Management of Waste

Fluids Disposal

41. (1) Fluids that are no longer required must always be disposed of at an approved waste disposal facility in accordance with relevant legislation and disposal to underground is not permitted.
- (2) The holder must maintain the following records-
- (a) volume of waste water fluids produced during hydraulic fracturing operations; and
 - (b) name of contractor, disposal sites, disposal methods, and mandatory disposal certificates.

Waste Management

42. (1) A holder must adhere to the waste management plan contemplated in regulation 26(b) and any relevant legislation when managing waste generated from its operations.
- (2) Waste containing naturally occurring radioactive materials must be managed in accordance with National Radioactive Waste Disposal Act, 2008 (Act No. 53 of 2008).
- (3) Drill cuttings and waste mud must be temporarily stored in above ground tanks or pits as prescribed under regulation 34.
- (4) All waste generated during operations must be disposed at a licensed landfill site and annular disposal of drill cuttings or fluids is prohibited.
- (5) A holder must keep track of all waste stream generated, treated, recovered, reused, disposed of and submit a quarterly record to the designated agency.

Management of Pollution Incidents

Management of Spillage

43. (1) Any spillage of hydraulic fracturing fluids or hydraulic fracturing flowback in excess of 50 litres must be reported to the designated agency within 24 hours of occurrence.
- (3) Any spillage of hydraulic fracturing fluids, hydraulic fracturing additives, or hydraulic fracturing flowback, used or generated during or after hydraulic fracturing operations must be cleaned up immediately.

Management of Air Quality

Fugitive Emissions

44. (1) A holder must minimise the emissions associated with venting of hydrocarbon fluids and natural gas during hydraulic fracturing operations by-
- (a) routing the recovered fluids into storage vessels; and-
 - i. routing the recovered gas into a gas gathering line, collection system, or to a generator for onsite energy generation subject to section 20 of the Act; or
 - ii. using another method other than venting.
 - (b) employing sand traps, surge vessels, separators and tanks as soon as practicable during cleanout operations to safely maximise resource recovery and minimise releases to the environment.
- (2) If a holder establishes that it is technically infeasible to minimise emissions associated with the venting of hydrocarbon fluids and natural gas during hydraulic fracturing operations using the methods specified in sub-regulation (1), the designated agency must require the holder to capture and direct any natural gas produced during the hydraulic fracturing operations phase to a flare, except in conditions that may result in fire hazards or explosion.
- (3) Any flare used as contemplated in sub-regulation (2), must be equipped with a reliable continuous ignition source over the duration of hydraulic fracturing operations and a holder must maintain and operate the flare in accordance with manufacturer's specifications.

- (4) In order to establish technical infeasibility as contemplated in sub-regulation (2), a holder must demonstrate, for each well site on an annual basis, that taking the actions listed in sub-regulation (1) are not feasible based on a site-specific analysis.
- (5) A holder that uses a flare during hydraulic fracturing operations, other than emergency conditions must file an updated site-specific analysis annually with the designated agency.
- (6) The analysis contemplated in sub-regulation (4) must have details about whether any changes have occurred that alter the technical infeasibility of a holder to reduce their emissions in accordance with sub-regulation (1).
- (7) A holder must record and report to the designated agency on a quarterly basis the amount of gas flared or vented from each hydraulic fracturing well.

Fugitive Dust

45. (1) A holder must employ practices for control of fugitive dust during hydraulic fracturing operations which must include, but are not limited to-
 - (a) the use of speed restrictions;
 - (b) regular road maintenance; and
 - (c) restriction of construction activity during high-wind days.
- (2) Additional management practices such as road surfacing, wind breaks and barriers or automation of wells to reduce truck traffic may also be required by the relevant Department if technologically feasible to minimize fugitive dust emissions.

Noise Control

- 46.(1) Site selection for drilling and hydraulic fracturing operations, including identification of traffic routes, must consider the potential effect of noise pollution on the surrounding environment including sensitive receptors.
- (2) Necessary abatement measures must be considered as part of the planning process for hydraulic fracturing operations.
- (3) Adherence to local by-laws concerning noise control and limits is mandatory.

CHAPTER 5

WELL SUSPENSION AND ABANDONMENT

Well Suspension

47. A holder may only suspend a well-
- (a) after obtaining the approval of the designated agency; and
 - (b) for a period determined by the designated agency.

Suspended Well Integrity Management

- 48.(1) A holder must ensure that management standards and procedures are in place for monitoring all wells that are in suspension phase following drilling and hydraulic fracturing operations prior to development phase, including the status of the equipment and any annulus pressure.
- (2) Procedures must take account of the specific circumstances of the well and must include the reporting criteria for any anomaly and a risk assessment of such anomaly.

Well Abandonment/Closure

- 49 (1) A well that is no longer active, suspended or producing must be plugged and abandoned in accordance with an abandonment plan approved by the designated agency.
- (2) The abandonment plan must take into account the following factors-
- (a) final condition and design of the well;
 - (b) height of cement in annulus outside casing;
 - (c) any permeable formations outside casing that must be covered by cement;
 - (d) cementing casing overlaps;
 - (e) the need for abandonment plugs to cover the full diameter of the hole;
 - (f) type of fluid in annuli above cement;
 - (g) difficulties of injecting cement into the annulus;
 - (h) future monitoring of the integrity of the well plug;
 - (i) the depth below surface at which casing must be cut; and
 - (j) related seismic activity risks.
- (3) Any abandoned well must be clear of all obstructions and equipment and cemented for the full length and diameter of the wellbore to surface.