

New Geothermal Terms and Definitions

A Guide to Reporting Resource Development Progress and Results to the
Geothermal Energy Association

November 2010



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Introduction

The Geothermal Energy Association's (GEA) *New Geothermal Terms and Definitions* are a guideline for geothermal developers to use when submitting geothermal resource development information to GEA for public dissemination in its annual *US Geothermal Power Production and Development Update*. GEA's *New Geothermal Terms and Definitions* serve to increase the consistency, accuracy, and reliability of industry information presented in the development updates. These updates are a valuable source of information regarding geothermal industry growth, financing, and public policy.

The decision to develop a more thorough and codified resource development reporting guide was precipitated by the emergence of industry reporting codes, as well as the realization that a guide will enhance reporting quality. Through meetings with GEA board level members GEA concluded that it would not develop a geothermal code for publicly reporting exploration and development results in the United States, but that a more thorough and vetted reporting guide was needed. In May 2010, GEA formed and began consulting with a committee of industry experts, as well as its own Scientific and Technical Advisory Committee, and began the process of drafting and adopting a set of *New Geothermal Terms and Definitions*. GEA continuously engaged both of the aforementioned committees and, over the course of four months, produced the *New Geothermal Terms and Definitions* as found in this document.

The *New Geothermal Terms and Definitions* are provided to geothermal industry companies and organizations as a guide to reporting development results to GEA. The *New Geothermal Terms and Definitions* are not a geothermal public reporting code. The information provided by developers to GEA through the *New Geothermal Terms and Definitions* is submitted on a voluntary basis to GEA and is not independently verified. GEA believes that the adoption of this reporting system will improve the reporting accuracy of geothermal project development, adding value to GEA's industry development reports.

Section I: Resource Types

In reporting project development information to the Geothermal Energy Association (GEA) please indicate what type of geothermal resource your organization's project(s) falls under. The different resource development categories are defined as follows:

Conventional Hydrothermal (Un-produced Resource): the development of a geothermal resource where levels of geothermal reservoir temperature and reservoir flow capacity are naturally sufficient to produce electricity and where development of the geothermal reservoir **has not** previously occurred to the extent that it supported the operation of geothermal power plant(s).

Conventional Hydrothermal (Produced Resource): the development of a geothermal resource where levels of geothermal reservoir temperature and reservoir flow capacity are naturally sufficient to produce electricity and where development of the geothermal reservoir **has** previously occurred to the extent that it currently supports or has supported the operation of geothermal power plant(s).

Conventional Hydrothermal Expansion: the expansion of an existing geothermal power plant **and** its associated drilled area so as to increase the level of power that the power plant produces.

Geothermal Energy and Hydrocarbon Co-production: the utilization of produced fluids resulting from oil and/or gas-field development for the production of geothermal power.

Geopressured Systems: the utilization of kinetic energy, hydrothermal energy, and energy produced from the associated gas resulting from geopressured gas development to produce geothermal electricity.

Enhanced Geothermal Systems: the development of a geothermal system where the natural flow capacity of the system is not sufficient to support adequate power production but where hydraulic fracturing of the system can allow production at a commercial level.

Section II: Phases of Development

In reporting your organizations geothermal projects in development to the GEA please indicate at what stage of development each separate geothermal project falls under. Stages of development have been divided into four different phases labeled Phase I, II, III, and IV. Each project must meet certain criteria to be considered and reported by the GEA as being in a respective phase of development. The separate phases and their subsequent criteria are specified below.

Phase I: Resource procurement and identification

In reporting a Phase I geothermal project to the GEA the developer must ascertain whether or not the project being reported meets the following specified criteria. The development criteria are divided into three different subsections of geothermal Phase I development (Resource, Transmission, and External Development). It is not necessary that a geothermal project meet all of the criteria listed. The number of criteria that a project must meet in each subsection of geothermal Phase I development is specified below.

Resource Development: for a project to be considered a Phase I project **at least two** of the following Resource Development criteria must be met.

- **Literature Survey Complete** – existing data and information from previous studies, exploration, and/or development has been acquired and analyzed by the developer. This preliminary analysis reveals conditions generally considered favorable for the presence of subsurface geothermal resources capable of being developed into a commercially viable geothermal reservoir.
- **Geologic Mapping Completed, Geophysical and Geochemical Sample Sites Identified** – a geologic survey and any necessary airborne surveys have detected areas that exhibit features characteristic of a viable subsurface geothermal resource. This has enabled the construction of a geologic map of the area as well as a first draft conceptual model of the hydrothermal system so that sample sites have been identified.
- **Geochemical and geophysical surveys in progress** – geochemical and geophysical survey techniques which determine the chemical properties, temperature, and overall characterization of the geothermal resource are underway or finished at the

time of reporting and further indicate the presence of a commercially viable geothermal reservoir.

