Codes, Standards and Regulations in the Canadian GeoExchange Industry

Report of a National Consultation Conducted by the Canadian GeoExchange Coalition

(Summary)

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TABLE OF CONTENTS

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Context

At the beginning of 2009, and after having analyzed more than 4,500 requests for certification of geothermal systems as part of the CGC's Global Quality GeoExchange Program, CGC personnel and accredited professionals identified several anomalies and weaknesses in the codes, standards and regulations affecting the geothermal industry in Canada. In the months following the implementation of its quality program, the CGC collected and continues to identify several contradictions in the current standards. There are also important omissions that slow and sometimes wholly block the introduction of new technologies in the marketplace. At the same time, officials from regulatory organizations and other public-sector parties, notably municipalities, are concerned about following the existing codes, standards and regulations.

In this context, and as part of its market transformation initiative and its efforts to consolidate the industry, the CGC organized a national consultation in June 2009 dealing with the regulatory issues affecting the geothermal industry in Canada. A total of seven intensive workshops were offered. Professionals accredited by the CGC and other industry players, in particular representatives of municipal and provincial governments, participated in these workshops. These sessions took place in Burnaby, Calgary, Regina, Toronto, Saint-Hyacinthe, Quebec City and Truro.

Introduction

Participants in the workshops were invited to identify problems concerning technical and regulatory issues, with the ultimate goal of formulating suggestions concerning improvements to the codes, standards and regulations, as well as recommendations for improving the CGC's Global Quality GeoExchange Program.

To orient these discussions, three themes had previously been identified by the CGC: (1) equipment, (2) practices relating to system design, and (3) the technologies. These themes were then subdivided into several sections to provide depth in the discussions. These oriented discussions were supported by open questions on the various subjects identified. In order to cover the widest possible range of issues, the final part of the workshops was devoted to open discussions, either to conclude the debates on issues previously raised or to identify new subjects and discuss them.

This report presents a summary of the seven workshops organized across Canada. CGC staff collected and organized the written comments of the participants into broad themes. Added to the participants' written comments are notes and comments collected by the CGC personnel who led these meetings. These additional comments convey the general tone of the discussions. Certain conclusions and recommendations emerge from this analysis conducted by CGC personnel.

The document takes both official languages into account. The comments were collected either in French or in English depending on the language of the participants. However, the analysis of all the comments and the recommendations were prepared in both languages.

A Installation Standards and Equipment Standards

The first part of the sessions dealt with the codes, standards and regulations that affect the equipment used in the geothermal industry. In order to better formulate the recommendations, we have grouped the various comments into three sub-sections: (1) heat pumps, (2) fluids and (3) piping.

A.1 Heat pumps

The majority of participants were in agreement with the principle of using a minimum efficiency ratio for heat pumps. The theoretical coefficients of performance (COP) of 3.3, as required by standard ISO 13256-1-01 (for water-air heat pumps in a closed loop) and of 3.0 for standard ISO 13256-2-01 (for water-water heat pumps in a closed loop) seemed acceptable. They are also used in standard C448 and correspond to the requirements of ENERGY STAR products. The debate on the minimum efficiency ratio is not limited to the determination of an exact target. In fact, the way this ratio is measured generated several discussions on the subject. A progressive performance scale was suggested. This scale should vary as a function of several factors, including the climate, the various technologies, the needs of the client, the water temperature at its entry point, the type of soil, the type of building (residential vs. commercial vs. institutional) and several others.

On the other hand, several participants also maintained that in geothermal systems, it was not relevant to require an ENERGY STAR product. To these participants, what counts is first and foremost the performance of a geothermal system as a whole and not just the theoretical performance of the heat pump. Some participants who are opposed to establishing a minimum performance ratio highlight the exclusionary character of such an approach. In fact, a minimum standard would discriminatory against certain geothermal systems – natural gas heat pumps, hybrid systems, etc. – and would not take the needs of the client into consideration. Opinions were thus divided with regard to the relevance of using or not using a minimum COP for ground source heat pumps.

Furthermore, many participants also expressed serious reservations with regard to the validity and the effectiveness of the tests performed on heat pumps. Although some deem these tests valid and adequate, others have stated that the test are performed by the manufacturers themselves, without external verification that the protocols established by the ISO standards mentioned above were applied effectively.

It is interesting to note that this latter argument was used by the Government of Canada during implementation of the *ecoENERGY Retrofit – Homes* program. Basically, although standard C448 requires that standards ISO 13256-1-01 and 13256-2-01 be respected, the federal government has made these requirements a recommendation[1] rather than a rule. This position recognizes directly the lack of relevance of the theoretical COP of the heat pump as compared to a design produced under the specific conditions of the building where the geothermal system will be installed.

To others, the importance of the tests' validity was deemed to be secondary, or even useless, to the extent that the theoretical COP of the heat pump is only one of numerous factors that have an impact on the performance of the geothermal system as a whole. Paradoxically, this position is also clearly expressed on the Web site of the ENERGY STAR program.

