Part 4 – Procurement Guidelines

Part four in the set of four Professional Guidelines for Geoexchange Systems in British Columbia

Second Edition

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GeoExchange BC – in pursuit of performance

Dear Reader,

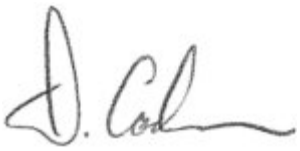
GeoExchange BC is a not for profit provincial industry association in British Columbia dedicated to the education, promotion and responsible design and installation of low temperature ground source (geoexchange) energy systems. Our mission and vision is to promote information sharing between industry professionals and other stakeholders associated with the geoexchange industry, as well as to maximize the energy performance of geoexchange systems to realize their full financial, environmental, and social benefits.

Geoexchange BC has published this document as one of a series of guidelines to educate key players on the requirements of a successful geoexchange project. These guidelines also help establish a strong standard of practice for the industry going forward. Each guideline covers a separate topic and is focused on commercial-scale applications within BC, although many of the concepts are applicable to smaller projects and other regions. The guidelines are for use by developers, owners, coordinating professionals, construction managers, engineers, installers and commissioning teams. The primary goal of these guidelines is to assist a project team in delivering a cost-effective geoexchange system that will provide reliable operation and energy savings throughout the life of the system.

A supplemental User Guide has also been developed to facilitate access to all the detailed information contained within the guideline documents. The User Guide summarises the key content of each guideline, provides a flowchart and checklist format for guidance and record-keeping, and identifies topics within the guideline relevant to each key player on the project team.

We hope and expect that these guidelines will be of great service to you, to your industry peers, and consequently to all British Columbians alike.

Best regards,



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1.0 INTRODUCTION

1.1 Professional Guidelines Series

With the rapid growth of the geoexchange industry in British Columbia, there is a widespread need for a set of professional guidelines for the rational, suitable and appropriate application of geoexchange technology. Such guidelines will promote appropriate and responsible designs, leading to successful, sustainable systems that will, in turn, meet owner's requirements and improve the reputation of the industry.

This document is one in a series called Professional Guidelines for Geoexchange Systems in British Columbia, made up of four parts:

- Part 1 – Assessing Site Suitability and Ground Coupling Options;
- Part 2 – Design;
- Part 3 – Commissioning and Troubleshooting; and
- Part 4 – Procurement (this document).

The full series covers the life cycle of a geoexchange project, from the initial concept through site evaluation, ground coupling selection, procurement, system design and commissioning.

The guidelines are intended as a resource for building owners, architects, project managers and construction co-ordinators to fully understand the steps involved in design, construction, commissioning and procurement of geoexchange systems. They are also a useful reference for industry professionals, engineers and contractors involved in the design and construction of geoexchange systems.

This series of guidelines is geographically focused on British Columbia, which has a very diverse range of geologic settings, topography, soil types, climatic conditions and site conditions. This series is also framed for provincial and federal regulatory regimes that apply to this province. However, the fundamental concepts presented here may also be applied in other parts of Canada and the general staged methodology could be applied anywhere.

1.2 Purpose

Developing large-scale geoexchange systems requires larger and more diverse teams than for typical conventional heating systems. Geoexchange teams commonly include participants from such diverse industry sectors as well drillers, refrigeration mechanics, mechanical engineers, hydrogeologists, plumbers, and others. The business culture across these disciplines varies widely, as do the expectations for routine exchange of information, business risks and strategies for managing these risks.

Some of the typical geoexchange team disciplines have no other common occasions for working together other than geoexchange projects. Geoexchange technology occupies a

relatively small niche, and it is a developing technology. Therefore, the structure of geoexchange teams, the roles and responsibilities of individual team members, the working relationships, and the appreciation of the needs for flow of information continue to evolve.

The purpose of this Resource Guide is to provide information and background to improve the delivery of geoexchange systems by improving the team-building process through the promotion of more effective procurement strategies.

1.2.1 Current System Delivery Concerns

Enormous growth in geoexchange system installations has occurred in recent years. While the growth is encouraging, the increasing incidence of reports of poor designs and/or poor installations is not. While the veracity of rumours and innuendo about poorly performing systems is often difficult to ascertain – and the motivations for conveying such information are often questioned – a significant increase in frequency of reports of poorly performing systems leads to a reasonable conclusion that the industry needs to improve system delivery to shore up consumer confidence.

A common complaint voiced both by designers and contractors is that the particular way in which they are engaged on projects often does not enable them to participate effectively or to provide value in the best interests of projects. The issues can include:

- Timing (e.g., earlier participation would have allowed the designs or installation methods to better adapt to the site setting);
- Definition of the scope (e.g., insufficient scope to enable practitioners to serve the best interests of the project); and
- Inadequate flow of information that constrains the overall geoexchange team from being able to collaborate effectively and synergistically.

1.2.2 Need for a Procurement Resource Guide

Current practices for engaging professional design services and contracting installation services for geoexchange systems are adapted from standard procedures that are used for procuring services for conventional heating, ventilation, and air conditioning (HVAC) systems. Often the procurement strategies are insufficiently tailored to appropriately account for unique needs of geoexchange service providers. As a consequence, geoexchange projects are burdened with inefficiencies that can result in sub-optimal designs, lower contractor productivity, or inappropriate shouldering of various business and operational risks by some or all members of the team (professionals and contractors alike). Combined, these factors lead to more expensive, less energy-efficient, and less reliable geoexchange systems, inevitably resulting in lower overall deployment of geoexchange in the marketplace.