-AND-

Transmission Development: for a project to be considered a Phase I project **all of the following** Transmission Development criteria must be met.

- **Internal transmission analysis complete** – internal analysis of possible transmission routes by the developer completed.

-AND-

External Development: for a project to be considered a Phase I project **all of the following** criteria must be met.

- **Land or lease acquired** – The developer has acquired acreage sufficient to develop the power plant of the magnitude (MW) it proposes. If public land, the developer will have acquired the lease to development from the Bureau of Land Management. If private land, the developer will have secured surface rights and at least 50% mineral rights.
- **Permitting process for exploration drilling (TGH and/or slimholes) underway** – the developer must have submitted and/or obtained either a permit for drilling a set of temperature gradient holes and/or a slimhole from the appropriate state agencies.

Phase I Terms and Definitions

The following terms and their definitions are to be applied to geothermal projects which are in the Phase I stage of geothermal development.

Possible Resource Estimate

For a geothermal project to be considered a Phase I Possible Resource it must exhibit known characteristics which lead the developer to believe, with a level of confidence appropriate to the stage of development, that further development of the geothermal project may lead to potential economic utilization of the resource.

Specifically, as mentioned above, the developer of a geothermal project must fulfill two of the criteria listed in the Phase I Resource Development Category, all of the criteria listed in the Phase I Transmission Development Category, and all of the criteria listed in the Phase I External Development Category.

It should be noted that the Possible Resource Estimate should not be used as a value to indicate the potential installed capacity of a geothermal power plant. Rather, it is the estimated value of the subsurface geothermal resource.

Possible Installed Capacity Estimate

The Phase I Possible Installed Capacity Estimate is that portion of a Possible Resource that the developer deems to be viable for the economic production of electricity under existing economic conditions. Also, the Possible Installed Capacity Estimate should represent the potential capacity that is currently controlled by the developer, and not the total capacity that the developer intends to control and produce in the future. In other words, if the developer were to utilize the geothermal resource under its control to produce electricity via a geothermal power plant the Phase I Possible Installed Capacity Estimate would be the power plants estimated installed capacity.

Phase II: Resource Exploration and Confirmation

In reporting a Phase II geothermal project to the GEA the developer must ascertain whether or not the project being reported meets the following specified criteria. The development criteria are divided into three different subsections of Phase II geothermal development (Resource, Transmission, and External Development). It is not necessary that a geothermal project meet all of the criteria listed. The number of criteria that a project must meet in each subsection of geothermal Phase II development is specified below.

Resource Development: for a project to be considered a Phase II project **at least one** of the following Resource Development criteria must be met.

- **Temperature Gradient Holes (TGH) Drilled** – A sufficient number of TGH holes have been drilled which measure temperature gradients that indicate a potential geothermal resource over a large enough thermal anomaly to justify further drilling.
- **Slim Hole Drilled** – at least one 3” or greater diameter slim hole drilled to a depth that penetrates a portion of the geothermal reservoir.
- **One Full Size Discovery Well Drilled** – one full sized well completed with bottom-hole temperatures and flow rates sufficient for a commercial size geothermal well (typically 3 to 5 MW) capable of simple payback given existing economic conditions and commercial terms for selling power.

-AND-

Transmission Development: for a project to be considered a Phase II project **at least one** of the following Transmission Development criteria must be met.

- **Interconnection application submitted and queue position established** – application to construct necessary transmission lines from the geothermal resource development project to the grid have been submitted to the utility for which the project will interconnect.
- **Transmission feasibility studies underway** – the developer has begun the analysis of necessary steps that must be taken to connect its project to an identified utilities transmission system.

-AND-

External to Resource Development: for a project to be considered a Phase II project **one of the following** External to Resource Development criteria must be met.

- **Permit for Slim Hole Drilling Applied for or Approved** – the developer must have obtained a permit for the drilling of a slim hole to a depth that penetrates a portion of the geothermal reservoir.
- **Permit for Production Well Drilling Applied for or Approved** – the developer must have obtained, or submitted an application for, a permit for the drilling of a full size production well from the appropriate state agency.

Phase II Terms and Definitions

The following terms and their definitions are to be applied to geothermal projects which are in the Phase II stage of geothermal development.

