CanGEA
CANADIAN GEOTHERMAL ENERGY ASSOCIATION

"Accelerate Canadian exploration and development of geothermal resources in order to provide secure, clean and sustainable energy"

5,000 MW BY 2015!

THE CANADIAN GEOTHERMAL CODE FOR PUBLIC REPORTING

REPORTING OF EXPLORATION RESULTS, GEOTHERMAL RESOURCES AND GEOTHERMAL RESERVES

2010 EDITION

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INTRODUCTION

The Canadian Geothermal Code Committee (the Committee), sponsored by the Canadian Geothermal Energy Association (CanGEA), was established in December 2008 to develop a Code for Public Reporting of Geothermal Resources and Reserves. CanGEA's sister organization, AGEA (Australian Geothermal Energy Association) recently collaborated with the Australian Geothermal Energy Group to jointly produce a methodology for estimation and quantification of Geothermal Resources and Reserves. The resulting document, The Geothermal Reporting Code (2008 Edition) was the world's first Code for public reporting of geothermal data. Key elements of the Australian Code have been adopted and/or formed the basis of the Canadian Geothermal Code for Public Reporting.

The Canadian Code will provide a basis for transparency, consistency and confidence in public reporting of geothermal information with the following primary objectives:

1. Provide a reporting basis that is satisfactory to investors, shareholders and capital markets, such as the Canadian Securities Exchanges, in a similar manner that existing Canadian Instruments provide for reporting of Mineral and Petroleum Resources (National Instruments 43-101 and 51-101, respectively).

2. Be applicable to geothermal plays in both Canada and internationally since the Canadian Securities Markets are utilized for the exploration and development of both national and international geothermal plays for companies based in Canada and other jurisdictions.

This document is the Canadian Geothermal Reporting Code for Public Reporting (the "Geothermal Code" or "Code"). It outlines the requirements for reporting of Exploration Results, Geothermal Resources and Geothermal Reserves and provides a minimum set of requirements for the public reporting of Geothermal Resources and Reserves. The Canadian Code will serve as an industry self-regulation and will be on a voluntary compliance basis for 2010. The Code is intended for all publically listed companies on Canadian Exchanges and all other private and public companies benchmarked against Canadian industry standards.

Reference in the Geothermal Code for Public Reporting relates to a report or reporting on Exploration Results, Geothermal Resources and/or Reserves, prepared for the purpose of informing investors or potential investors and their advisors. This includes a report or reporting to satisfy regulatory requirements.

It is anticipated that the reporting of Exploration Results and Geothermal Resource and Reserve assessments will principally be undertaken by companies exploring or operating geothermal properties. Reports may also be issued by other entities such as non-operating joint venture companies, government regulatory agencies or academic institutions.

The Geothermal Code is intended to be a living document and it is recognized that further consultation, presentations and stakeholder input will be required during implementation, since reporting of geothermal results through the Canadian Securities Exchanges is relatively recent. Once established, however, it will require a formal process to change. This process will be managed initially through CanGEA. The process for managing the Geothermal Code is anticipated to evolve over time as the practical application of the Code progresses.

ACKNOWLEDGMENT

Since key elements of this Geothermal Code were adopted from the Australian Code, the work performed by the Australian Geothermal Code Committee (AGCC) is recognized as forming an essential part of the development of a Canadian Code. The AGCC acknowledged that the Australian Code was based closely on that of the Joint Ore Reserves Committee's "Australian Code for the Reporting of Exploration Results, Mineral Resources and Ore Reserves" (the JORC Code 2004 Edition), and the development of the Australian Code included the support of the JOR Committee.

FORMAT

In this edition of the Geothermal Code some guidelines are placed after the respective Code clauses using indented italics. They are intended to provide assistance and guidance to readers. They do not form part of the Geothermal Code, but should be considered pertinent when interpreting the Geothermal Code. Tables A - H and Form 1 are also intended to provide guidance to the reader.

GOVERNING PRINCIPLES

The main principles governing the operation and the application of the Geothermal Code are transparency, materiality and competence.

A) **Transparency** requires that the reader of a public report is provided with sufficient information, the presentation of which is clear and unambiguous, to understand the report and is not misled.

B) **Materiality** requires that a public report contains all relevant information which investors and their professional advisors would reasonably require, and reasonably expect to find in the report, for the purpose of making a reasoned and balanced judgment regarding the Exploration Results, Geothermal Resources or Reserves being reported.

C) **Competence** requires that the Public Report be based on work that is the responsibility of suitably qualified professionals who are members of recognized, relevant professional organizations (subject to accountability and a professional Code of Ethics) as well as members in good standing of the Canadian Geothermal Energy Association.

SCOPE

Geothermal Energy is the energy in form of heat beneath the surface of the solid Earth. The Geothermal Code is relevant to all end uses of geothermal energy (including naturally permeable aquifers, engineered geothermal systems and both magmatic and non-magmatic heat sources) and all forms of end-use applications of geothermal energy (including electricity generation and direct use projects). Ground source heat pumps operating at low temperatures are excluded from coverage by the Geothermal Code. In this context "geothermal energy" is taken to include only thermal energy from the Earth to which legal rights of extraction can, in principle, be obtained (in most jurisdictions this will only apply above a minimum certain temperature).

The Geothermal Code is a required minimum standard for Public Reporting. Companies are encouraged to provide information in their Public Reports which is as comprehensive as possible.

Public Reports include any form of publication of Exploration Results, Geothermal Resource and/or Reserve assessments. They may include but are not limited to:

- *Company annual reports, quarterly reports and other reports to the Canadian Securities Exchanges, and/or other organizations required by law.*
- *Company information in the form of postings on company web sites.*
- *Information releases, briefings or updates for shareholders, stockbrokers and investment analysts.*
- *Reports, if they have been prepared for the purpose of informing investors, including: environmental statements, information memoranda, expert reports, and technical papers.*

For companies issuing public reports with abbreviated information, or other such summary reports, inclusion of all material information concerning Exploration Results, Geothermal Resources and/or Reserves is recommended. In cases where summary information is presented it should be clearly stated that it is a summary, and a reference attached giving the location of the Geothermal Code-compliant Public Report, on which the summary is based.

It is recognized that companies may be required to issue reports into more than one regulatory jurisdiction, with compliance standards that may differ from this Geothermal Code. It is recommended that such reports include a statement alerting the reader to this situation.

The term 'regulatory requirements' is not intended to cover reports provided to Provincial and Federal Government agencies for statutory purposes, where providing information to the investing public is not the primary intent. If such reports become available to the public, they would not normally be regarded as Public Reports under the Geothermal Code.

Reference in the Geothermal Code to "documentation" is to company documents prepared as a basis for, or to support, a Public Report.

It is recognized that situations may arise where documentation prepared by Qualified Persons for internal company or similar non-public purposes may not comply with the Geothermal Code. In such situations, it is recommended that the documentation include a prominent statement to this effect. This may reduce the likelihood that such non-complying documentation will be relied upon if made public.

While every effort has been made within the Geothermal Code to cover most situations likely to be encountered in Public Reporting, there may be occasions when doubt exists as to the appropriate form of disclosure. On such occasions, users of the Geothermal Code and those compiling reports to comply with the Geothermal Code should be guided by its intent, which is to provide a minimum standard for Public Reporting and to ensure that such reporting contains all information which investors and their professional advisors would reasonably expect to find in the report, for the purpose of making a reasoned and balanced judgment regarding the Exploration Results, Geothermal Resources or Reserves being reported.

COMPETENCE AND RESPONSIBILITY

A Public Report concerning a company's Exploration Results, Geothermal Resources and/or Reserves is the responsibility of the company. Any such report must be based on, and fairly represent, the information and supporting documentation prepared by, or under the direction of, a Qualified Person or Persons. A Public Report must provide the name(s) of the Qualified Person or Persons, the name of the company issuing the report, state whether the Qualified Person(s) are independent of the company and, if independent, the name of the company contracted to complete the report. The Public Report may be issued subsequent to written consent of the Qualified Person or Persons, providing the form and context of the consent is consistent with the Report.

An example of an appropriate form of compliance statement is as follows:

"The information in this report that relates to Exploration Results, Geothermal Resources or Geothermal Reserves is based on information compiled by (insert name of Qualified Person) of (company) who are responsible for its contents and are "Qualified Persons" under the Code."

