

Directive [XXX]

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Requirements for Geothermal Resource Development

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1 Introduction

1.1 Purpose of This Directive

This directive contains the requirements for geothermal resource development below the base of groundwater protection.

Geothermal resource means the natural heat from the earth that is below the base of groundwater protection, as defined under the *Geothermal Resource Development Act (GRDA)*. Geothermal resource development covers both the commercial and noncommercial development of the geothermal resource and can involve wells, pipelines, and for commercial purposes only, facilities.

The entire life cycle of geothermal development is covered: initiation, construction, operation, and closure.

Many of the requirements for geothermal development are the same as for oil and gas development. As a result, there are a number of references in this directive to other Alberta Energy Regulator (AER) directives that contain requirements that must be followed.

If a proposed geothermal development is not covered in this directive, contact the AER for direction.

1.2 AER Requirements

In this directive, the term “must” indicates a requirement, while terms such as “should,” “recommends,” and “expects” indicate a recommended practice.

If a requirement applies at both the application stage and later in a development’s life cycle, the requirement may refer to both the applicant and the licensee.

Each AER requirement is numbered.

Information on compliance and enforcement can be found on the AER website.

2 Geothermal Resource Development – General Requirements

This section contains general requirements for geothermal resource development regardless of whether it involves a well, facility, or pipeline.

2.1 Documentation

- 1) All documentation required under this directive must be provided to the AER upon request.
- 2) Unless otherwise specified, documentation must be retained for the lifetime of the site.

2.2 Application Submission

All applicants are responsible for understanding and complying with legislative and regulatory requirements. When an applicant files a licence application, it declares that it understands and will follow the relevant requirements in this directive.

As per section 7 of the *GRDA*, applicants must not start any site preparation, construction, or operation before approval. This includes work such as stripping topsoil, removing vegetation, constructing access roads; stringing, bending, and welding pipe; and installing equipment. However, surveying the site is permitted.

- 3) Applicants must submit applications via the designated information submission system, which is indicated on the directive landing page.

However, the submission system is not able to accept all the information required in an application.

- 4) Any information that cannot be submitted via the designated information submission system must be submitted to GeothermalApplications@aer.ca within 24 hours and must contain the application number provided by the submission system.

This directive indicates which information needs to be submitted by email.

All geothermal development applications will be publicly available on the AER website for at least 30 days.

2.3 Rights and Consents

The *Surface Rights Act* does not apply to geothermal resource development in Alberta.

- 5) An applicant must obtain written consent from the owner of the land for surface access before the AER makes a decision on the geothermal resource development application.

Subsurface rights requirements are set out in the regulations made under the *GRDA*. The right to develop the geothermal resource in the subsurface can be obtained from the Crown or through consent from a Freehold mineral rights owner or leaseholder, or from others identified by the AER.

- 6) An applicant must obtain the subsurface rights to develop the geothermal resource before applying for a geothermal well.
- 7) Documentation of the subsurface rights must be retained by the applicant or licensee and provided to the AER on request.

2.4 Eligibility to Apply for a Licence

- 8) Before applying for a licence, the applicant must
 - a) obtain a business associate (BA) code from Petrinex, and
 - b) obtain licensee eligibility as per *Directive 067: Eligibility Requirements for Acquiring and Holding Energy Licences and Approvals*.

2.5 Participant Involvement

- 9) An applicant must meet the participant involvement requirements in this directive and section 3 of *Directive 056: Energy Development Applications and Schedules* and follow the process set out in section 2 of *Manual 012: Energy Development Applications*.

Section 3.3.4.1 of *Directive 056* and section 2.3 of *Manual 012*, however, do not apply since geothermal development is not covered by the *Surface Rights Act*.

The consultation and notification requirements depend on the type of well, facility, or pipeline and are set out in the following tables in *Directive 056*:

- For wells – table 5. Category type is based on the hydrogen sulphide (H₂S) content, H₂S release rate, and proximity to the public.
 - For facilities – table 1. Category type is based on the H₂S and sulphur content of the inlet gas stream.
 - For pipelines – table 3. Category type is based on pipe diameter and H₂S content of the transported product.
- 10) In addition to the consultation and notification requirements in *Directive 056*, the applicant must provide the following information in a project overview to the parties listed in *Directive 056*, tables 1, 3, and 5:
 - a) the area and capacity of the proposed geothermal resource development project
 - b) a description of the project-related activities
 - c) a map showing the location of the project, including all current and proposed facilities, wells, and pipelines
 - d) the proposed schedule for submitting regulatory applications for any new and converted facilities, wells, and pipelines
 - 11) After a geothermal well, facility, or pipeline licence is issued, the licensee must provide updates to the parties listed in *Directive 056*, tables 1, 3, and 5.

The AER expects the licensee to provide updates every five years from the date the licence is issued.

- 12) The update must be provided in an information package that includes
 - a) licensee name and contact information;
 - b) a map showing the location of the project, including all current and proposed facilities, wells, and pipelines;
 - c) a summary of what regulatory applications have been filed with the AER;
 - d) an updated schedule for submitting regulatory applications for any additional facilities, wells, and pipelines; and
 - e) a summary of any monitoring done and the results to date.

2.6 Emergency Preparedness and Response

- 13) The applicant or licensee must meet the emergency preparedness and response requirements in *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry*, including developing and maintaining a corporate-level emergency response plan (ERP) if a site-specific ERP is not required.
- 14) The site-specific or corporate-level ERP must contain procedures to effectively respond to an emergency arising from any of the hazards identified under section 3.3 of this directive that may pose a significant risk to public safety or the environment.