1.2.3 Unique Considerations for Geoexchange Procurement (Particularly in BC)

Geoexchange systems consist of two distinctly different types of infrastructure (inside the building and outside the building). The system components inside the building (heat pumps and heating/cooling distribution systems) are in most ways similar to conventional mechanical systems and therefore the procurement of services for designing and constructing this part of the system is quite well suited to procedures that are typically used for procuring conventional systems. In contrast, the components outside the building (the ground heat exchanger, or GHX) is more typical of civil or earthworks infrastructure and procurement practices should reflect this.

Standard practices for carrying out pre-design investigations, design development, construction, and construction oversight for developing underground civil or earthworks infrastructure are distinctly different than for mechanical infrastructure. The differences are largely attributable to the different circumstances and conditions under which civil and mechanical systems are developed.

Mechanical infrastructure is typically developed in a built-environment with relatively predictable and controlled conditions in a setting where the work can be readily examined and potentially altered after installation. Underground infrastructure, on the other hand, is often developed out of view (concealed work) with little or limited opportunity to examine the work after installation. Accordingly, practices for procuring and coordinating services for developing underground infrastructure have evolved in a way that:

- Fosters formalized processes for gathering sufficient and reliable information in a professional manner during pre-design investigations (to help reduce uncertainties and reduce the risk for unwelcome surprises during construction).
- Supports appropriate quality control and quality assurance measures to ensure concealed work is installed according to the intent of the design (recognizing concealed work is difficult or impossible to adequately inspect after installation and impossible or expensive to correct after installation).

The need to strive for best-practice procurement strategies is particularly important in British Columbia where unusually diverse geological conditions create challenges for developing many kinds of underground civil infrastructure, including geoexchange. Typical planning, design, and construction practices for other types of underground infrastructure have evolved in BC to more thoroughly account for site-specific geological and hydrogeological factors than in other regions, so site conditions can be properly reflected in the design and implementation. For example, building foundations, bridge foundations, shoring projects, tunnel bores, mine-works, and road construction are carried out in British Columbia with:

- Specialized evaluation and design expertise provided by geotechnical engineers, geological engineers, hydrogeologists, and other specialized civil engineers.

- Specialized installation expertise provided by contractors with regional and task-specific expertise.

Geoexchange projects in BC can benefit from careful and selective adoption of practices from the wider sphere of regional earthworks infrastructure development experience. In the long run, this approach will serve the regional BC geoexchange industry better than relying on geoexchange practices that are accepted and routine in other regions where geology and hydrogeology are less complex and more predictable.

1.3 Intent

There are several existing technical resource guides for supporting sound geoexchange design fundamentals. Accordingly, this document is not intended to be used as a design guide, but rather to serve as a resource guide to support effective procurement of professional and contracting services for designing and constructing geoexchange systems.

The document has been prepared with the project coordinating professional (terminology as defined in the BC Building Code) in mind as the target reader. Usually the coordinating professional is the project architect, though in other cases depending on factors such as whether the project is new or retrofit construction, the mechanical engineer or civil engineer may commonly act in the role of coordinating professional. Sometimes the owner will ask for services at an early stage and will act as a coordinating party.

Although pitched towards architects and other coordinating professionals, it is expected that the document contains information that all the various geoexchange team members will find useful for improving project delivery and appreciating the interdependent needs of other team members.

Stated simply and succinctly, the ultimate goal of this document is to present information and to describe a process that helps coordinating professionals engage the right people, on the right scope, at the right time.

1.3.1 Standardized Example Specifications and Terms of Reference Information

Example specifications for constructing the two most common types of GHX systems are included in Appendix A. Example terms of reference information for installing test boreholes and conducting borehole thermal property testing are also included.

The intent for including example specifications is twofold:

- Important aspects of geoexchange installations are often neglected or insufficiently described in specification documents that are in current circulation. Consistently capturing key requirements is a necessary step for improving procurement practices. It is hoped that the example specifications can be used as a resource to help reduce common oversights. For example, the grouting sections for vertical borehole GHX specifications rarely describe the work in sufficient detail. This is a critically

important task that cannot afford to be overlooked since the primary purpose of the grout is to provide an environmental seal to prevent cross-migration of groundwater or contaminants into or between aquifer zones.

- The specification documents in current circulation vary widely in structure and content. The example specifications are hoped to lead to more uniformity in specification documents which will help estimators process information more quickly and with less likelihood for misinterpretation or oversights.

1.4 Scope

The document presents information on the following relevant topics:

- Delivery formats. Introduces, describes, and discusses various design and construction delivery formats. Each of the delivery formats has strengths and each format is suited for application in various situations. Accordingly, the presentation is intended to agnostically introduce each of the delivery formats with no intent or attempt to judge the relative merits or appropriateness of the formats.
- Flow of Information. Describes the flow of information that should be fostered for each delivery format.
- Graphical Presentations. Provides graphical presentation of delivery formats and an overall project progression flowchart.

2.0 GENERAL PROCUREMENT OPTIONS

Methods of procurement dictate the hierarchy, procedures and structure of project delivery. Three methods are most often used:

1. Design-Spec-Tender (the most traditional method of delivery),
2. Construction Management, and
3. Design-Build.

The intent of this section is to introduce these options in general terms and not necessarily with specific reference to their use in geoexchange. The introduction provided here provides background and context for Section 3 which focuses on describing specific procurement strategies for geoexchange projects.

Much of the information in this section is paraphrased from resource guides published by the Canadian Design-Build Institute (CDBI). For further reference, more detailed discussion of the three general procurement methods is provided in the CDBI documents (CDBI 2013, CDBI 2004) referenced in Section 5.0.

Each of these methods has their strengths and short-comings, but none are a blanket solution to all projects. Each project must be evaluated to determine which method will allow for the most seamless delivery that will be most flexible to the challenges that are most likely to arise.