Documentation detailing Exploration Results, Geothermal Resource and/or Reserve estimates, which a Public Report on Exploration Results, Geothermal Resources and/or Reserves is based must be prepared by, or under the direction of, and signed by, a Qualified Person or Persons. The documentation must provide an accurate

representation of the Exploration Results, Geothermal Resources and/or Reserves being reported. In many jurisdictions, if the information provided is for government reporting, or is likely to become public, the estimation and disclosure processes may be considered to be professional activity, and as such may be governed by applicable professional regulations.

A 'Qualified Person' must have a minimum of five years experience and professional registration with an Association that has a governing Code of Ethics or equivalent. As well, if the Qualified Person is not a member of a professional organization, but believes themselves qualified for the expertised efforts provided, they should clearly state that they are not a professional, and provide a summary of their credentials, and state the reasons that they believe they are qualified for the work provided. The Qualified Person or company contracted to complete reporting must be a member in good standing of CanGEA.

Experience must be relevant to the type of Geothermal Play under consideration and to the activity that the person is undertaking. If the Qualified Person is preparing a report on Exploration Results, the experience must be relevant to Geothermal Exploration. If the Qualified Person is estimating or supervising the estimation of Geothermal Resources, the experience must be relevant to the estimation, assessment and evaluation of Geothermal Resources. If the Qualified Person is estimating or supervising the estimation of Geothermal Reserves, the experience must be relevant to the estimation, assessment, evaluation and economic extraction of Geothermal Reserves.

> *The key qualifiers in the definition of a Qualified Person is the word 'relevant'. Determination of what constitutes relevant experience can be a difficult area and common sense has to be exercised. The key word 'relevant' also means that it is not always necessary for a person to have five years experience in each and every type of Geothermal Play in order to act as a Qualified Person if that person has relevant experience in other system types.*
>
> *In addition to experience in the type of Geothermal Play, a Qualifed Person taking responsibility for the compilation of Exploration Results or Geothermal Resource and/or Reserve estimates should have sufficient experience in the data gathering and the analytical techniques relevant to the Geothermal Play under consideration to be aware of problems which could affect the reliability of data. Some appreciation of heat extraction and energy conversion techniques applicable to the type of Geothermal Play may also be important.*
>
> *As a general guide, persons being called upon to act as Qualified Persons should be clearly satisfied in their own minds that they could face their peers and be asked to demonstrate competence in the type of Geothermal Play and situation under consideration. If doubt exists, the person should either seek opinions from appropriately experienced colleagues or refer the client to other persons with that experience or should decline to act as a Qualified Person.*

Estimation of Exploration Results, Geothermal Resources or Geothermal Reserves may be a team effort (for example, involving two persons or a multidisciplinary team with segregation of duties). It is recommended that, where there is clear division of responsibility within a team, each Qualified Person and his or her contribution should be identified and responsibility accepted for that particular contribution. If only one Qualified Person signs the Exploration Results, Geothermal Resources or Geothermal Reserves documentation, that person is responsible and accountable for the whole of the documentation under the Code. It is important in this situation that the Qualified Person accepting overall responsibility for Exploration Results, Geothermal Resources or Geothermal Reserves estimates and supporting documentation has been prepared in whole or in part by others, is satisfied that the work of the other contributors is acceptable. Professional regulations restrict the type of work that the Qualified Person can authenticate, so it is important that the report states the capacity in which they are signing the report.

CATEGORIES OF GEOTHERMAL RESOURCES AND RESERVES

Categories of Geothermal Resources and Reserves are important to provide explicit understanding of the certainty (quality and reliability) of the information that is used to define their magnitude. The classification regime used by the Geothermal Code is illustrated in Figure 1. Some explanation and definitions of the categories are given below and are summarized in Table 1.

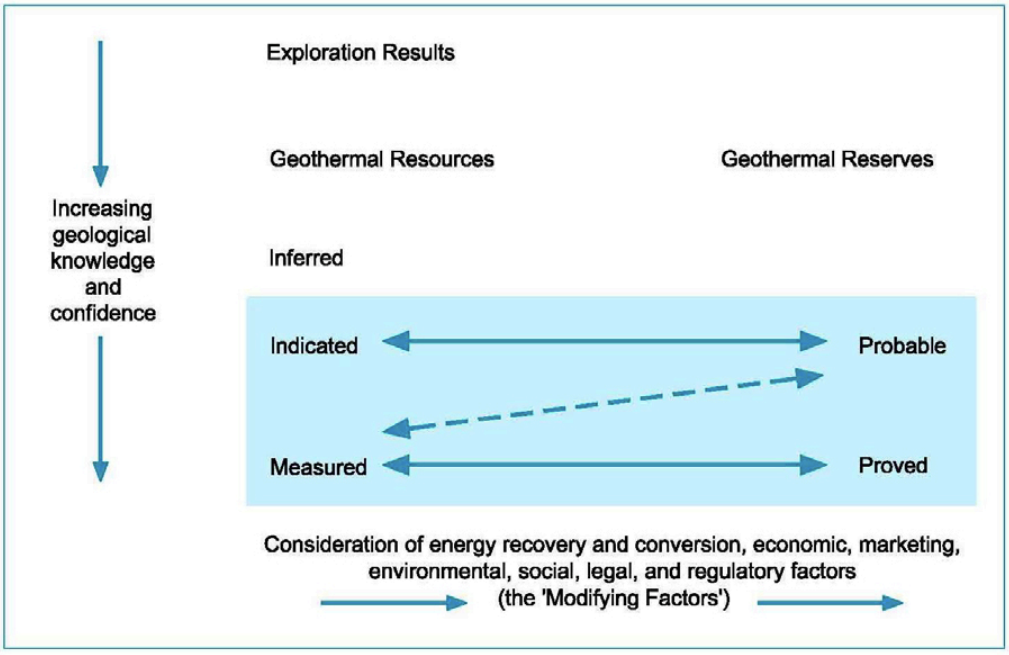

Figure 1. Relationship between Exploration Results, Geothermal Resources and Geothermal Reserves. Source: Australian Geothermal Energy Association. The Geothermal Reporting Code. 2008 Edition.

The Geothermal Code recognizes three levels of Geothermal Resource (Inferred, Indicated and Measured) based upon increasing levels of geological knowledge and confidence which directly affect the assessment of the probability of occurrence. Geothermal Resources by consideration and application of "Modifying Factors", which directly affect the likelihood of commercial delivery (production, economic, marketing, legal, environmental, land access, social and government factors), form Geothermal Reserves. Two categories of Geothermal Reserves are recognized (Probable and Proved) based upon confidence in both the underlying Geothermal Resource estimate and in the Modifying Factors. General relationships and pathways between the various Geothermal Resource and Reserve categories that are permitted under the Geothermal Code are as shown.

REPORTING TERMINOLOGY

Public Reports dealing with Exploration Results, Geothermal Resources and/or Reserves must only use the categories set out in Figure 1.

Figure 1 sets out the framework for Geothermal Resources and Reserves estimates to reflect different levels of geological confidence and different degrees of technical and economic evaluation. Geothermal Resources will usually be estimated by a geologist on the basis of geoscientific information with some input from other disciplines. Geothermal Reserves, which are a modified sub-set of the Indicated and Measured Geothermal Resources, require consideration of the Modifying Factors affecting extraction and energy conversion and should in most instances be estimated with input from a range of disciplines.

Neither Geothermal Resources nor Geothermal Reserves are precise calculations.

> *To emphasize the imprecise nature of Geothermal Resources and Reserves estimates, the final results should always be referred to as 'estimates' and not as 'calculations'.*

Geothermal Resources and Reserves should be reported in units of **Recoverable Thermal Energy** in the play i.e. Megawatts (MWth-years) relative to defined base and cut-off temperatures. If thermal energy is to be converted into other forms of energy, such as electricity, then units appropriate to the net transformed energy should be used for assessments (i.e. recoverable electrical energy by multiplying the thermal energy in place by the thermal energy recovery factor and the power conversion efficiency). In all cases, the subscripts "thermal / th" or "electrical / e" must be used to distinguish thermal from converted electricity generation and all recovery and conversion factors used must be stated separately and clearly.

Geothermal Reserves should be associated with an identified development plan and, if applicable, a plan for all or part of the Geothermal Resource (i.e. you may have a project producing power with plans to expand it). For example, Geothermal Reserves used to generate electrical energy should be reported as either the net rate of generation for the life of the project (e.g. x MWe for y years) or the net total saleable energy generated over the life of the project (e.g. GWh). The production rates associated with extraction should be reported in thermal power units as MWe.