2.7 Working Interest Participants

- 15) To apply for, hold, or transfer a well or facility, an applicant must be a working interest participant.
- 16) The applicant must provide current information about each working interest participant, including the following:
 - a) full legal name of the working interest participant, which cannot be a partnership
 - b) their contact information, including an email address
 - c) their percentages of working interest, totalling 100 per cent, for every well and facility included in the application
- 17) The information about working interest participants must be provided via an email to GeothermalApplications@aer.ca that contains the application number or licence number in the subject line and indicates that it is about working interest participants.

18) Licensees must inform the AER of any changes to the working interest participant information within 30 days of the changes.

2.8 Holistic Licensee Assessment

The AER will holistically assess the licensee to inform regulatory decisions regarding the licensee. This assessment uses a multifactor approach to assess the capabilities of licensees to meet their regulatory and liability obligations throughout the geothermal development life cycle. This multifactor approach includes the factors outlined below and the factors listed in section 4.5 of *Directive 067* for determining if a licensee poses an unreasonable risk. Additionally, information provided from the licensee throughout the life cycle, including applications, amendments, reporting, and other submissions to the AER, may be considered in the assessment. This assessment is to ensure the responsible management by the licensee of their liability from their collective wells, facilities, pipelines, and sites.

The results from the assessment will inform regulatory decisions regarding the licensee, including licence eligibility under *Directive 067*.

The holistic assessment uses various factors to identify risks posed by a licensee:

- financial health
- estimated total magnitude of liability (active & inactive), including abandonment, remediation, and reclamation
- remaining lifespan of the geothermal development and infrastructure and the extent to which existing operations may fund current and future liabilities
- rate of closure activities and spending and pace of inactive liability growth
- management and maintenance of regulated infrastructure and sites, including compliance with operational requirements
- compliance with administrative regulatory requirements, including the management of debts, fees, and levies
- any other factor the AER considers appropriate

The data that feeds into the assessment are drawn from numerous sources available to the AER, including the financial information submitted under *Directive 067*.

Financial information provided to the AER will be kept confidential for the period outlined in section XXX of the *Geothermal Resource Development Rules*.

19) Licensees must provide complete and accurate information as required by the AER for the holistic assessment.

A geothermal licence application (for a well, facility or pipeline) will trigger a holistic licensee assessment. The AER will consider the results of the assessment and any other factors determined appropriate in making the decision to approve, approve with conditions, or deny a licence application.

2.9 Licensee Management Program

The Licensee Management Program is how the AER will proactively monitor licensees to support the responsible management of geothermal development. Under this program, the results from the holistic licensee assessment will be used to identify those licensees that are at greater risk of potential failure in meeting their regulatory and liability obligations throughout the geothermal development life cycle.

The AER may then undertake specific engagement or regulatory actions with the licensee. This may be done through providing education, encouragement to follow industry best practices, and, where appropriate, the initiation of specific regulatory actions.

The AER encourages licensees to use available collaborative closure planning tools, such as area-based closure, to help reduce their overall closure costs and work more efficiently to reduce liability on the landscape. Where special action is warranted, the AER may take regulatory steps such as changing licence eligibility under *Directive 067*, placing restrictions on new applications, requiring security deposits, or issuing orders.

20) Licensees must provide information to the AER as requested under the Licensee Management Program to ensure the responsible management of energy development throughout the geothermal development life cycle.

2.10 Liability Assessment

21) An applicant or licensee must provide an estimate of the total liabilities associated with the geothermal development, including the cost of providing care and custody and the cost to permanently end operations, which includes abandoning and reclaiming the site.

The following are factors related to a geothermal liability assessment:

- a) Geographic location
 - i) Location within province
 - ii) Proximity to environmentally sensitive areas
 - iii) Proximity to urban areas
- b) H₂S and CO₂ content of production fluid (applies to open-loop wells, described in section 3, and facilities)

- c) Site contamination
- d) Well
 - i) New or converted well
 - ii) Geothermal well type, as defined in section 3
 - iii) Depth and diameter of a well
 - iv) Wellbore configuration
 - v) Cementing and completion details
 - vi) Wellbore integrity (applies to converted wells)
 - vii) Groundwater protection
 - viii) Surface casing vent flow and gas migration
- e) Facilities
 - i) Facility type
 - ii) Facility area and design capacity
 - iii) Hazardous materials
- f) Other factors that affect costs to close infrastructure and sites

A site-specific liability assessment may be required for a geothermal development. A site-specific liability assessment is conducted by a licensee to estimate the cost of suspension, abandonment, reclamation, or remediation of a particular site.

- 22) When directed by the AER, the licensee must conduct and submit a site-specific liability assessment, in accordance with *Directive 001: Requirements for Site-Specific Liability Assessments in Support of the ERCB's Liability Management Programs*, unless otherwise directed by the AER.

The AER will continually assess the liability holistically to ensure the responsible management by the licensee of their ongoing liability from their collective wells, facilities, pipelines, and sites.

2.11 Security Deposits

Section XXX of the *Geothermal Resource Development Rules* gives the AER broad authority to require security deposits across the geothermal development life cycle. This includes at time of application and amendment for well and facility licences, as well as for licence transfers.

23) When directed by the AER, the licensee must provide security in the amount and by the due date specified by the AER. The AER will not issue a licence or transfer a licence without confirmation that the appropriate security has been posted by the licensee.

The AER will determine the need for security and the amount based on the AER's holistic assessment, including whether the licensee poses an unreasonable risk (as outlined in section 4.5 of *Directive 067*), and any other factor the AER considers appropriate. The maximum amount of security that may be required is the licensee's total liabilities, including the cost of providing care and custody and the cost to permanently end operations, which includes abandoning and reclaiming the site.

A licensee may request a refund of security. In assessing this request, the AER will consider the factors of the holistic licensee assessment, including whether the licensee poses an unreasonable risk (outlined in section 4.5 of *Directive 067*), and any other factor the AER considers appropriate.

For further information on the processes that apply when a security deposit is required or can be refunded, refer to *Directive 068: ERCB Security Deposits*.

