
APPENDIX A - DEFINITIONS, ACRONYMS, ABBREVIATIONS, AND REFERENCES

Abandonment

Conducting wellbore work that will permanently plug a well or a formation.

Acid Gas

Gas separated in the treating of solution or non-associated gas that contains hydrogen sulphide (H₂S), total reduced sulphur compounds, and/or carbon dioxide (CO₂).

Adverse Effects

Means impairment of or damage to the environment, human health, safety, or property as defined in the Environmental Protection and Enhancement Act.

Alternate Products

Alternate products are chemical or material compounds that are designed to meet the casing cementing objectives and which may be deployed with cement or in place of cement.

Artesian Water

The flow of non-saline water from ground water springs or shallow water wells.

Casing Standoff or Centralization

A measurement of the eccentricity of a casing inside a wellbore. It is measured in percent and is based on the distance that the casing is from the outside of the casing to the hole on the shortest distance and the longest distance from the outside of the casing to the hole. If the casing is exactly in the middle of the hole the standoff is 100%, and if the casing is touching the hole on one side the standoff would be 0%.

Cement

A powdered substance made from limestone and clay or shale. When mixed with water, a slurry is formed which hardens upon curing. Portland cement is the most common cementitious material used in the construction and oil industries.

Cement Compressive Strength

A testing procedure for cement compressive strength is outlined in API RB 10B-2 Recommended Practice for Testing Well Cements.

Conductor Pipe

Pipe used to keep the wellbore open and to provide a means of conveying the drilling fluid flowing up from the wellbore to the rig tanks and, if required for well control purposes, to accommodate a diverter system. The conductor pipe is set before or soon after drilling has commenced. Conductor pipe may be cemented, driven, or screwed into place before drilling the surface hole. The AER considers conductor pipe to be casing that is placed at depths not exceeding 30 metres.

Critical Sour Well

In Alberta, a well with an H₂S release rate greater than 2.0 m³/s or wells with lower H₂S release rates in close proximity to an urban centre as defined in AER Directive 056: Energy Development Applications and Schedules.

Crude Bitumen

A naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulphur compounds and that, in its naturally occurring viscous state, will not flow.

Gas Migration (GM)

A flow of gas or liquids that is detectable at surface outside of the outermost casing string.

Ground Water

All water under the surface of the ground.

Hydraulic Isolation

The prevention of communication flow between discrete porous zones or formations in a wellbore, to the atmosphere, onto the ground, or into surface water.

Intermediate Casing

Casing strings which are used to ensure wellbore integrity down to total depth or the next full-length casing point. Intermediate casing strings are set after the surface and before the production casing.

Liner

Any string of casing in which the top does not extend to the surface but instead is suspended from inside the previous casing string. The liner can be either protective or productive and must be designed accordingly.

Non-associated Gas

Gas produced from a gas pool (i.e., not associated with oil or bitumen reservoirs or with production).

Non-saline Water

Water with less than 4,000 milligrams per litre (mg/l) of total dissolved solids.

Porosity Interval

In Alberta, carbonate formations with effective porosity greater than 1 per cent, sandstones with effective porosity greater than 3 per cent, any zone with offset production regardless of the porosity, or any zone with drill stem test formation fluid recoveries greater than 300 linear meters or gas volumes greater than 300 cubic meters. A porosity interval may contain hydrocarbons, gases, and/or water.

Risk Assessment

A process carried out to capture and understand the frequency of events, and the nature and magnitude of the consequences that arise from those events. It involves risk identification, risk analysis, and risk evaluation.

Single Barrier System

A well system designed for hydraulic fracturing operations comprised of a primary barrier system only.

Strength Retrogression

Strength retrogression is the loss of compressive strength and increase in permeability that occurs over time when cement is continually exposed to or cycled at high temperatures.

Surface Casing Vent Flow (SCVF)

The flow of gas and/or liquid or any combination out of the surface casing/casing annulus.

Thermal Cement

In general, thermal cement is designed to minimize degradation in strength properties above 120°C and during temperature cycling. Thermal cement is commonly formed by reducing the bulk lime (CaO or C) to silica (SiO₂ or S) ratio of non-thermal cement. The C:S ratio of a thermal cement is 1.0 or less and is normally obtained by the addition of silica to the Portland cement, typically 35 - 40% by weight of cement.

Thermal Well

A well that is completed in a reservoir that is, was, or has the potential to be artificially heated.

Uncontaminated Cement

Planned cement blend without mixing of formation fluids, drilling fluids, pre-flush fluids, or scavenger cement.

Well Integrity

Prevention of the escape of fluids (i.e., liquids or gases) to subsurface formations or surface. It is the application of technical, operational, and organizational solutions to reduce risk of the loss of hydraulic isolation throughout the life cycle of a well.

Zone

Means any stratum or any sequence of strata that is designated by the Regulator as a zone. Means a geological formation, member, or zone.

Acronyms and Abbreviations

- ALARP - As Low As Reasonably Practicable
- API - American Petroleum Institute
- ASTM - American Society for Testing and Materials
- BGWP - Base of Ground Water Protection (can be found for locations on the AER website in the Base of Ground Water Protection Tool)
- CHOPS - Cold Heavy Oil Production Systems
- CSA - Canadian Standards Association

- ISO - International Organization for Standardization

APPENDIX B - PROPERTIES TO CONSIDER WHEN ASSESSING USE OF ALTERNATE PRODUCTS

The following are general guidelines for assessing the physical properties/characteristics of alternate products and the list may not include all items that should be considered.