> *The net transformed electrical energy will usually be that energy which is available for sale at the output terminals of the first power sub-station or grid connection.*

The term **'Geothermal Play'** is used as an informal qualitative descriptor for an accumulation of heat energy within the earth's crust. It can apply to heat contained in rock and/or in fluid. It has no connotations as to permeability or the recoverability of the energy. A Geothermal Play does not necessarily imply the existence of Geothermal Resources or Reserves and quantitative amounts of energy should not be reported against it.

The term **'Modifying Factors'** is defined to include energy recovery and conversion, production, economic, marketing, environmental, social, legal, land access and regulatory factors.

REPORTING –GENERAL

1. Public Reports concerning a company's Exploration Results should include appropriate data presented in a way that has no implication regarding commerciality and should not include any assessment of the energy quantum.

2. Public Reports concerning a company's Geothermal Resources should, as a minimum, include an estimate of thermal energy in place is the estimated recoverable thermal energy. It must be stated in terms of recoverable thermal energy relative to defined base and cut-off temperatures. Where practicable, the gross and net transformed energy should be reported in appropriate units (MWe) for Indicated and Measured Resources, for projects intended for power generation.

3. Public Reports concerning a company's Geothermal Reserves should include estimates of recoverable thermal energy under the same conditions and parameters as for Resources in (2) above. Geothermal Reserves requires that Modifying Factors have been applied, and therefore the project be defined and the associated expected economically recoverable thermal energy is estimated. In this case the quantum of saleable energy should also be reported, for example, x MWe for y years or GWh over the economic life of a power generation project.

Examples of other potential key parameters can be found in Form 1.

4. A company must disclose all relevant information concerning a Geothermal Reserve that could materially influence the economic value of that Reserve to the company. A company must promptly report any material changes in its Geothermal Resources or Geothermal Reserves.

5. If made Public, Companies must review and publicly report on their Geothermal Resources and Geothermal Reserves at least annually.

Tables A - H provide a list of the main criteria which should be considered when preparing reports on Exploration Results, Geothermal Resources and Geothermal Reserves. These criteria need not be discussed in a Public Report unless they materially affect estimation or classification of a Geothermal Resource or Reserve.

It is not necessary when publicly reporting to comment on each item in Tables A - H, but it is essential to discuss any matters which might materially affect the readers understanding or interpretation of the results or estimates being reported. This is particularly important where inadequate or uncertain data affect the reliability of, or confidence in, a statement of Exploration Results or an estimate of Geothermal Reserves, for example, poor repeatability of down hole measurements, etc.

If there is doubt about what should be reported, it is better to err on the side of providing too much information rather than too little. Uncertainties in any criteria that could lead to an under-or over statement of Geothermal Resources or Reserves estimates should be disclosed in accordance with the governing principals of Transparency, Materiality and Competence.

REPORTING OF EXPLORATION RESULTS

6. Exploration results include data and information generated by exploration programs. The Exploration Results may or may not be part of a formal declaration of Geothermal Resources or Geothermal Reserves.

The reporting of such information is common in the early stages of the exploration when the quantity of data available is generally not sufficient to allow any reasonable estimates of Geothermal Resources.

If a company reports Exploration Results they must not include any assessment of thermal energy in place or recoverable thermal energy or net energy available for sale. They should state whether or not the actual reservoir measurements have been undertaken or sampling has been conducted and, if so, should include both the measured values and the associated depth. Where Exploration Results include analogs, modeled or extrapolated data, the rationale for prediction should be discussed. An assessment of the reliability or accuracy of the estimate should be provided. Public Reports of Exploration Results must not be presented to unreasonably imply that potentially economically extractable energy has been discovered.

Examples of Exploration Results include results of hot springs or fumarole sampling, surface heat flow, geochemical results and geophysical survey results, rock property measurements, temperature measurements and temperature extrapolations (to a reasonable degree and on a rational basis).

Reports of borehole temperature measurements should state the duration of time elapsed between the end of drilling and/or the end of the most recent circulation in the hole prior to the recording of the temperature so as to give some indication of whether or not the measurements reflect the true reservoir temperature.

7. Public Reports of Exploration Results must contain sufficient information to allow a considered and balanced judgment of their significance. Reports must include relevant information such as exploration context, type, and method of surface sampling, type and method of geochemical analysis, type and method of geophysical surveys, lease status plus information on any of the other criteria that are material to an assessment. Where analytical or measurement results are reported, the report must include all results, along with sample type, location, analytical methods, etc. Reporting of selected information such as measurements from isolated boreholes or surface samples, without placing them in perspective, is unacceptable.

8. It is recognized that it is common practice for a company to comment on and discuss its exploration in terms of target size and type. Any such information relating to exploration targets must be expressed so that it cannot be misrepresented or misconstrued as an estimate of Geothermal Resources or Geothermal Reserves. The terms Resource(s) or Reserve(s) must not be used in this context. Any statement referring to a potential quantity of thermal energy or recoverable thermal energy must be expressed as ranges and must include a detailed explanation of the basis for the statement that the potential quantity of energy is conceptual in nature, that there has been insufficient exploration to estimate a Geothermal Resource and that it is uncertain if further exploration will result in the determination of a Geothermal Resource.

REPORTING OF GEOTHERMAL RESOURCES

9. A 'Geothermal Resource' is a Geothermal Play which exists in such a form, quality and quantity that there are reasonable prospects for eventual economic extraction. If there is no prospect for eventual economic extraction then the body of heat should not be included in estimates of Geothermal Resources or Geothermal Reserves. The location, quantity, temperature, geological characteristics and extent of Geothermal Resource are known, estimated or interpreted from specific geological evidence and knowledge. Geothermal Resources are sub-divided, in order of increasing geological confidence, into Inferred, Indicated and Measured categories.

   Portions of a Geothermal Play that do not have reasonable prospects for eventual economic extraction must not be included in a Geothermal Resource. If the judgment as to 'eventual economic extraction' relies on untested technology, practices or assumptions, this is a material matter which must be disclosed in a public report (e.g. recovery of supercritical geothermal water).

   If the reporting of Geothermal Resources includes estimates of end use energy, for example electricity that may be generated, the report must refer to reasonable and defendable factors pertaining to energy conversion related to likely end use.

   The term 'Geothermal Resource' covers those Geothermal Plays which have been identified and estimated through exploration and sampling and within which Geothermal Reserves may eventually be estimated by reduction of the risk after the consideration and application of the Modifying Factors.

   The term 'reasonable prospects for eventual economic extraction' implies a judgment (albeit preliminary) by the Qualified Person in respect of the technical and economic factors likely to

influence the prospect of economic extraction, including the approximate exploitation parameters. In other words, a Geothermal Resource is not an inventory of all heated areas drilled or sampled, regardless of base or cut-off temperature, likely dimensions, location or extent. It is a realistic inventory of those Geothermal Plays which, under assumed and justifiable technical and economic conditions, might, in whole or in part, be developed.

When considered appropriate by the Qualified Person, Geothermal Resource estimates may include a small portion of the Geothermal Play below the selected cut-off temperature providing that the total Geothermal Resource retains reasonable prospects for eventual economic extraction.

Documentation of Geothermal Resource estimates should clearly identify any known potential risks, including geological factors such as faults, which could prejudice production or be sources of cool fluid intrusion which could degrade the Geothermal Resource. Public Reports should include commentary on such matters wherever they are considered material by the Qualified Person(s) responsible for the Public Reports. Any material assumptions made in determining the 'reasonable prospects for eventual economic extraction' should be clearly stated in the Public Report. Interpretation of the word 'eventual' may vary depending on the context of the project.

Any assumptions made on the basis of the data for the purpose of making the Geothermal Resource estimate, for example by interpolation or extrapolation, should be clearly stated and described in the Public Report.

Certain reports (e.g. inventory well reports, exploration reports to government and other similar reports or other geoscientific information not intended primarily for providing information for investment purposes) may require full disclosure of all potential thermal energy extractions, including some Geothermal Plays that do not have reasonable prospects for eventual economic extraction. Such estimates of extraction would not qualify as Geothermal Resources or Geothermal Reserves in terms of this Geothermal Code and this should be clearly stated in the respective reports.