3 Geothermal Wells

3.1 Well Types

Geothermal well types are based on their configuration.

The two most common geothermal configurations in use are the open-loop configuration and the closed-loop configuration.

In an open-loop configuration, warm or hot fluids are produced to surface from a formation through production wells, while cool or cold fluids are injected or reinjected into a formation through injection wells. The well types designated for an open-loop geothermal configuration are

- geothermal injection, and
- geothermal production.

In a closed-loop configuration, fluids are circulated into and out of one or more wells. The well types designated for closed-loop configurations are

- geothermal circulation (for a single closed-loop well),
- geothermal circulation: in (for multiwell closed-loop configuration receiving cold-side circulation fluids), and

- geothermal circulation: out (for multiwell closed-loop configuration producing hot-side circulation fluids to surface).

There may be wells proposed that do not use an open- or closed-loop configuration or do not use any fluids. The designated well type for these wells is

- geothermal other.

For any observation wells to monitor downhole temperature or pressure, the designated well type is

- geothermal observation.

3.2 Technical Requirements

3.2.1 General

The design work for a geothermal well is a professional work product, and is therefore expected to be completed by a qualified professional licensed to practice in Alberta, such as a member of the Association of Professional Engineers and Geoscientists of Alberta.

24) In addition to the requirements in this directive, geothermal wells must meet

- a) section 7.7 of *Directive 056* except for section 7.7.9, “Drill Cutting Sample Requirements,”
- b) section 7.7.14 of *Directive 056*,
- c) *Directive 008: Surface Casing Depth Requirements*,
- d) *Directive 009: Casing Cementing Minimum Requirements*,
- e) *Directive 010: Minimum Casing Design Requirements*, and
- f) *Directive 080: Well Logging Requirements*

25) The licensee must take drill cutting samples for the first drilled geothermal well of the well pad as follows:

- a) The licensee must start sampling as per the applicable scenario below:
 - i) If there are no existing wells within a two-kilometre (km) radius of the new geothermal well: From the base of the surface casing of the new geothermal well.
 - ii) If there is an existing well within a 2 km radius of the new geothermal well: At the top of the deepest formation penetrated by the offset well.
 - iii) If there is an existing well within a 2 km radius that has been drilled deeper than the new geothermal well: Thirty metres above the target formation of the new geothermal well.

- b) The licensee must sample in 5 m intervals in the vertical section and 20 m in the horizontal section of the new geothermal well.
- c) The licensee must sample to the total depth of the new geothermal well.

For geothermal wells that will encounter temperatures greater than 110°C downhole, the AER expects the licensee to consider and document the use of thermal cement for any new wells or for any portion of the wellbore that will be extended from existing wells.

- 26) For closed-loop geothermal wells, the surface casing must be completed down to the base of groundwater protection.
- 27) If a geothermal well is hydraulically fractured, the licensee must meet the requirements in *Directive 083: Hydraulic Fracturing – Subsurface Integrity*. (Geothermal wells are not the thermal wells excluded from *Directive 083*.)
- 28) The licensee must meet the requirements in *Directive 087: Well Integrity Management*, including using the packer test form, and, if requesting variances, use the variance request forms found on the AER website.
- 29) The licensee must meet the storage requirements in *Directive 055: Storage Requirements for the Upstream Petroleum Industry*.
- 30) The licensee must meet the setback requirements in *Directive 056*.
- 31) The licensee must have acceptable measures to protect any water bodies from contamination during drilling and operations and to mitigate the impacts of a spill as set out in *Directive 056*.
- 32) The licensee must meet the air emissions management requirements in *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*.
- 33) The licensee must manage their waste at wells and facilities as per the drilling waste requirements in *Directive 050: Drilling Waste Management* and the waste requirements in *Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry*.
- 34) The licensee must handle any radioactive material from geothermal operations in accordance with *Directive 058*.

3.2.2 Inactive Wells

- 35) For all inactive geothermal wells, the licensee must meet the requirements in this directive and *Directive 013: Suspension Requirements for Wells*.

Inactive observation wells under *GRDA* are not exempt from *Directive 013* requirements. A geothermal observation well is deemed inactive when no bottomhole temperature has been

taken for 12 consecutive months. (Temperature data are reported annually, as per section 7.3.3 of this directive.)

Under *Directive 013*, inactive wells are classified as low, medium, and high risk. The AER classifies inactive geothermal observation wells as low risk. All other inactive geothermal wells are classified as medium risk.

Table 1 in *Directive 013* summarizes the suspension requirements for each risk classification. In the row “Initial suspension & ongoing inspection requirements,” option 3 for medium-risk wells does not apply to inactive geothermal wells.

36) For inactive geothermal observation wells, licensees must meet the requirements for low-risk, type 1 wells set out in table 1 of *Directive 013*.

3.2.3 Well Closure

Well closure activities include abandonment, remediation, and reclamation.

37) The licensee must meet the abandonment requirements in *Directive 020: Well Abandonment*.

Geothermal wells are included in the definition of “specified lands” in the *Conservation and Reclamation Regulation* and thus subject to that regulation and the reclamation process for closure of a well site. At the time of closure, the site must be returned to an equivalent land capability, as defined in the *Conservation and Reclamation Regulation*.

3.3 Risk Assessment Requirements

38) Applicants must assess the risks related to following hazards:

- a) breach of reservoir containment
- b) failure of well integrity
- c) surface deformation (e.g., ground subsidence and heave)
- d) induced seismicity (applies only to open-loop well operations)
- e) any other hazards specific to the project

39) For each hazard that may pose a significant risk to public safety or to the environment, a monitoring and mitigation plan must be developed and implemented.

See the next section for the plan requirements specific to induced seismicity.

3.3.1 Induced Seismicity

Critically stressed faults are faults within 30 degrees of maximum horizontal stress for the geothermal well.