1. Compressive strength, gel strength, viscosity, and other physical properties,
2. Ability to remove drilling fluids/filter cake when the alternate product is circulated in the wellbore and placed behind casing or placed in open hole as a permanent isolating material,
3. Potential degradation after setting and the life expectancy of the alternate product,
4. Expansion or shrinkage,
5. Potential miscibility with wellbore fluids or formation fluids,
6. Capability of bonding/sealing to formations and to casing and in maintaining hydraulic isolation of porosity intervals when in service,
7. Protecting the casing from corrosion,
8. Potential toxicity before and after placing/installing,
9. Potential leaching before and after placing/installing,
10. Potential reaction to wellbore fluids through the life of the well,
11. Potential adverse effects to ground water if used above BGWP, and
12. Ability to maintain design properties under all well lifecycle events including well interventions and potential subsurface development in the formations that the subject well has penetrated.

Additional guidance on the selection and use of alternate products can be found on the Oil & Gas UK's website under Guidelines on qualifications of material for the suspension and abandonment of wells (Issue 1 July 2012). Further information may be found in the Det Norske Vertis document.

APPENDIX C - GUIDELINES FOR RISK ASSESSING ALTERNATE PRODUCTS

The following are general guidelines for a risk assessment when considering the use of alternate products in a wellbore and the list may not include all risks to be considered.

1. Toxicity assessment of the alternate product and safe procedures for handling, storage deployment, disposal, and any risks to ground water and mitigation procedures.
2. A validation procedure to ensure the service provider's operating procedures are followed in the deployment of the alternate product and with appropriate documentation maintained by the producer for audit requirements.
3. Status and conditions of the well bore prior to installing/setting the alternate product.
4. Potential adverse effects that may occur to the wellbore from installing/setting the alternate product.
5. Post-setting conditions of the well bore and the alternate product considering any potential adverse effects that could occur including the ability to re-enter the wellbore.
6. Long term stability, potential for corrosion or degradation of the alternate product or other potential adverse effects on the wellbore formations, cement, or casing.
7. Ability to provide permanent hydraulic isolation considering the loads and stresses the wellbore is subjected to during the full life cycle including post abandonment.
8. Potential for leaching into ground water during setting and after setting or installing.
9. Potential for failure due to a change in well service or reservoir conditions including chemical and geological processes, the potential for reservoir re-pressuring over thousands of years and offset subsurface development.
10. Potential for the product to come into contact with groundwater.
11. Potential risks of toxicity if the product comes into contact with groundwater.
12. The alternate product design considering all conditions that the wellbore, and formations in the wellbore, could experience including but not limited to thermal activity stimulations on the subject well.
13. Procedures to confirm the placement of the alternate product.
14. Procedures to safely transport, store, handle and install the alternate product.
15. Compliance with federal, provincial, and local regulations.
16. Ability or limitations on future well activity, intervention, or re-entry work.
17. Methods to ensure the product blend does not vary from what was accepted for use by the regulator, and
18. Any alternate product limitations for the application that is under consideration.

APPENDIX D - REFERENCES

Alberta Energy Regulator (AER)

Information regarding artesian water and ground water springs can be found on the Alberta Energy Regulator Website (www.aer.ca) and on the Alberta Energy & Parks website (aep.alberta.ca/water/reports-data).

Base of Groundwater Protection Data can also be accessed through AER website via the Base of Groundwater Protection (BGWP) Query Tool.

AER Directive 008 - Surface Casing depth Requirements.

AER Directive 009 - Casing Cementing Minimum Requirements.

AER ID2003-01 -

Oil and Gas Conservation Rules (OGCR) - Sections 6.080 (4), (6) and 6.090 of the OGCR.

Oil Sands Conservation Rules (OSCR) - Sections 14, 15(5), and 42(4) (e) of OSCR.

Coal mines in Alberta - refer to the map of Alberta coal mines on the AER website.

Canadian Standards Association's (CSA)

Z625 - Well Design Standard Overview, note the definitions in this Standard.

Z341.4-14 - Salt Cavern Waste Disposal.

American Petroleum Institute (API).

API 10A - Cements and Materials for Well Cementing

API 65-2 - Isolating Potential Flow Zones During Well Construction

American Society for Testing and Materials (ASTM) has numerous publications applicable to energy well cementing, and which can also be referenced for cementing standards and practices.

ASTM Spec c150/c150M - 12 Standard Specification for Portland Cement

International Organization for Standardization (ISO).

ISO 12835 - Qualification of Casing Connections for Thermal Wells

ISO 31000 - Risk Management

ISO -31010 - Risk Management - Risk Assessment Techniques

Industry Recommended Practices (IRPs) refer to Energy Safety Canada website.

ESC DACC IRP3 - In Situ Heavy Oil Operations.

ESC DACC IRP 24 (and FAQs) - Fracture Stimulation

ESC DACC IRP 25 - Primary Cementing

ESC DACC IRP 26 - Wellbore Remediation