10. An **'Inferred Geothermal Resource'** is that part of a Geothermal Resource for which recoverable thermal energy (MWth-years) can be estimated only with a low level of confidence. Assumptions made in making the estimate must be stated, especially in respect of the base and cut-off temperatures and the technology pathway for usage. If there is a reasonable basis to do so, convertibility into electricity can be assessed and an additional estimate of the recoverable, converted electrical energy may be stated using units of MWe-years. The recovery and conversion factors (if used) must be separately stated alongside the Geothermal Resource figure. This category of Geothermal Resource is inferred from geosciences, engineering and geophysical evidence and is assumed but not verified as to its extent or capacity to deliver geothermal energy. There must be a sound basis for assuming that a Geothermal Play exists, estimating the temperature and having some indication of its extent.

The Inferred category is intended to cover situations where a Geothermal Play has been identified and limited measurements and sampling completed, but where the data are insufficient to allow the extent of the Geothermal Resource to be confidently interpreted. It is based mainly on indirect measurements, for example extrapolation of temperature profiles (to a reasonable degree and on a rational basis) and other associated measurements such as rock properties and heat flow, and requires a reasonably sound understanding of the subsurface geology in three dimensions derived, for example, from geophysical surveys, to indicate temperature and dimensions.

Commonly, it would be reasonable to expect that the majority of Inferred Geothermal Resources would be upgraded to Indicated Geothermal Resources with continued and reasonably proximate exploration such as drilling and testing. However, due to uncertainty of Inferred Geothermal Resources, it should not be assumed that such upgrading would always occur.

Confidence in the estimate of Inferred Geothermal Resources is usually not sufficient to allow the results of the application of technical and economic parameters to be used for detailed planning. For this reason, there is no direct link from an Inferred Resource to any category of Geothermal Reserves. Caution should be exercised if this category is considered in studies of technical and economic viability.

11. An **'Indicated Geothermal Resource'** is that part of a Geothermal Resource which has been demonstrated to exist through direct measurements that indicate temperature and dimensions so that recoverable thermal energy (MWth-years) can be estimated with a reasonable level of confidence. Thermal energy in place has been estimated through direct measurements and assessments of volumes of hot rock and fluid with sufficient indicators to characterize the temperature and chemistry. Direct measurements are sufficiently spaced so as to indicate the extent of the thermal energy in place. Assumptions made in making the estimate must be stated, especially in respect of the base and cut-off temperatures and the technology pathway for usage. If there is a reasonable basis to do so, convertibility into electricity can be assessed and an additional estimate of the recoverable, converted electrical energy may be stated using units MWe-years. The recovery and conversion factors (if used) must be separately stated alongside the Geothermal Resource figure.

A Geothermal Play can be classified as an Indicated Geothermal Resource when there has been sufficient delineation drilling, testing and other survey information into the Play such that the nature, quality, amount and distribution of data allow confident interpretation of the geological framework, the assumption of continuity of the thermal energy distribution and a reasonable estimate of the extent of the Play. For an Indicated Geothermal Resource the well locations would be too widely or inappropriately spaced to confirm reservoir continuity but would be spaced closely enough for continuity to be indicated.

An Indicated Geothermal Resource has a lower level of confidence than that applying to a Measured Geothermal Resource, but has a higher level of confidence than that applying to an Inferred Geothermal Resource. Confidence in the estimate is sufficient to allow the application of technical and economic parameters, and to enable an initial evaluation of economic viability.

12. A **'Measured Geothermal Resource'** is the part of a Geothermal Resource which has been demonstrated to exist through direct measurements that indicate at least reservoir temperature, reservoir volume and well deliverability, so that recoverable thermal energy (MWth-years) can be estimated with a high level of confidence. The thermal energy in place has been demonstrated to exist through direct measurements and assessments of drilled and tested volumes of rock and/or fluid where well deliverability has been demonstrated, and which have sufficient indicators to characterize the temperature and chemistry. Direct measurements must be sufficiently spaced to confirm continuity. Assumptions made in making the estimate must be stated, especially in respect of the base and cut-off temperatures and technology pathway for usage. If there is a reasonable basis to do so, convertibility into electricity can be assessed and an additional estimate of the recoverable, converted electrical energy may be stated using units of MWe-years. The recovery and conversion factors (if used) must be separately stated alongside the Geothermal Resource figure.

A Geothermal Play may be classified as a Measured Geothermal Resource when the nature, quality, amount and distribution of data are such as to provide reasonable certainty in the opinion of the Qualified Person determining the Geothermal Resource, that the thermal energy in place

can be estimated to within close limits and that any variation from the estimate would be unlikely to significantly adversely affect potential economic viability. This category requires a high level of confidence in, and understanding of the dynamics of the heat source.

Confidence in the estimate is sufficient to allow the application of technical and economic parameters and to enable an evaluation of economic viability that has a greater degree of certainty than an evaluation based on an Indicated Geothermal Resource.

13. The choice of the appropriate category of Geothermal Resource depends upon the quantity, distribution and quality of data available and the level of confidence that attaches to those data. The appropriate Geothermal Resource category must be determined by a Qualified Person.

Geothermal Resource classification is a matter for skilled judgment of Qualified Persons.

In deciding between Measured Geothermal Resources and Indicated Geothermal Resources, Qualified Persons shall consider the definition for Measured Geothermal Resources that any variation from the estimate would be unlikely to significantly affect potential economic viability.

In deciding between Indicated Geothermal Resources and Inferred Geothermal Resources, Qualified Persons shall take into account the definition for Indicated Geothermal Resources which states that 'an "Indicated Geothermal Resource" is that part of a Geothermal Resource which has been proved to exist through direct measurements that indicate temperature and dimensions so that the thermal energy in place or transformed energy can be estimated with a reasonable level of confidence.' This contrasts with the definition for Inferred Geothermal Resources which states that these are '…based mainly on indirect measurements, for example extrapolation of temperature profiles (to a reasonable degree and on a rational basis) and other associated measurements, for example, from geophysical surveys to indicate temperature and dimensions.'

The Qualified Person should take into consideration issues of the type of heat extraction (e.g. pumped or non-pumped) and cut-off temperature when assessing continuity. The cut-off temperature chosen for the estimation should be realistic in relation to the technology pathway for the recoverable thermal energy.

14. Geothermal Resources estimates may not be precise calculations, being dependent on the interpretation of limited information on the location, depth and the extent of the body of heat and on the available geoscientific results. Reporting of thermal energy in place and recoverable thermal energy or transformed energy figures should reflect the relative certainty of the estimate. Rounding off values to appropriately significant figures and, in the case of Inferred Geothermal Resources, by qualification with terms such as 'approximately'.

In most situations, rounding to the second significant figure should be sufficient. For example: 30 MWth and 6.5 MWe. There will be occasions, however, where rounding to the first significant figure may be necessary in order to convey properly the uncertainties in estimation. This would usually be the case with Inferred Geothermal Resources.

To emphasize the imprecise nature of a Geothermal Resource estimate, the final result should always be referred to as an estimate, not a calculation.

Qualified Persons are encouraged, where appropriate, to discuss the relative accuracy and/or confidence of the Geothermal Resource estimates. Where a statement of the relative accuracy and/or confidence is not possible, qualitative discussion of the uncertainties should be provided.

15. Public Reports of Geothermal Resources must specify one or more of the categories of 'Inferred', 'Indicated' and 'Measured'. Categories must not be reported in a combined form unless details for the individual categories are also provided. Geothermal Resources must not be added to Geothermal Reserves.

    Public Reporting of thermal energy in place, recoverable thermal energy or transformed energy outside the categories covered by the Code is not permitted unless the situation is covered by Clause 9, and then only strict accordance with the requirements of that clause.

    Estimates of thermal energy in place, recoverable thermal energy or transformed energy outside of the categories covered by the Code may be useful for a company in its internal calculations and evaluation processes, but their inclusion in Public Reports could cause confusion.

16. The word 'Reserve' or 'Reserves' must not be used in describing Geothermal Resource estimates as the term implies technical feasibility and economic viability and is only appropriate when all relevant Modifying Factors have been considered. Reports and statements should continue to refer to the appropriate category or categories of Geothermal Resources until technical feasibility and economic viability have been established to an appropriate level of confidence. If re-evaluation indicates that the Geothermal Reserves are no longer viable, the Geothermal Reserves must be reclassified as Geothermal Resources or removed from Geothermal Resource/Geothermal Reserve statements.

    It is not intended that re-classification from Geothermal Reserves to Geothermal Resources or vice versa should be applied as a result of changes expected to be of a short term or temporary nature, or where company management has made a deliberate decision to operate on a non-economic basis. Examples of such situations might be energy price fluctuations expected to be of short duration, emergencies of non-permanent nature, transmission failure, etc.