- 40) To determine the potential for induced seismicity, the risk assessment must identify the presence of critically stressed faults within a 3 km radius of the proposed geothermal well. This task can be done by identifying and documenting known earthquakes around the proposed wellbore and any faults using publicly available data (e.g., Alberta Geological Survey, Earthquake Canada).
- 41) If induced seismicity is identified as a risk by the applicant, licensee, or AER or if a seismic event is induced or triggered by the geothermal well operations, the applicant or licensee (whichever is applicable) must do the following:
 - a) Develop a monitoring, mitigation, and response plan that sets out how to eliminate or reduce the magnitude of seismic events, including following a “traffic light” protocol, detailed below. The plan is expected to be prepared by a qualified professional licensed to practice in Alberta.
 - b) Implement the plan in (a) prior to starting drilling operations.
 - c) Install the following seismic monitoring equipment:
 - i) a seismograph station at the geothermal injection well site
 - ii) accelerometers at strategic locations near residences, communities, and any critical infrastructure within a 10 km radius from the geothermal well, unless otherwise directed by the AER
- 42) The seismic monitoring equipment must be able to detect a seismic event of 2.0 local magnitude (M_L) within 10 km of the geothermal well.
- 43) Seismic monitoring information and data generated or collected pursuant to this directive must be submitted to
 - a) the AER in real time,¹ and
 - b) the Incorporated Research Institutions for Seismology no later than one year after the data are collected.
- 44) As part of the monitoring, mitigation, and response plan, the licensee must follow the traffic light protocol summarized in figure 1 and described below in response to a seismic event recorded by the licensee or any other party.

¹ See the AER's [Open File Report 2019-09: The Scientific Induced Seismicity Monitoring Network \(SCISMN\)](#) for details on how to provide seismic information to the AER.

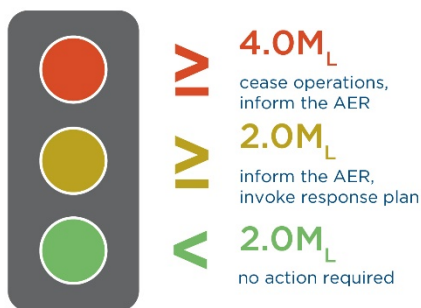


Figure 1. Traffic light protocol for a seismic event

- a) Green light: if the seismic event is less than 2.0 M_L within 10 km of the geothermal well, no action is required by the licensee
 - b) Yellow light: if the seismic event is 2.0 M_L or greater within 10 km of the geothermal well, then the licensee must
 - i) immediately report the event to the Energy and Environmental Emergency 24-Hour Response Line (1-800-222-6514), and
 - ii) implement its response plan in a manner that eliminates or reduces the magnitude of future seismic events.
 - c) Red light: if the seismic event is 4.0 M_L or greater, then the licensee must immediately
 - i) suspend injection operations or hydraulic fracturing operations at the subject well,
 - ii) return the well to a safe state, and
 - iii) report the event to the Energy and Environmental Emergency 24-Hour Response Line (1-800-222-6514).
- 45) The licensee must receive written consent from the AER to resume injection or hydraulic fracturing operations suspended under a “red light” event.
- The AER may permit resumption of injection or hydraulic fracturing operations at the geothermal well if the licensee presents a plan acceptable to the AER for modified operations to prevent future seismic events of 4.0 M_L or greater.
- 46) The licensee must implement the plan accepted by the AER to resume operations at the geothermal well.
- 47) The licensee must retain a copy of its induced seismicity monitoring, mitigation, and response plan on site during geothermal operations and submit the plan to the AER upon request.

As an open-loop geothermal injection well is operated over time, the risk of induced seismicity in the project area becomes better defined.

- 48) Based on the operational data acquired, the licensee must adjust the seismic magnitude thresholds in the traffic light protocol, if necessary, as their project develops. Any adjustments must be approved by the AER.

3.4 Application Requirements

3.4.1 General

- 49) An applicant must apply for a geothermal well licence as per this directive and *Directive 056*.

Each well under the AER’s jurisdiction is assigned a well classification under a system designed to differentiate between exploration and exploitation activity. The classifications and definitions for geothermal wells are set out in table 1.

Table 1. AER classifications for geothermal wells

AER classification	Description
Exploratory (XPL)	A well drilled to obtain reservoir parameters for previously unexplored geothermal resources in a formation or to test new geothermal technology.
Development (DEV)	Additional wells drilled to further develop the geothermal resource in a formation.
Re-entry (REN)	A well that re-enters an existing wellbore to recomplete the well as a producer or as a service well with no new strata being drilled. If additional strata are to be drilled (e.g., by deepening, whipstock, or sidetracks), the geothermal well is assigned the classification XPL or DEV.
Development service well (DSW)	A well drilled to introduce fluids down the wellbore or into a formation or to gather pressure or temperature data for determining how well the development is performing.

- 50) The applicant must email the following information to GeothermalApplications@aer.ca with the subject line “Supplementary geothermal well application information:”
- a) a summary of the results from the risk assessment as per section 3.3, and
 - b) a plan for each hazard that may pose a significant risk, which includes the following components:
 - i) monitoring
 - ii) mitigation, and
 - iii) where applicable, a response.

3.4.2 Injection Approval

For open-loop geothermal wells, an injection approval is required prior to injection.

51) The licensee must apply for

- a) an injection scheme approval as per *Directive 065: Resources Applications for Oil and Gas Reservoirs* (the term “disposal scheme” in *Directive 065* is to be read as injection scheme); and
- b) if the injection fluid is a class II fluid under *Directive 051*, an injection approval as per that directive. If the injection fluid is not a class II fluid, the licensee must contact the AER for direction.

3.4.3 Variances and Disclosures

Variances are needed in the following situations:

- An applicant cannot meet a technical requirement.
- An applicant cannot meet the participant involvement requirements.
- An applicant proposes to implement new technology.