Possible Resource Estimate

For a geothermal project to be considered a Phase II Possible Resource it must exhibit known characteristics which lead the developer to believe, with a level of confidence appropriate to the stage of development, that further development of the geothermal project may lead to potential economic utilization of the resource.

Specifically, as mentioned above, the developer of a geothermal project must fulfill one of the criteria listed in the Phase II Resource Development Category, one of the criteria listed in the Phase II Transmission Development Category, and one of the criteria listed in the Phase II External Development Category.

It should be noted that the Possible Resource Estimate should not be used as a value to indicate the potential installed capacity of a geothermal power plant. Rather, it is the estimated value of the subsurface geothermal resource.

Possible Installed Capacity Estimate

The Phase II Possible Installed Capacity Estimate is that portion of a Possible Resource that the developer deems to be viable for the economic production of electricity under existing economic conditions. Also, the Possible Installed Capacity Estimate should represent the potential capacity that is currently controlled by the developer, and not the total capacity that the developer intends to control and produce in the future. In other words, if the developer were to utilize the geothermal resource under its control to produce electricity via a geothermal power plant the Phase II Possible Installed Capacity Estimate would be the power plants estimated installed capacity.

Phase III: Permitting and initial development

In reporting a Phase III geothermal project to the GEA the developer must ascertain whether or not the project being reported meets the following specified criteria. The development criteria are divided into three different subsections of geothermal Phase III development (Resource, Transmission, and External Development). It is not necessary that a geothermal project meet all of the criteria listed. The number of criteria that a project must meet in each subsection of geothermal Phase III development is specified below.

Resource Development: for a project to be considered a Phase III project **at least two** of the following Resource Development criteria must be met.

- **At least one full size production well drilled and operational** – at least one full sized production well with a bottom hole temperature and flow rates sufficient for a commercial size geothermal well (typically 3 to 5 MW gross) drilled.
- **At least one full size injection well drilled and operational** – at least one full size injection well capable of recharging the geothermal resource drilled.
- **Reservoir characterization completed and sustainable reservoir capacity determined** – the developer has adequately characterized fluid flow within the rock mass of the geothermal reservoir and has also determined the sustainable capacity of the geothermal reservoir with relative accuracy. This may include a flow test performed including two production wells and one injection well confirming at least 20% of proposed contract capacity.

-AND-

Transmission Development: for a project to be considered a Phase III project **at least two** of the following Transmission Development criteria must be met.

- **Interconnection feasibility study complete** – the steps and resources necessary for connecting the geothermal power plant to the transmission system of an identified utility have been identified by the developer.
- **System impact study (SIS) underway or complete** – the utility has assessed the adequacy of the targeted transmission system to accommodate the additional electricity provided by the developer and whether additional costs may be incurred to provide transmission service.

- **Interconnection facility study underway** – The utility has begun to identify to the developer the steps, equipment, and costs necessary to complete the interconnection.
- **Transmission Service Request Submitted** (if appropriate) – in the event that power from the developers geothermal development project must be transmitted through the transmission systems of one or more utilities to the point of delivery, the developer will have submitted a Transmission Service Request to the utilities whose transmission systems will need to accommodate the delivery of MW to the point of delivery.

-AND-

External to Resource Development: for a project to be considered a Phase III project **at least two of the** following External to Resource Development criteria must be met.

- **Plant permit application complete or in process** – the developer has submitted, or is in the process of submitting, an application to the appropriate state agencies for the construction and operation of the proposed geothermal power plant.
- **Power purchase agreement secured or in negotiation** – the developer (provider) and the identified power purchaser (host) have entered, or are in the process of entering into, a legal agreement regarding the purchasing of electricity from the provider by the host where that electricity is provided via the planned geothermal power plant.
- **Financing secured, or being secured, for portion of project construction** – the developer has secured financing sufficient to meet the project PPA requirements and make the initial deposit for power plant equipment.

Phase III Terms and Definitions

The following terms and their definitions are to be applied to geothermal projects which are in the Phase III stage of geothermal development.

Delineated Resource Estimate

A Delineated Resource is a geothermal project that has undergone exploration testing and drilling to the extent needed to construct an accurate characterization of the geothermal reservoir as well as to give an accurate estimation of total recoverable energy.

Specifically, as mentioned above, the developer of a geothermal project must fulfill two of the criteria listed in the Phase III Resource Development Category, two of the criteria listed in the Phase III Transmission Development Category, and two of the criteria listed in the Phase III External Development Category.