REPORTING OF GEOTHERMAL RESERVES

17. A 'Geothermal Reserve' is that portion of an Indicated or Measured Geothermal Resource which is deemed to be economically recoverable after the consideration of both the Geothermal Resource parameters and the Modifying Factors. These assessments demonstrate, at the time of reporting, that energy extraction could reasonably be economically and technically justified.

    The term 'economically recoverable' implies that heat extraction of the Geothermal Reserve has been demonstrated to be viable under reasonable financial assumptions. What constitutes the term 'reasonably economically and technically justified' will vary with the type of Geothermal Play, the level of study that has been carried out and the financial criteria of the individual company.

    In order to achieve the required level of confidence in the Modifying Factors, appropriate studies will have been carried out prior to estimation of the Geothermal Reserves. The studies will have determined an exploration and development plan that is technically achievable and economically viable and from which the Geothermal Reserves can be derived. It may not be necessary for these studies to be at the level of a final feasibility study.

    The term 'Geothermal Reserve' need not necessarily signify that plant facilities are in place or operative, or that all necessary approvals or sales contracts have been received. It does signify that there are reasonable expectations of such approvals or contracts. The Qualified Person

should consider the materiality of any unresolved matter that is dependent on a third party which exploration and development is contingent.

If there is doubt about what should be reported, it is better to err on the side of providing too much information rather than too little.

Any adjustment made to the data for the purpose of making the Geothermal Reserve estimate, for example assumptions made regarding temperature measurements, should be clearly stated and described in the Public Report.

18. A **'Probable Geothermal Reserve'** is the economically recoverable part of an Indicated or Measured Geothermal Resource. It will differ from Proved Reserves because of greater uncertainty, usually in terms of factors that impact the recoverability of thermal energy such as well deliverability or longevity of the project. There will be sufficient geoscience and engineering indicators to characterize flow, temperature and chemistry but may be less direct measures indicating the extent of the Geothermal Resource, within an economically feasible drilling depth. Appropriate technical evaluation, assessments and studies will have been carried out, and include consideration of and modification by appropriate assumptions related to drilling, economic, legal, environmental, social, and governmental factors.

    A Probable Geothermal Reserve has a lower level of confidence than a Proved Geothermal Reserve but is of sufficient quality to serve as the basis for a decision on the development of the Geothermal Resource. It is 'more likely than not' that the Reserve estimate is correct, reflecting a greater than 50% chance of occurrence.

19. A **'Proved Geothermal Reserve'** is the economically recoverable part of a Measured Geothermal Resource. It includes a drilled and tested volume of rock within which well deliverability has been demonstrated and commercial production for the assumed lifetime of the project can be forecast with a high degree of confidence. In addition, Proved Geothermal Reserves will have undertaken appropriate assessments and studies, which include consideration of and modification by the assumed economic, market, legal, environmental, social and governmental factors. While these assessments demonstrate at the time of reporting that heat extraction could reasonably be economically justified, it is not until production is achieved which satisfies all the technical and Modifying Factors that is 'Proved'.

    A Proved Geothermal Reserve represents the highest confidence category of Geothermal Reserve estimate. The type of Geothermal Play or factors could mean that Proved Geothermal Reserves are not achievable in some parts of a Measured Geothermal Resource.

    Once a Geothermal Reserve has entered production and some reservoir response can be observed, classification of remaining Geothermal Reserves should become better defined. Geothermal Reserves under production should be re-estimated with reservoir models re-calibrated to produce new estimates which are more closely linked to observe temperature and pressure changes in the reservoir and related to the rate of energy recovery achieved.

20. The choice of the appropriate category of Geothermal Reserve is determined primarily by the relevant level of confidence associated with the Geothermal Resource, after including any uncertainties in the Modifying Factors. Allocation of the appropriate category must be made by a Qualified Person.

    The Geothermal Code provides for a direct two-way relationship between Indicated Geothermal Resources and Probable Geothermal Reserves and between Measured Geothermal Resources and Proved Geothermal Reserves. In other words, the level of geological confidence for Probable Geothermal Reserves is similar to that required for the determination of Indicated Geothermal

Resources, and the level of geological confidence for Proved Geothermal Reserves is similar to that required for the determination of Measured Geothermal Resources. Reserves, however, require development commitment and project derived positive economics.

The Geothermal Code also provides for a two-way relationship between Measured Geothermal Resources and Probable Geothermal Reserves. This is to cover a situation where uncertainties associated with any of the Modifying Factors considered when converting Geothermal Resources to Geothermal Reserves may result in there being a lower degree of confidence in the estimate of Geothermal Reserves than in the corresponding estimate of Geothermal Resources. Such a conversion would not imply a reduction in the level of geological knowledge or confidence.

A Probable Geothermal Reserve derived from a Measured Geothermal Resource may be converted to a Proved Geothermal Reserve if the uncertainties in the Modifying Factors are sufficiently reduced. No amount of confidence in the Modifying Factors for conversion of a Geothermal Resource to a Geothermal Reserve can override the upper level of confidence that exists in the Geothermal Resource. Under no circumstances can an Indicated Geothermal Resource be converted directly to a Proved Geothermal Reserve.

Application of the category of Proved Geothermal Reserve implies the highest degree of confidence in the estimate, with consequent expectations in the minds of the readers of the report. These expectations should be borne in mind when categorizing a Geothermal Reserve as Proved.

21. Geothermal Reserve estimates are not precise calculations. Reporting of recoverable energy should reflect the relative uncertainty of the estimate by rounding off to appropriately significant figures. Refer also to Clause 14.

To emphasize the imprecise nature of a Geothermal Reserve, the final result should always be referred to as an estimate not a calculation.

Qualified Persons are encouraged, where appropriate, to discuss the relative accuracy and/or confidence of the Geothermal Reserve estimates. Where a statement of the relative accuracy and/or confidence is not possible, a qualitative discussion of the uncertainties should be provided (Refer to Table G: Estimation of Geothermal Reserves).

22. Public Reports of Geothermal Reserves must specify one or both of the categories of "Proved" and "Probable". Reports must not contain combined Proved and Probable Geothermal Reserve figures unless the relevant figures for each of the categories are also provided.

Public reporting of recoverable thermal energy or transformed energy outside the categories covered by the Code is not permitted unless the situation is covered by Clause 8, and then only in strict accordance with the requirements of that clause.

Estimates of recoverable thermal energy or transformed energy outside of the categories covered by the Code may be useful for a company in its internal calculations and evaluation processes, but their inclusion in Public Reports could cause confusion.

When revised Geothermal Reserve and Geothermal Resource statements are publicly reported they should be accompanied by reconciliation with previous statements. A detailed account of differences between the figures is not essential, but sufficient comment should be made to enable significant changes to be understood by the reader.

23. In situations where figures for both Geothermal Resources and Geothermal Reserves are reported, a statement must be included in the report which clearly indicates whether the Geothermal Resources are inclusive of, or additional to Geothermal Reserves.

    Geothermal Reserve estimates should not be aggregated with the Geothermal Resource estimates to report a single combined figure. The resulting total may be misleading and capable of being misunderstood, or of being misused, or may lead to unclear results which result in a false impression of a company's prospects.

    In some situations there are reasons for reporting Geothermal Resources inclusive of Geothermal Reserves and in other situations for reporting Geothermal Resources additional to Geothermal Reserves. It must be made clear which form of reporting has been adopted. Appropriate forms of clarifying statements may be:

    'The Measured and Indicated Geothermal Resources are inclusive of those Geothermal Resources modified to produce the Geothermal Reserves', or 'The Measured and Indicated Geothermal Resources are additional to the Geothermal Reserves'.

    In the former case, if any Indicated and Measured Geothermal Resources have not been modified to produce Geothermal Reserves for economic or other reasons, the relevant details of these unmodified Geothermal Resources should be included in the report. This is to assist the reader of the report in making a judgment of the likelihood of the unmodified Geothermal Resources eventually being converted to Geothermal Reserves.

    Inferred Geothermal Resources are by definition always additional to Geothermal Reserves.

24. Tables E - G provide, in a summary form, a list of the criteria which should be considered when preparing reports on Exploration Results, Geothermal Resources and Geothermal Reserves. These criteria need not be discussed in a Public Report unless they materially affect estimation or classification of the Geothermal Reserves. Changes in economic or political factors alone may be the basis for significant changes in Geothermal Reserves and should be reported accordingly.

TABLE 1 SUMMARY OF RESOURCES AND RESERVES CLASSIFICATION

This table should be used as a guideline only for those preparing reports on Exploration Results, Geothermal Resources and Geothermal Reserves. For full formal definitions of Geothermal Resources and Reserves, please refer to the Code text.