52) Any variances must be approved by the AER.

Applicants may seek variances from the following and other requirements either when submitting a well licence application or before:

- H₂S release rate assessment (*Directive 056*, section 7.7.15)
- critical well drilling plan (*Directive 036: Drilling Blowout Prevention Requirements and Procedures* and *IRP Volume 1: Critical Sour Drilling*)
- surface casing (section 2.8 of this directive; *Directive 056*, section 7.7.11; *Directive 008*)
- drill cutting samples (*Directive 056*, section 7.7.9)

53) If an applicant is proposing to use new technology, the application must contain enough information to substantiate that an equivalent level of environmental protection and public safety will be achieved to the requirements in this directive.

54) The applicant must submit the request to use new technology, including for a “geothermal other” well type, at the same time as the geothermal well licence application.

55) The applicant must disclose in its well licence application if

- a) any variances, excluding for new technology, have been approved or are being sought;
- b) surface access consent has not yet been obtained; or
- c) there are any outstanding concerns or objections to the application.

3.4.4 Licence Expiry, Extension, and Cancellation

56) Licensees must meet the requirements in section 7.2 of *Directive 056* for licence expiries, extensions, and cancellations.

3.4.5 Licence Amendments and Information Updates

57) The licensee must meet the requirements in section 7.5 of *Directive 056* for licence amendments and information updates for wells.

58) For any changes to a well licence not captured in *Directive 056*, the licensee must email the AER at GeothermalApplications@aer.ca for direction.

3.4.6 Conversion of an Oil and Gas Well to a Geothermal Well

A well licence issued under the *Oil and Gas Conservation Act (OGCA)* may be converted to a well licence issued under the *GRDA* for geothermal development.

Surface access granted for an *OGCA*-regulated well will not meet the surface access requirement for a geothermal well set out in section 2.3.

59) If the applicant is the current licensee of the *OGCA* well licence, they must apply to convert the well licence through an amendment application submitted via the designated information submission system.

60) If the applicant is not the current licensee of the *OGCA* well licence, they must first apply to transfer the well licence, as per section 6, and email the following information to GeothermalApplications@aer.ca with the subject line “Well licence transfer for geothermal conversion:”

- a) the transfer application number
- b) the well licence number and unique well identifier (UWI)
- c) proposed geothermal well type as per section 3.1
- d) substance type (e.g., steam, water)
- e) AER well classification as per table 1

The AER will then review the information in the transfer application, provided via the designated information submission system, and the emailed information about the proposed well conversion before deciding on the transfer application. Approval of the transfer application does not guarantee that a conversion application for the subject well will be approved.

61) Upon approval of the licence transfer, the new licensee must apply to convert the well licence through an amendment application submitted via the designated information submission system that includes the same information that was in the email about the proposed conversion.

62) Any converted wells must meet the requirements in this directive and the requirements in section 3 of *Directive 020*.

3.4.7 Re-entry, Resumption, and Deepening

Re-entry and resumption both refer to conducting further activity at an existing wellbore. When it is done by the existing licensee, it is called “resumption.” When it is done by someone else, such as a new licensee, it is called “re-entry.”

63) A licensee must meet the requirements for re-entry, resumption, and deepening in section 7.6 of *Directive 056*.

4 Geothermal Facility

A geothermal facility is a facility that uses geothermal energy to produce heat or power for *commercial purposes*.

64) Open-loop geothermal wells that produce either heat or power and closed-loop wells that produce power must be connected through an AER-licensed geothermal facility.

65) The applicant must contact the AER at GeothermalApplications@aer.ca to determine if a geothermal facility licence is required for closed-loop wells that produce heat.

An *OGCA* facility licence may be amended to include heating or power generated from geothermal energy for use only within the facility. In this situation, a facility licence under the *GRDA* is not required. However, the licensee is responsible for applying under the *OGCA* for any amendments required.

4.1 Technical Requirements

4.1.1 General

66) In addition to the requirements in this directive, geothermal facilities must meet

- a) *Directive 038: Noise*,
- b) *Directive 055: Storage Requirements for the Upstream Petroleum Industry*,

- c) *Directive 056*, section 5.6, except for the sulphur recovery requirements,
- d) *Directive 058: Oilfield Waste Management Requirements for the Upstream Petroleum Industry*, and
- e) *Directive 060: Upstream Petroleum Industry Flaring, Incinerating, and Venting*.

4.1.2 Inactive Facilities

A geothermal facility is deemed inactive when no volumetric activity has been reported for 12 consecutive months. The facility inactive date is 12 months from date of the last reported volumetric activity.

67) A licensee of an inactive facility must

- a) suspend the facility,
- b) abandon the facility, or
- c) reactivate the facility.

The AER expects the licensee to prepare the suspension plan for the facility and start suspension activities shortly after volumetric reporting has ceased.

68) To suspend an inactive facility, the licensee must prepare a suspension plan that includes the following:

- a) details of suspension activities, including
 - i) identification and control of hazardous materials
 - ii) isolation and de-energization of facility equipment
 - iii) purging and cleaning of facility equipment
- b) timelines for suspension activities, including the completion date of suspension
- c) ongoing monitoring and maintenance activities

69) The licensee must ensure that the suspension plan reflects ongoing activities and must provide the plan to the AER within 30 days of a request.

70) The licensee must complete all suspension activities no later than one year after the facility inactive date.

The facility suspension date is the date all suspension activities have been completed.

71) The licensee must report the facility suspension date and any other suspension activity information requested by the AER within 30 days of the suspension date through the designated information submission system.

- 72) A licensee of a suspended facility must either abandon or reactivate the facility.
- 73) Reactivation of a suspended facility must occur within 24 months of the suspension date.
- 74) Reactivation of an inactive facility that has *not* been suspended must occur within 12 months of the facility inactive date.
- 75) To reactivate a facility, the licensee must be able to
- a) safely reactivate the facility to serve its licensed purpose, and
 - b) have a proven source of geothermal energy.

