

Part 3 – Commissioning Guidelines

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

First Edition

Copyright © 2014 by GeoExchange BC

Published by: GeoExchange BC
admin@geoexchangebc.com
www.geoexchangebc.com

All rights reserved. No part of this work may be reproduced by any mechanical, photographic, or electronic process, or in the form of a photographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without written permission of the publisher.



GeoExchange BC – in pursuit of performance

Dear Reader,

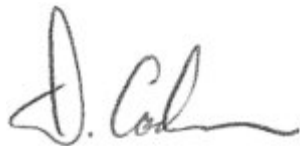
GeoExchange BC is a not for profit provincial industry association in British Columbia dedicated to the education, promotion and responsible design and installation of low temperature ground source (geoexchange) energy systems. Our mission and vision is to promote information sharing between industry 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,



David Cookson, B.Eng MBA
Project Director, GeoExchange BC



Disclaimer

The information and recommendations contained in this guideline have been compiled from sources believed to be reliable and representative of the best opinions on the subject at the date of publishing. No warranty, guarantee, or representation, express or implied, is made by GeoExchange BC, however, as to the correctness or sufficiency of this information or to the results obtained from the use thereof. It cannot be assumed that all necessary warnings, safety suggestions, and precautionary measures are contained in this guideline, or that any additional information or measures might not be required or desirable because of particular conditions or circumstances, or because of any applicable Canadian federal, provincial, or local law, or any applicable foreign law or any insurance requirements or codes. The warnings, safety suggestions, methods, procedures and precautionary measures contained herein do not supplement or modify any Canadian federal, provincial, or local law, or any applicable foreign law, or any insurance requirements or codes.

Acknowledgements

Commissioning Guidelines

First Edition authors

Date: March 2014

Produced by: Rachel Bolongaro, P.Eng, Ruben Arellano, P.Eng, Associated Engineering Ltd.
Daniel Booy, P.Eng Dipl.T, Altum Engineering Ltd.

Jason Rockson, CGD, Mercury Refrigeration

Stuart Yanow, P. Eng., LEED, CGD, Geotility Geothermal Systems

Contact: Rachel Bolongaro, P.Eng, 604-293-1411, bolongaror@ae.ca

Support: Thanks to the following for their technical review:

Gordon Monk, P.Eng MBA CEM, BC Hydro Power Smart

Jeff Quibell, P.Eng, JDQ Engineering

Jarek Bekesza, P.Eng, FortisBC Alternative Energy Services

Doug Smith, P.Eng, City of Vancouver

Geoexchange BC Board of Directors

First Edition Funding partners

Special thanks: Doug Smith, P.Eng, Assistant Director, Sustainability
City of Vancouver

Special thanks: Gordon Monk, P.Eng MBA CEM, Technology Integration Manager
BC Hydro Power Smart

Special thanks: Kristen Mucha, Senior Manager,
Community, Commercial & Industrial Energy Solutions, FortisBC Energy Inc.

Special thanks: Keith Veerman, P.Eng, Manager, PowerSense Programs
FortisBC Inc.

April 2014

TABLE OF CONTENTS

1	Introduction	1
1.1	Professional Guidelines Series	1
1.2	Purpose and Scope of This Guideline	1
1.3	Acknowledgements.....	2
2	Commissioning Overview	3
2.1	Definition	3
2.2	Benefits of Commissioning.....	3
2.3	Geoexchange-Specific Commissioning	5
3	Geoexchange Commissioning	8
3.1	Overall Approach	8
3.1.1	Pre-design phase	8
3.1.2	Design phase	8
3.1.3	Construction and Acceptance phase	9
3.2	Ground Heat Exchanger Commissioning	9
3.2.1	Sequencing	11
3.2.2	Individual Commissioning Processes.....	12
3.3	Mechanical Systems Commissioning	20
3.3.1	GHX Circulation Pump	21
3.3.2	Heat Pump.....	21
3.3.3	Load Side Mechanical Systems	22
3.4	Control System Commissioning.....	22
3.5	Commissioning Duration.....	23
3.6	Other Closed Loop System Types	23
4	Substantial Project Completion	23
5	Preventive Maintenance	24
6	Troubleshooting	26
7	System Performance Monitoring.....	29
8	Additional Resources	30

LIST OF FIGURES

Figure 2-1 – Elements of Project Lifecycle Cost.....	4
Figure 5-1 – Rehabilitation Cost Deferral due to Effective Preventive Maintenance	24
Figure 6-1 – Troubleshooting Sequence	27
Figure 7-1 - Cycle of System Performance Monitoring	28

LIST OF TABLES

Table 3-1 – Commissioning Processes Performed on the Ground Heat Exchanger.....	11
Table 5-1 – Sample of Critical Preventive Maintenance Items	25
Table 5-2 – Preventive Maintenance Considerations for Open Loop.....	26
Table 6-1 – Common GSHP Troubleshooting Issues.....	27

APPENDICES

APPENDIX A - Commissioning Checklists

APPENDIX B - Sample Commissioning Specification Sections

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 (this document); and
- Part 4 – Procurement.

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 and Scope of This Guideline

The purpose of this Guideline is to provide owners, developers and industry professionals with an outline of best practices in commissioning geoexchange systems. This document is not intended to constitute a stand-alone, comprehensive guide for the commissioning of geoexchange systems. Rather, it should be used in conjunction with other resources as identified in this document.

This guideline focuses on commercial scale geoexchange systems which, because of their scale and complexity, require close attention to many details in the commissioning process. However, many of the tasks outlined in this document are relevant and can be

applied to residential geoexchange systems. This guideline primarily considers closed loop Ground Heat Exchanger (GHX) applications (e.g. vertical GHX, horizontal GHX, slinky GHX, and closed loop surface water), in light of the dominance of this type of ground coupling application currently in BC. However, preliminary guidance on considerations specific to open loop applications (e.g. open loop groundwater and open loop surface water) is provided where appropriate.

The scope of this guideline includes commissioning of the GHX and heat pump only. Commissioning of building mechanical systems is not included due to the variety of system types that exist. For general commissioning guidelines and practices, including those for building mechanical systems, refer to the additional resources provided by ASHRAE and listed in Section 8.0 of this guideline.

This Guideline is not an official standard method, but refers to standard methods and other reference documents where useful.

1.3 Acknowledgements

The authors of this report, together with Geoexchange BC, would like to acknowledge the following individuals and corporations for their input, expertise and support in the development of this guideline.

We'd also like to thank our funding partners, and their representatives on the project steering committee, for their financial support and the valuable input they have provided to this project.

- Gordon Monk, Technology Integration Manager
BC Hydro Power Smart
- Doug Smith, Assistant Director, Sustainability
City of Vancouver
- Keith Veerman, Manager, PowerSense Programs
FortisBC Inc.
- Kristen Mucha, Senior Manager, Community, Commercial & Industrial Energy Solutions
Fortis BC Alternative Energy Services Inc.
- Members of the Geoexchange BC technical review committee.
- Daniel Booy of Altum Engineering, Jason Rockson of Mercury Refrigeration and Stuart Yanow of Geotility Geothermal Systems who have represented the many practitioners in the geoexchange industry and have provided guidance on content and review of the draft guideline.
- The authors of previous guidelines and Geoexchange BC, for having established the vision, framework, and momentum for this valuable initiative.