It should be noted that the Delineated Resource Estimate should not be used as a value to indicate the potential installed capacity of a geothermal power plant. Rather, it is the estimated value of the subsurface geothermal resource.

Delineated Installed Capacity Estimate (MW)

The Phase III Delineated Installed Capacity Estimate is that portion of a Delineated Resource that the developer deems to be viable for the economic production of electricity under existing economic conditions. Also, the Delineated Installed Capacity Estimate should represent the potential capacity that is currently controlled by the developer, and not the total capacity that the developer intends to control and produce in the future. In other words, if the developer were to utilize the geothermal resource under its control to produce electricity via a geothermal power plant the Phase III Delineated Installed Capacity Estimate would be the power plants estimated installed capacity.

Phase IV: Resource Production and Power Plant Construction

In reporting a Phase IV geothermal project to the GEA the developer must ascertain whether or not the project being reported meets the following specified criteria. The development criteria are divided into three different subsections of geothermal Phase IV development (Resource, Transmission, and External Development). It is not necessary that a geothermal project meet all of the criteria listed. The number of criteria that a project must meet in each subsection of geothermal Phase IV development is specified below.

Resource Development: for a project to be considered a Phase IV project **at least two** of the following Resource Development criteria must be met.

- **Plant equipment on order** – The majority of equipment required to construct the proposed geothermal power plant has been ordered.
- **Plant construction underway** – the developer has issued a notice to proceed to the EPC contractor to begin on-site construction.
- **Production and injection drilling underway** – Development drilling underway and at least 50% of the resource to be used for the power plant has been confirmed.

-AND-

Transmission Development: for a project to be considered a Phase IV project **the Interconnection Agreement must be signed**. If the transmission of power from the project to the end user requires point-to-point service through one or more utility networks then all of the below criteria must be met for the project to be considered a Phase IV project.

- **Interconnection Agreement Signed** – the developer and the identified utility have entered into a contractual agreement where the utility has agreed to accommodate the transmission of the power from the developers geothermal development project. In turn, the developer allocates a specific amount of money to get the power from its geothermal development project to the point of delivery.
- **Transmission System Service Request studies completed** – In the event that a Transmission System Service Request has been submitted (see Phase III

Transmission Development), the studies of the tending impacts of granting the request to the developer by the utility will have been completed.

-AND-

External to Resource Development: for a project to be considered a Phase IV project **all of the following** Resource Development criteria must be met.

- **Plant permit(s) approved** – the permits necessary to the construction of a geothermal power plant at the geothermal resource have been approved and granted to the developer by the appropriate state and federal agencies.
- **EPC contract signed** – the developer and an identified contractor have entered into a contractual agreement where the contractor will design and construct the geothermal power plant, the steam gathering system, and transmission lines as well as procure the necessary materials.
- **PPA secured** – At this phase of geothermal development the developer and the identified power purchaser must have entered into a legal agreement regarding the purchasing of electricity from the provider by the host where that electricity is provided via the planned geothermal power plant.

Phase IV Terms and Definitions

The following terms and their definitions are to be applied to geothermal projects which are in the Phase IV stage of geothermal development.

Confirmed Resource Estimate

A Confirmed Resource is a geothermal project that has undergone extensive exploration testing and drilling so as to construct, with a high degree of confidence, an accurate characterization of the geothermal reservoir as well as to give an accurate estimation of total recoverable commercial energy.

Specifically, as mentioned above, the developer of a geothermal project must fulfill two of the criteria listed in the Phase IV Resource Development Category, the “Large Generator Interconnection Agreement” criteria listed in the Phase IV Transmission Development Category must be met, and all of the criteria listed in the Phase IV External Development Category. The developer must identify to GEA which of those criteria, in their respective categories have been met.

It should be noted that the Confirmed Resource Estimate should not be used as a value to indicate the potential installed capacity of a geothermal power plant. Rather, it is the estimated value of the subsurface geothermal resource.

Confirmed Installed Capacity Estimate (MW)

The Phase IV Confirmed Installed Capacity Estimate is that portion of a Confirmed Resource that the developer deems to be viable for the economic production of electricity under existing economic conditions. Also, the Confirmed Installed Capacity Estimate should represent the potential capacity that is currently controlled by the developer, and not the total capacity that the developer intends to control and produce in the future. In other words, if the developer were to utilize the geothermal resource under its control to produce electricity via a geothermal power plant the Phase IV Confirmed Installed Capacity Estimate would be the power plants estimated installed capacity.



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