The reactivation date of an inactive or suspended facility is the date of first reported commercial heat or power after the facility inactive date.

- 76) The licensee must report the reactivation date and any reactivation activity information requested by the AER through the designated information submission system within 30 days of the reactivation date.

4.1.3 Facility Closure

Facility closure activities include abandonment, remediation, and reclamation.

- 77) To close a geothermal facility, the licensee must prepare a closure plan that includes the following:
- a) details of abandonment activities:
 - i) how hazardous materials will be controlled
 - ii) how the facility equipment will be isolated, de-energized, purged, and cleaned
 - iii) how all aboveground equipment and infrastructure will be dismantled and removed
 - iv) how the facility site will be maintained in a safe and secure manner
 - b) details of ongoing site monitoring and maintenance activities, including vegetation controls and site security
 - c) details of environmental site assessment, remediation, and reclamation activities
 - d) timelines, including completion dates of abandonment, site remediation, and surface land reclamation activities
- 78) The licensee must update the closure plan to reflect ongoing activities and must provide the plan to the AER within 30 days of a request.

The facility abandonment date is the date all abandonment activities have been completed.

- 79) The licensee must report the facility abandonment date and any other abandonment activity information requested by the AER within 30 days of the abandonment date through the designated information submission system.

Geothermal facilities are included in the definition of “specified lands” in the *Conservation and Reclamation Regulation* and thus subject to that regulation and the reclamation process for closure of a facility site. At the time of closure, the site must be returned to an equivalent land capability, as defined in the *Conservation and Reclamation Regulation*.

4.2 Application Requirements

- 80) An applicant must apply to construct or operate a geothermal facility in accordance with this directive and *Directive 056*.
- 81) Applicants must include in the facility application an assessment of potential impacts of air emissions and noise from all sources, including power generation equipment.
- 82) The geothermal facility must be separated from any existing oil and gas operations and must be located on a separate lease. If the applicant plans to have integrated geothermal equipment such as heat exchangers residing off site, the applicant must contact the AER via email at GeothermalApplications@aer.ca prior to filing the application.
- 83) If the geothermal facility will receive from or send to an oil and gas facility production or working fluids, the applicant must
- a) clearly differentiate the geothermal (*GRDA*) equipment from the oil and gas (*OGCA*) equipment on the plot plan,
 - b) provide process flow diagrams for both the geothermal facility and the oil and gas facility, and
 - c) provide a table listing the equipment for the geothermal facility and for the oil and gas facility.

Because geothermal resource development is regulated separately from other types of energy development, oil and gas wells must not be connected to geothermal facilities. Only geothermal wells are permitted to be connected to a geothermal facility. They may also be connected to other types of facilities.

4.2.1 Variances and Disclosures

Variances are needed in the following situations:

- An applicant cannot meet a technical requirement
- An applicant cannot meet the participant involvement requirements

- An applicant proposes to implement new technology
- 84) Any variances must be approved by the AER.
- 85) An applicant must include any requests for variances in their application for a geothermal facility.
- 86) If an applicant is proposing to use new technology, the application must contain enough information to substantiate that an equivalent level of environmental protection and public safety will be achieved to the requirements in this directive.
- 87) The applicant must disclose in its facility licence application if
- a) surface access consent has not yet been obtained, or
 - b) there are any outstanding concerns or objections to the application.

4.2.2 Licence Expiry and Extension

- 88) Applicants must meet the requirements under section 5.2 of *Directive 056* for licence expiries and licence extensions.

4.2.3 Licence Amendments

- 89) A licensee must apply to amend the geothermal facility licence through the designated information submission system if proposing a modification that
- a) is listed in *Manual 012*, table 4, or
 - b) is listed in section 5.5 of *Directive 056*.
- 90) The licensee must apply to amend the geothermal facility licence via email to GeothermalApplications@aer.ca with the subject line “Geothermal Facility Application Amendment” if the lease area is being expanded or if any of the following will increase:
- a) noise levels
 - b) the total inlet rate, including fluids (m³/d)
 - c) the total production capacity
 - d) the commercial heating output
 - e) the commercial power output
- 91) If any changes to the licence are proposed other than those listed above in this section, the licensee must email the AER at GeothermalApplications@aer.ca for direction.

5 Geothermal Pipeline

5.1 Technical Requirements

92) Applicants and licensees must meet the technical requirements in the *Pipeline Act*, the *Pipeline Rules*, and section 6.6 of *Directive 056* and must meet the design specifications as per the Canadian Standards Association *CSA Z662: Oil and Gas Pipeline Systems*.

5.1.1 Closure

Pipeline closure activities include abandonment, remediation, and reclamation.

Geothermal pipelines are included in the definition of “specified lands” in the *Conservation and Reclamation Regulation* and thus subject to that regulation and the reclamation process for closure of a pipeline. At the time of closure, the site must be returned to an equivalent land capability, as defined in the *Conservation and Reclamation Regulation*.

5.2 Application Requirements

93) Applicants must apply for a geothermal pipeline licence under the *Pipeline Act* and *Pipeline Rules* and as per section 6 of *Directive 056*.

6 Transfer of Geothermal Well, Facility, or Pipeline Licences

6.1 Application Requirements

Agreements for the purchase and sale of AER-licensed wells, facilities, and pipelines do not result in a transfer of the associated licences until a licence transfer application has been submitted to and approved by the AER.

The AER will not accept a licence transfer application unless both the transferor and transferee have AER identification codes that permit the holding of all licence types contained within the licence transfer application. For further information about agent appointments, identification code requirements, and other eligibility requirements, refer to *Directive 067*.

The AER will process licence transfer applications as they are received.