		Resource			Reserve	
	Exploration Results	**Inferred**	**Indicated**	**Measured**	**Probable**	**Proved**
Commerciality	No implications regarding commerciality.	Commerciality not yet established. Possibly feasible with current or future technology, prevailing and/or more favourable market conditions.			Commercial. Feasible with existing technology and prevailing market conditions.	
Definition	Data from exploration that is of material value to Geothermal Resource estimation, but which in itself is insufficient to define a Geothermal Resource category.	The recoverable thermal energy within an area/volume that has enough direct indicators of Geothermal Resource character or dimensions to provide a sound basis for assuming that a body of thermal energy exists, estimating temperature and having some indication of extent.	The recoverable thermal energy within a more reliably characterized volume of rock than the Inferred Geothermal Resource. Sufficient indicators to characterize temperature and chemistry, although with a few direct measures indicating extent.	The recoverable thermal energy within a drilled and tested volume of rock within which well deliverability has been demonstrated, with sufficient indicators to characterize temperature and chemistry and with sufficient direct measurements to confirm the continuity of the reservoir.	Equivalent to an Indicated Resource for which commercial production for the assumed lifetime of the project can be forecast with sufficient confidence to be considered a Proved Reserve. The chance of occurrence is 'more likely than not'.	Applies directly to production satisfying all Modifying Factors. Directly related to a Measured Resource for which commercial production for the stated lifetime of the project can be forecast with a high degree of confidence.
Units	As appropriate.	Thermal energy in place (MWth) and recoverable thermal energy with assumptions and recovery factors stated.	Thermal energy in place (MWth) and recoverable thermal energy. May be reported as assumed electricity generation with assumptions, rate and recovery factors stated (MWe) or GWh in total.	Thermal energy in place (MWth) and recoverable thermal energy. May be reported as assumed electricity generation with assumptions, rate and recovery factors stated (MWe) or GWh in total.	Thermal energy in place (MWth) and recoverable thermal energy (PJ) defined in relation to a stated technology and recovery rate. Electricity generation should be presented as net electrical output (MWe) for a defined period or GWh in total.	Thermal energy in place (MWth) and recoverable thermal energy (PJ) defined in relation to a stated technology and recovery rate. Electricity generation should be presented as net electrical output (MWe) for a defined period or GWh in total.

TABLE 2 CHECK LIST OF ASSESSMENT AND REPORTING CRITERIA

These tables are checklists and guidelines which those preparing reports on Exploration Results, Geothermal Resources and Reserves should use as a reference. They are for guidance only and are not formally part of the Geothermal Code.

The checklist is not prescriptive. It is to identify parameters and assumptions used in geothermal exploration/development and to consider each of these from the viewpoint of the disclosure required for transparency and materiality and are overriding principles that determine what information should be publicly reported. It is, however, important to report any matters that might materially affect a reader's understanding or interpretation of the results or estimates being reported. This is particularly important where inadequate or uncertain data affect the reliability of, or confidence in, a statement of Exploration Results or an estimate of Geothermal Resources or Reserves.

The order and grouping of criteria reflects the normal systematic approach to geothermal exploration and evaluation. Criteria in the first group, 'A. Pre-Drilling Exploration Technical Data', may apply to all succeeding groups. In the remainder of the criteria listed in preceding groups would often apply to succeeding groups and should be considered when estimating and reporting. Thus, data required in group A may also be relevant to group B and data in groups A & B may be relevant to group C but that in C, for instance, may not be required for B. In group D, a distinction is made between those parameters more relevant to convetional resources and those more related to Engineered/Enhanced Geothermal Systems (EGS).

A. Pre-Drilling Exploration Technical Data

Parameters listed in this group may be required in all succeeding groups.

Criteria	Considerations
Geological Maps and Interpretation	• Nature and quality of available mapping (e.g. scale, completeness, age, authors, 2D, 3D, etc.) including basis for interpretation and any implications for likely Geothermal Resource types • Description of any relevant Geothermal Resources previously recorded in the vicinity or same geological province
Data Location and Spacing	• Adequacy of base maps • Methodology and quality of sample location (e.g. GPS, etc.) • Datum and projection used along with any relevant parameters (whenever possible locations should be reported using recognized co-ordinate systems and not local grids) • Spacing of available data points • Extent of data interpolation/extrapolation including explanation of techniques applied
Evidence for Past or Present Water/Rock Interaction	• Location and description of observed hydrothermal alteration and mineralization
Hydrology	• Nature and quality of near-surface hydrological data and the basis for interpretation including indicators of deeper hydrology
Sampling Techniques	• Nature and appropriateness of geological, geochemical or fluid sampling procedures including collection, steps taken to ensure samples are representative, sample identification and preservation
Analytical Techniques	• Identification and experience of analytical laboratory • Nature, quality and appropriateness of laboratory techniques and related quality control procedures (e.g. in determination of petrographic, geochemical, fluid or gas analysis, physical rock properties, isotope, age data, etc.) • The level of analytical uncertainty and whether acceptable levels of accuracy and precision are considered to have been established
Temperature Measurement and Geothermometry	• Ambient, 1m probe, aerial infrared scans, existing shallow wells, etc. • Nature, quality and appropriateness of techniques used to determine temperatures from fluid or rock chemical geothermometry, including source of fluids, level of uncertainty in measurement and key assumptions made • Nature of thermal features used to determine temperature and their relation to chemical sampling
Temperature Gradient	• Nature, quality and appropriateness of calculations used to determine temperature gradient including the nature and source of surface temperature data and the associated level of uncertainty • Depth intervals of determined gradients

Criteria	Considerations
Thermal Conductivity (K)	• Whether determined analytically, modeled or assigned • Where determined analytically, identification and experience of analytical laboratory and nature, quality and appropriateness of analyses used (e.g. number and frequency of samples, technique used to determine K, type of samples (e.g. core, etc.), sample preparation (e.g. sample dimension, polish, etc.) and analytical specifications (e.g. orientation of samples, wet or dry analysis, temperature at which K was determined, etc.) • Where modeled, the nature, quality and appropriateness of the model used to the source and quality of input parameters, corrections applied and/or key assumptions made • Where assigned, the basis for interpretation including key assumptions and data sources • The estimated level of uncertainty
Heat Flow	• Whether based upon measured or assumed parameters • Where based on measured data, the nature and quality of the measurements (temperature and thermal conductivity), including characteristics of any thermal features from which they were derived, frequency and distribution of the samples, method(s) used for depth matching temperature and thermal conductivity data, assumptions made and any evidence of temporal change • Where reliant upon assumed or assigned data, the basis for interpretation, including key assumptions and data sources • In all cases nature, quality and appropriateness of the model(s) used (e.g. 1D, 2D or 3D modeling), corrections applied and key assumptions made regarding physical conditions, vertical heat flow, topographic models, etc. • The estimated uncertainty including key assumptions made
Heat Generation Determination	• Basis for identification of significant sources of subsurface heat generation • Nature, quality and appropriateness of model used to calculate heat generation capacity and the level of uncertainty in the results
Geophysical Techniques	• Nature, quality and appropriateness of any geophysical techniques used to describe or define geothermal anomalies including uncertainty and key assumptions made before, during and after interpretation, modeling, calibration of rock properties especially with drill hole data, contractors used and available survey parameters (e.g. resistivity, seismic, gravity, magnetic) for both regional and local surveys
Data Integrity and Verification	• Measures taken to ensure data have not been corrupted between initial collection and use in models/calculations • Data validation process • The verification of significant results by application of alternative techniques and/or independent personnel

B. Permit, Environmental and Infrastructure Data

Parameters listed in the preceding group apply where relevant. Parameters listed in this group may be required in all succeeding groups. Information in this group in particular may require updating and re-issuing at later stages in the development process.

Criteria	Considerations
Permit and Land Tenure Status	• Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical site, wilderness or national park and environmental settings • The security of permit held at the time of reporting along with any known impediments to obtaining a license to operate in the area
Terrain, Geotechnical Issues and Access	• Identification of significant geotechnical, geohazard or access issues which could affect future drilling locations or sterilize sectors
Environmental Issues	• Identification of significant environmental issues which could affect future drilling locations or sterilize sectors
Land Use Issues	• Identification of significant land use conflicts which could affect future drilling locations or sterilize sectors
Infrastructure	• Proximity to and quality of relevant infrastructure and water supply, in particular transmission lines when the project is being considered for electricity generation
Exploration by Other Parties	• Acknowledgement and appraisal of exploration by other parties

C. Subsurface and Well Discharge Data

Parameters listed in the preceding groups apply where relevant. Parameters listed in this group may be required in all succeeding groups.