A licence transfer application will trigger a holistic licensee assessment (as outlined in section 2.8) of both the transferor and transferee. The AER will consider the results of this assessment and any other factors determined appropriate in making the decision to approve, approve with conditions, or deny a licence transfer application. The AER may require a site-specific liability assessment to be completed to support the holistic assessment.

For licences that have a public lands disposition that needs to be assigned or transferred, if either party has arrears in respect of any debt to the Crown or any taxes owing to a municipality, the AER

will reject the public lands application for assignment or transfer of the disposition, as outlined in the *Public Lands Administration Regulation*, section 153.

It is the transferor's responsibility to ensure that all information relevant to the licences contained in a transfer application is updated in AER systems before the application is submitted.

94) An applicant must apply for a licence transfer and submit the numbers of all the licences proposed for transfer through the designated information submission system.

A licence transfer application can be submitted by the transferor, the transferee, or an authorized agent or consultant acting on behalf of either party.

95) Before a licence transfer application will be accepted by the AER, both parties must make the declarations outlined in appendix 1.

96) As part of a licence transfer application, the parties must provide current information about each working interest participant, including the following:

- a) full legal name of each working interest participant (which cannot be a partnership)
- b) contact information for each working interest participant, including an email address
- c) the percentages of working interest, totalling 100 per cent, for every well and facility included in the application

97) For licence transfer applications that include problem sites (see appendix 6 of *Directive 006*), any site-specific liability assessments submitted must have been completed within the previous three years, unless otherwise directed by the AER, and must be accompanied by an evaluation of cost changes that have occurred since the assessments were completed.

The AER will conduct a holistic licensee assessment of both the transferor and transferee to ensure that abandoned, reclaimed, and reclamation-exempt sites are managed and monitored and that future issues, should they arise, can be addressed by a responsible party. As a result, the AER will consider the whole package of licences to be transferred and may reject a licence transfer application that does not include licences that have received reclamation certification or that are abandoned and classified as "reclamation exempt."

To offset any potential increase in risk that may arise from a licence transfer, a transferor or transferee may be required, as a condition of approval, to provide a security deposit to the AER. When making this determination, the AER will consider the factors of the holistic licensee assessment, including whether the licensee poses an unreasonable risk (outlined in section 4.5 of *Directive 067*), and any other factor the AER considers appropriate.

The AER does not determine security deposit requirements until the licence transfer application has been received and reviewed.

If a required security deposit is not received by the due date identified by the AER, the licence transfer application will be closed, and the transferor will remain the licensee.

The AER will convey its decision regarding a licence transfer application to both the transferor and the transferee. If a transferor or transferee is represented by an agent or uses the services of a consultant, the AER will also provide notice of its decision to the agent or consultant.

The licensee of record (transferor) remains responsible to comply with all applicable regulatory requirements for any well, facility, or pipeline in a licence transfer application until the AER approves the transfer. On approval of a licence transfer application, the new licensee of record (transferee) becomes responsible for any well, facility, or pipeline in the application as of the effective date of the transfer.

7 Geothermal Data Filing, Measurement, and Reporting Requirements

7.1 Well Data Filing Requirements

98) Licensees must meet the requirements in *Directive 059: Well Drilling and Completion Data Filing Requirements* and *Directive 080*.

99) If drillstem tests are conducted, licensees must meet the requirements in sections 2.6 and 3.7 of *Directive 040: Pressure and Deliverability Testing Oil and Gas Wells*.

100) For open-loop wells, the licensee must conduct initial sampling and analysis of the chemical and physical properties and composition of reservoir fluids, including

- a) standard water chemistry parameters (e.g., pH, TDS),
- b) density,
- c) H₂S, and
- d) hydrocarbons.

101) For open-loop wells, the licensee must email the analysis results from the initial reservoir fluid sampling to Geothermal.DataSubmission@aer.ca within 60 days of the sampling date.

102) For any fluid sampling and analysis conducted, whether for open- or closed-loop systems, the licensee must meet the requirements in sections 2.4 and 3.8 of *Directive 040*.

7.1.1 Confidentiality and Release of Well Data

The following geothermal well data, as well as sample drill cuttings and core preserved by the AER, are confidential for a one-year period:

- fluid analysis data
- routine pressure, temperature, and flow test data
- any log data, drillstem test data, wireline formation test data, and completion details,
- any core analysis data
- hours on production and injection

The drill cuttings, core, and data automatically become nonconfidential one year from the well’s finished drilling date.

Only under exceptional circumstances will the AER consider an extension to the period of confidentiality.

103) Any extension must be applied for at least 30 business days before the one-year expiry date and submitted to the GeoConfTeam@aer.ca.

The following information is not held by the AER as confidential and is part of the public domain upon the applicant’s submission:

- the surface- and bottomhole locations, elevation, current depth, drilling status, and casing and cementing data
- the monthly totals of each type of fluid injected into injection wells and produced from production wells
- any information submitted about hydraulic fracturing fluids used in geothermal operations

7.2 Measurement Requirements

104) Licensees must meet the water measurement requirements in the following sections of *Directive 017: Measurement Requirements for Oil and Gas Operations*:

- a) section 1.8.3, “Injection Systems,” only the row for total water
- b) section 1.9, “Measurement Schematics”
- c) section 2, “Calibration and Proving”
- d) section 14, “Liquid Measurement”
- e) section 15, “Water Measurement”

- 105) If geothermal production fluids contain any incidental hydrocarbons (i.e., gas, condensate, or oil), licensees must meet the hydrocarbon-related measurement requirements in *Directive 017*.
- 106) A geothermal licensee must have the corresponding mineral rights, either by purchase or through agreement, before any hydrocarbons or other minerals may be produced.
- 107) Water, either fresh or brackish, from open-loop production wells must be continuously measured before commingling with water or fluids from another source, as per section 15.2.3 of *Directive 017*.
- 108) Water injected into open-loop injection wells must be continuously metered at each wellhead at the injection site, and the measured volumes must be reported to Petrinex, as per section 15.2.4 of *Directive 017*.
- 109) Fluids used in closed-loop wells must be continuously metered and the pressure measured at
 - a) the wellhead before circulation downhole, and
 - b) at the wellhead after circulation uphole.
- 110) If the required metering and pressure measurement at closed-loop wells indicate an unexpected volumetric difference or pressure change, the licensee must investigate the cause and take corrective action as applicable.