Criteria	Considerations
Drilling Data	• Type of drilling used (e.g. core, rotary, etc.) including basic spud/collar details (e.g. date drilled, depth, etc.) • Availability of drilling records and data from rig instrumentation (e.g. rate of penetration, weight on bit, circulation losses, mud logging, drilling breaks, well kicks, etc.) • Nature and quality of directional survey data • Type of completion used and related details (e.g. depth to casing, etc.)
Sample Recovery	• Nature and quality of down hole samples (e.g. cuttings, core, fluids, etc.) and sampling intervals including the basis for determination of sampling depths and measures taken to ensure samples are representative
Geological Log	• The nature and scale of logging as well as the basis for geological interpretation and identification of alteration zones (e.g. qualitative vs. quantitative logs, lithology, palaeontology, palynology, mineralogy, fluid inclusions, Vitrinite reflectance, etc.) • Whether there is any evidence for mineralogy indicating acid or high gas fluids
Down-hole Temperature Pressure and Flow Logs	• Nature (e.g. continuous log, maximum recording thermometer test, pressure build up, etc.), quality (e.g. tool precision, operating parameters, time allowed, resolution, type and frequency of calibration) and appropriateness (e.g. tool operating parameters relative to hole conditions, tool resolution, processing or corrections required and/or applied) of instrument(s) used • Characteristics and quality of measurement(s) (depth, frequency, timing, precision, accuracy, etc.) including level of uncertainty • Appropriateness of interpretation with consideration for all significant influences (e.g. presence of local aquifers or known fluid circulation, well status) at time of logging (e.g. shut in, flowing, injection rate, etc.) • Nature and quality of any temperature correction(s) applied or justification for neglecting correction (e.g. length of time elapsed between drilling and temperature measurement) • If no corrections are applied and the measured temperature is likely to be affected by the drilling thermal anomaly this must be clearly stated
Other Down Hole Logging	• Nature (e.g. formation micro-imaging, gamma, caliper, etc.) quality (e.g. tool precision, operating parameters, resolution, type and frequency of calibration) and appropriateness (e.g. tool operating parameters, resolution, type and frequency of calibration) and appropriateness (e.g. tool operating parameter relative to hole conditions, tool resolution, processing or corrections required and/or applied) of instrument(s) used • Nature and quality of measurements(s) (depth, frequency, timing) • Appropriateness of interpretation with consideration for all significant influences (e.g. hole condition, temperature, formation invasion, etc.)
Aquifers	• Location of permeable zones/aquifers, their significance and relationship to structures and stratigraphy • Nature, quality and appropriateness of model(s) used to determine adjusted heat flow

Criteria	Considerations
Depth of Reservoir	• Depth of anticipated reservoir development
Injection Tests	• Nature and quality of injectivity tests conducted across permeable zones • Nature (e.g. calculated or observed, flow versus wellhead pressure) and appropriateness of determined injection capacity of well including key assumptions and temperature data • Any evidence of temporal change
Multi-well tests	• Nature (e.g. circulation, interference, tracer, etc.) and quality of well tests and measurements, including duration and sampling method where relevant • Appropriateness of test interpretation including any corrections or omissions and any evidence of temporal variation
Well Discharge Testing	• Nature (e.g. James Method, separator and orifice plates, tracer dilution flow test, etc.) and duration of tests including completeness of the measurement suite over the wellhead pressure discharge curve • Quality and reliability of monitoring equipment • Characteristics observed over time including any chemical and/or physical indications of dilution by drilling fluids, stability, multi-zone behaviour, possible scaling or dry-out, tracer returns

D1. Conventional Resource Parameters

Parameters listed in the preceding groups apply where relevant. Parameters listed in this group apply to all succeeding groups where relevant.

Criteria	Considerations
Flow Rate	• Nature (e.g. individual vs. interference, duration, depth, etc.), quality and appropriateness of techniques used to record flow rates in wells together with key assumptions made • Where rates are derived from individual well tests these must be detailed individually and must not be summed except with suitable acknowledgement of possible interference • Magnitude and uncertainty of temperature and pressure drawdown observed during flow tests, in relation to chemical indications of stability and long-term trends
Pressure Data	• Nature, quality and appropriateness of techniques used to determine reservoir pressures including multi-well correlation, fluids and key assumptions made
Recharge	• What allowance (if any) has been made for heat and fluid recharge and the basis thereof
Water Saturation and Enthalpy	• Nature and appropriateness of techniques used to determine in-situ water saturation • Nature and quality (e.g. accuracy) of measurements of well discharge enthalpy including consideration of how they relate to insitu saturation
Scaling, Gas Content and Acidity	• Data on reservoir fluid chemistry • Nature and appropriateness of tests carried out to determine surface and down hole scaling potential of fluids including the basis for interpretation of test results • Nature and appropriateness of tests run, models applied or analogies used as evidence for possible offset of scaling by methods of down hole or surface inhibition
Reservoir Properties	• Nature, quality and appropriateness of methods used to determine reservoir properties (rock types, porosity, permeability, anisotropy, specific permeable structures, etc.) • Basis for interpretation of temperature and pressure profiles
Conceptual Model: Nature of the System	• Nature, quality and appropriateness of integrated hydrogeological reservoir model including analogies used and key assumptions made • Whether the fluid is naturally convecting • If the project is based on a laterally extensive aquifer, its hydrological properties outside the concession area • Interpretation of physio-chemical reservoir processes
Numerical Modeling	• Nature of numerical simulation modeling, including model structure, key parameters, boundaries and relationship to conceptual modeling • Results of natural state modeling • Results of history matching (if any) • Results of forecast runs including description of scenarios modeled • Sensitivity analysis and the effects of alternative interpretation
Data Extrapolation	• The extent of data interpolation/extrapolation including explanation and justification of techniques applied

D2. Engineered/Enhanced Geothermal System (EGS) Resource Parameters

Parameters listed in the preceding groups including D1 apply where relevant. Parameters listed in this group apply to all succeeding groups where relevant.

Criteria	Considerations
Lithology	• Nature, condition and volume of reservoir target
Stress Condition	• Nature, quality and appropriateness of available stress measurements • Number and spacing of available stress measurements
In-situ Fractures	• Nature, quality and appropriateness of data (orientation, location, frequency) regarding the natural fracture network including knowledge of flowing fractures, their depth and relevance to the reservoir development • Fracture character including aperture, width, mineral content and surrounding cataclastic zone
Reservoir Stimulation	• Nature, location and frequencies of reservoir stimulation events • Corresponding pressure/flow data, including basis for interpretation and displaying temporal variations • Quality and reliability of monitoring equipment
Micro-seismic monitoring	• Nature, quality and appropriateness of the seismic network used to monitor reservoir stimulation (e.g. instrumentation, distribution, locational accuracy, sensitivity, resolution, check shot, etc.) • Volume estimation of the derived reservoir including key assumptions made and estimation of uncertainty • Evidence for achievement of stacked heat exchangers where appropriate

E. Reporting of Exploration Results

Parameters listed in the preceding groups apply where relevant. Parameters listed in this group may be required in all succeeding groups.

Criteria	Considerations
Diagrams	• Where possible, maps and sections (with scales) and tabulations of intercepts should be included for any material discovery being reported if such diagrams significantly clarify the report • Diagrams and maps should be presented using recognized coordinate systems with datum, projection and all relevant parameters declared on the map face
Balanced Reporting	• Where possible, reporting should be comprehensive • Where comprehensive reporting of all Exploration Results is not practical, representative reporting should be practiced to avoid misleading reporting of Exploration Results
Other Substantive Exploration Data	• Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; groundwater; geotechnical and rock characteristics; potentially deleterious or contaminating substances
Audit or Reviews	• The results of any audits or independent reviews of exploration data, models or interpretations
Further Work	• The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large-scale step out drilling)

F. Estimation and Reporting of Geothermal Resources

To be considered in conjunction with previous groups when reporting results of Geothermal Resource assessment.