7.3 Reporting Requirements

- 111) Licensees must meet the reporting requirements in *Directive 007: Volumetric and Infrastructure Requirements*. Refer to *Manual 011: How to Submit Volumetric Data to the AER* for information on how to submit the volumetric data.
- 112) Licensees must report any incidentally produced hydrocarbons as per *Directive 007*.

7.3.1 Well Status Codes for Petrinex Reporting

113) Licensees must use the well status codes in table 2 for reporting volumetric data to Petrinex for the various types of geothermal configurations.

Contact Production Accounting at the AER (PA.Help@aer.ca) for help changing well status codes.

Table 2. Well status codes for Petrinex reporting

Geothermal configuration	Geothermal well type	Well status codes			
		Fluid	Mode	Type	Structure
Single-well closed-loop configuration (single well with two different event sequences)	Geothermal circulation	Water	Potential	Injection	N/A
	Geothermal circulation	Water	N/A	Source	N/A
Multiple-well closed-loop configuration	Geothermal circulation: In	Water	Potential	Injection	N/A
	Geothermal circulation: Out	Water	N/A	Source	N/A
Open-loop configuration	Geothermal injection	Water	Potential	Injection	N/A
	Geothermal production	Water	N/A	Source	N/A

7.3.2 Facility Subtypes for Petrinex Reporting

114) Licensees must use the facility subtype and product codes in table 3 to report volumetric data to Petrinex.

Contact Production Accounting at the AER (PA.Help@aer.ca) for help setting up the facility subtype.

Table 3. Facility subtype and product codes for Petrinex reporting

Geothermal configuration	Geothermal well types	Facility subtype	Subtype code	Linked well types	Activity code	Product codes
Single-well closed-loop configuration	Geothermal circulation	AER-issued enhanced recovery injection facility	508	Water potential well	Injection (INJ)	WATER
	Geothermal circulation			Water source well	Production (PROD)	BRKWTR*
Multiwell closed-loop configuration	Geothermal circulation: In	AER-issued enhanced recovery injection facility	508	Water potential well	Injection (INJ)	WATER
	Geothermal circulation: Out			Water source well	Production (PROD)	BRKWTR*
Open-loop configuration	Geothermal injection	AER-issued enhanced recovery injection facility	508	Water potential well	Injection (INJ)	BRKWTR
	Geothermal production			Water source well	Production (PROD)	BRKWTR, OIL, GAS

* Although brackish water is not used in closed-loop configurations, this code must be used for the circulation fluid.

7.3.3 Annual Reporting

115) The licensee must annually compile the following data for the previous calendar year and email it to Geothermal.DataSubmission@aer.ca by June 30:

- a) For open-loop wells,
 - i) monthly representative compositions of production fluids.
- b) For all wells, including open-loop,
 - i) bottomhole monthly minimum, average, and maximum temperature (°C), and
 - ii) wellhead monthly minimum, average, and maximum temperature (°C) (excluding observation wells).
- c) For commercial heating, the total monthly heat displaced (kJ), including how it was calculated (i.e., measurement points and parameters).

- d) For commercial power, the total monthly power generated, exported, and imported (kW), including how these numbers were calculated (i.e., measurement points and parameters).
 - e) For surface deformation, if applicable,
 - i) a summary of the results from implementing the monitoring and mitigation plan, including measurements of any surface deformations, and
 - ii) a description of activities taken to mitigate any surface deformations.
- 116) The licensee must annually compile all geothermal observation well data for the previous calendar by June 30 and submit the compiled data to the AER on request.

Appendix 1 Transfer Application Declaration

In submitting this application as transferor or transferee, you hereby declare the following:

- Your use of the confidential identification code and password for submission of this application has been duly authorized by your company (transferor/transferee), and the confidential identification code and password used are equivalent to and have the same binding effect as a signature executed by a duly authorized representative of the transferor/transferee company.
- You have the authority to make these (and the following, if transferee) statements and thereby bind your company.
- The information in the application is complete and accurate.

In submitting this application as transferee, you declare that the transferee

- holds valid surface access rights for all wells, pipelines and, facilities included in this application;
- holds valid mineral rights for all licensed producing wells included in this application;
- has the right to produce, inject, or dispose of fluids for all licensed active wells included in this application;
- is a working interest participant in all wells and facilities included in this application; and
- will ensure that all applicable AER signage requirements are met as required, including erecting or changing signs to accurately reflect the new licensee name and contact, and accepts and assumes the responsibilities and obligations of a licensee as provided for in law, including the *Oil and Gas Conservation Act*, *Oil and Gas Conservation Rules*, *Pipeline Act*, *Pipeline Rules*, *Geothermal Resource Development Act*, *Geothermal Resource Development Rules*, and AER directives and requirements.

For pipeline licence transfers only:

- The **transferor** hereby confirms that it has collected and retained all records required under the *Pipeline Rules* and *Canadian Standard Association Z662: Oil and Gas Pipeline Systems*. The transferor confirms that it has provided these records to the transferee by the effective date of the licence transfer.
- The **transferee** hereby confirms that it has received all records required to be collected and retained under the *Pipeline Rules* and *Canadian Standard Association Z662: Oil and Gas Pipeline Systems* from the transferor. The transferee is responsible for producing these records on request by the AER. Failure to do so constitutes a noncompliance of AER requirements.