Criteria	Considerations
Expected Use	• Nature of the anticipated Geothermal Resource exploitation including any assumptions made
Data Integrity	• Source and reliability of all relevant Geothermal Resource data • Measures taken to ensure data described has not been corrupted between initial collection and use in models/calculations • Data validation process
Data Interpretation	• Confidence in (or conversely the uncertainty of) any interpretation of geological, geophysical or geochemical data to be used in the Geothermal Resource estimation • The effect, if any, of alternative interpretation(s) upon Geothermal Resource estimation
Well Deliverability	• Must be demonstrated if Geothermal Resource(s) to be regarded as Measured • Whether the project will rely on pumping or self-discharging wells
Estimation and Modeling Techniques	• The nature and appropriateness of the estimation technique(s) applied and key assumptions made • The availability of previous production records and whether such data is considered • Any assumptions regarding the correlation of variables • The process of validation e.g. the checking process used and the reconciliation of model to measured data and the verification of significant results by application of alternative techniques and/or independent personnel
Cut-off Parameters	• The basis for any adopted cut-off temperatures, flow rates or quality parameters applied (e.g. reservoir porosity, well deliverability, etc.), preferably related to a known technology pathway
Conversion Efficiency	• If used, expected conversion efficiency for heat into electricity • Methodology used for determination of conversion efficiency including an explanation of the technology pathway and justification of any assumptions made
Dimensions	• The extent and variability of the estimated Geothermal Resource expressed as surface area and depth below surface including an explanation of the basis for any interpretations of reservoir geometry
Geothermal Resource Life	• The expected life of the Geothermal Resource based upon available modeling and anticipated development • Nature, quality and appropriateness of methods used for Geothermal Resource-life modeling including key assumptions • Estimation of the risk posed by deleterious elements (e.g. short circuiting, scaling, etc).
Classification	• The basis for the classification of the Geothermal Resource into varying confidence categories • Whether appropriate account has been taken of all factors • Whether the result appropriately reflect the views of the Qualified Person
Third Party Involvement	• Acknowledgment of possibly conflicting developments by other parties

Criteria	Considerations
Audits or Reviews	• The result of any audits or reviews of the Geothermal Resource estimate
Balanced and Impartial Reporting	• Where possible reporting should be comprehensive • Where comprehensive reporting of Geothermal Resource estimation is not practical, representative reporting should be practiced to avoid misleading reporting of Geothermal Resource estimation
Discussion of Relevant Accuracy/Confidence	• Where appropriate a statement of the relative accuracy and/or confidence in the Geothermal Resource estimate using an approach or procedure deemed appropriate by the Qualified Person. For example, the application of sensitivity analysis, probabilistic analysis or use of scenario trees, or if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate • The statement should specify whether it relates to the whole or partial Geothermal Resource and, if partial, clearly state the extents along with assumptions made and procedures used • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available
Qualifications and Accountability	• A statement of the qualifications, experience and accountability of the Qualified Person making the assessment

G. Estimation and Reporting of Geothermal Reserves

To be considered in conjunction with previous groups when reporting results of Geothermal Reserve assessment.

Criteria	Considerations
Resource Assessment Conversion	• Description of the Geothermal Resource estimate to be used as a basis for conversion to Geothermal Reserve, including data sources and justification for all assumptions made • Clear discrimination between Geothermal Resources reported as additional to Geothermal Reserves and those included within the Geothermal Reserves
Study Status	• The type and level of study undertaken to enable the Geothermal Resource to be converted to Geothermal Reserve
Plant when Related to Electricity Generation	• Technology to be used and demonstration of technical viability if novel • Expected capacity and life of associated power plant development • Expected plant factor including key assumptions in determination

Environmental and Land Use	• Identification of any significant environmental factors or land use conflicts which sterilize sectors or impact on project economics including, but not limited to:
	  • Third party development
	  • Emissions to air or water
	  • Subsidence
	  • Effect on groundwater
	  • Effects on natural thermal activity or ecosystems
	  • Changes in surface heat flow, induced hydrothermal eruptions
	  • Induced seismicity
	  • Effects on tourism, bathing or other land uses

Cost and Revenue Factors	• The derivation of, or assumptions made, regarding projected capital and operating costs • The assumptions made regarding revenue • The allowances made for royalties payable
Market Assessment	• Location of the Geothermal Resource relative to the expected market • Market capacity vs. price • Where applicable, the electricity price used, including the basis for assuming this value, its estimated uncertainty and the effects of any uncertainty upon the Geothermal Reserve estimation
Other	• The effect, if any, of natural risk, infrastructure, legal, social or governmental factors on the likely viability of the project • The status of titles and approvals critical to the viability of the project
Classification	• The basis for the classification of the Geothermal Reserve into varying confidence categories • Whether appropriate account has been taken of all factors • Whether the results appropriately reflect the views of the Qualified Person
Audits or Reviews	• The results of any audits or reviews of the Geothermal Reserve estimate

Criteria	Considerations
Discussion of Relevant Accuracy/ Confidence	• Where appropriate, a statement of the relative accuracy and/or confidence in the Geothermal Reserve estimate using an approach or procedure deemed appropriate by the Qualified Person. For example, the application of sensitivity analysis, probabilistic analysis or use of scenario trees, or if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate • The statement should specify whether it relates to the whole or partial Geothermal Reserve and, if partial, clearly state the extent along with assumptions made and procedures used • These statements of relative accuracy and confidence of the estimate should be compared with production data, where available
Qualifications and Accountability	• A statement of the qualifications, experience and accountability of the Qualified Person making the assessment

H. Additional Factors: Existing Developments

To be considered in conjunction with previous groups. The purpose of this group is to account for previous Geothermal Resource extraction and to use production data to better characterize future Geothermal Reserve estimation.

Criteria	Considerations
Production Data	• Nature, quality and completeness of production data on past total heat and fluid extraction and re-injection • Pressure, temperature, enthalpy and chemical historical trends both for individual wells and the whole Geothermal Resource, together with any interpretations in terms of reservoir processes and the hydrogeological conceptual model • Any assessments of heat and fluid recharge

Reservoir Monitoring	• Monitoring, including but not limited to:
	  • Surface and down hole pressure and temperature measurements
	  • Fluid flows and enthalpy measurements
	  • Tracer tests
	  • Well output tests
	  • Thermal activity and heat flow monitoring
	  • Ground deformation monitoring
	  • Microgravity Monitoring
	  • Environmental monitoring

Production History	• History of Geothermal Resource usage including numbers and locations of wells used for production and reinjection, especially in relation to observed reservoir changes
Numerical Modeling	• Numerical simulation modeling must be used at this stage • Good history matchings should be achieved for credibility • Should include a detailed description of all scenarios modeled and bear a close relationship to the actual existing or proposed development scheme
Development Scenarios	• Future Geothermal Resource usage scenarios

FORM 1 - GEOTHERMAL DISCLOSURE SUMMARY

The intent of the Geothermal Disclosure Summary is to assist the knowledgeable investor to evaluate different projects on a comparable basis - usually prepared by equity research analysts.

Canadian Geothermal Energy Association Guidelines
Project cost: $_____MM
Feasibility study: Yes No

Independent Resource and Reserve Assessments:

Resources		
	Gross MW	Deliverable MW
Inferred		
Indicated		
Measured		

Reserves		
	Gross MW	Deliverable MW
Probable		
Proved		

Resource annual decline rate _____%
If no production wells are drilled, describe test well program and results, and non-invasive tests performed:
_____
_____
_____
_____

Drilling results:

Well	Well Name	MW Gross	MW Deliverable	Depth, m	Temp., ^{o}C	Flow Rate, lbs/hr @ 100psia	Cost, $MM
1							
2							
etc							

*Deliverable MW is MW delivered to the grid before line losses are calculated.

Transmission
Distance to grid connection _____ km
Cost $MM (if paid by developer) $_____ MM
Line loss % _____ %
Wheeling charge $_____ /MWh

Off-Taker (if signed)
Name _____
Term Years _____
Price/MWh (if disclosure permitted) $_____/MWh
Escalator (% annually) _____%

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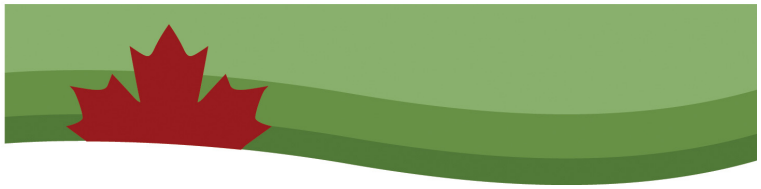
CanGEA

CANADIAN GEOTHERMAL ENERGY ASSOCIATION



"Accelerate Canadian exploration and development of geothermal resources in order to provide secure, clean and sustainable energy"

5,000 MW BY 2015!