> *"Your new heating and cooling system should be a custom fit for your home. Sizing and a handful of other installation practices can dramatically affect how well your new equipment will*

[1] Question 38 of the F.A.Q. dealing with the implementation of the *ecoENERGY Retrofit – Homes* program specifies the following: "The system must conform to standard CAN/CSA-C448 Design and Installation of Earth Energy Systems. It is also strongly recommended that the equipment conform to the following test standards:

- CAN/CSA-C13256-1-01 Water-source heat pumps - Testing and rating for performance - Part 1: Water-to-air and brine-to-air heat pumps; or
- CAN/CSA-C13256-2-01 Water-Source Heat Pumps - Testing and Rating for Performance - Part 2: Water-to-water and brine-to-water heat pumps.

NOTE : Standard CAN/CSA-C13256 is essentially the same as ISO 13256.

deliver comfort and savings. Expect to pay a little more for a good contractor who follows these practices.[2]"

Given the low level of confidence expressed concerning the test protocols surrounding the theoretical tests on ground source heat pumps, several participants suggested that these tests at least be conducted by an independent third party. Although a certain consensus exists with regard to the importance of having a minimum efficiency ratio, several participants also highlighted the fact that the relevance of a minimum efficiency ratio depends on the way in which this ratio is used. Basically, the relevance of the COP varies depending on the type of system, the geographical region, the client's specific needs, constraints relating to design, etc. On the other hand, other participants argue that a minimum COP encourages technological development and can serve as a benchmark for the establishment of subsidy programs. One participant also indicated that the only way to establish the performance of a geothermal system with certainty would be to install energy counters on the main unit as well as on the auxiliary unit.

The discussions also dealt with the relevance of using a seasonal coefficient of performance (SCOP) on the entire system rather than a theoretical COP on the heat pumps. Despite the numerous arguments in favour of using a seasonal ratio, this option was, from all opinions, not very practical and overly complex. The number of factors that have to be taken into consideration and the difficulties inherent in its comprehension are considered major obstacles to its use in the geothermal industry. The theoretical COP of heat pumps is thus considered a lesser evil.

In a more general approach concerning heat pumps, the global quality of these pumps is a significant issue, whether due to unequal comparisons between the various heat pumps available or because of the poor quality of some heat pumps. The arrival of Asian heat pumps also raises some serious concerns, and better management of these transitions is strongly recommended. However, these concerns seem to focus more on possible erosion of market share than on the quality of the products. From the same perspective, the idea of someday seeing local heat pumps appear on the market is attractive to some. However, it is recognized that the Canadian market is not yet sufficiently developed to sustain the emergence of a local manufacturer of ground source heat pumps. On the same theme, CGC personnel note that several participants use Europe as a model with regard to equipment quality and the minimum performance standards to be achieved. The CGC pays close attention to these many comments, and attempts to reconcile European practices with the reality of the Canadian market.

Another specific issue that was frequently raised during the workshops is that of evaluating the noise emitted by heat pumps which, according to the comments, is an important criterion to clients. Once again, more thought is required on this subject to evaluate the possibility of integrating noise evaluation criteria into the regulations.

In many of the discussions, CGC personnel noted a recurring contradiction in the demands of the various participants. Basically, cautions against excessive regulation were heard, while the same people argued that it was important to avoid using a "rule of thumb" in design. In the CGC's opinion, this apparent contradiction could be resolved by the preparation of guidelines that would include the industry's best practices. Such guidelines would also enable reconciliation of another dissonance concerning the minimum performance ratio: continually increasing the quality of installations vs. establishing an economically-attainable minimum COP.

A.2 Heat-transfer Fluids

The question of the liquids and fluids used in geothermal systems was the subject of some very interesting and lively discussions. The comments can be grouped into the following categories:

1. The heat-transfer liquids used in closed, vertical and horizontal loops;
2. The refrigerants used in heat pumps for heat exchange;
3. The responsibility of the various parties with regard to the handling of these liquids.

[2] http://www.energystar.gov/index.cfm?c=heat_cool.pr_properly_sized

With regard to heat-transfer fluids, certain tendencies were observable in the opinions of the participants, however, we noted that divergences were abundant on several subjects. First of all, we note the need for better comprehension of the various fluids and their environmental impacts. Determination of the impacts – biodegradation, contamination of soil and ground water, etc. – would enable an exhaustive identification of the fluids that have both a low environmental impact and performance properties adapted to geothermal systems. This step requires additional research.

Note that with regard to environmental issues, there is a major polarization in the various points of view. Some people consider that the issues relating to the risks of contamination are not genuine, while others maintain that protection of ground water will be an important factor to consider for the future of the geothermal industry. Reducing greenhouse gases is a concern to some participants, and has become an important issue for the geothermal industry. More specifically, the problems associated with the use of refrigerants were formerly linked to destruction of the ozone layer. At the present time, the impact of using these refrigerants on emissions of greenhouse gases is becoming the most important issue. In light of the discussions in the various workshops, the CGC notes that there is a considerable lack of technical and environmental knowledge on these fluids within the industry. Basically, the wide diversity of opinions expressed by the participants is an obvious sign of confusion with regard to the performance and use of certain fluids.

To most of the participants, the rules regulating the management of heat-transfer liquids and refrigerants are not clear. For example, Article 5.5.3 c) of standard C448-02 stipulates that “the heat-transfer fluid must cause little corrosion on the internal surfaces of all of the materials currently used in ground source heat pump systems”. From all evidence, a better definition of the expression “little corrosion” would be appropriate. The participants would prefer rather that clear guidelines specific to geothermal systems be established and published as required in order to establish a classification of recommended products, rather than just a list of prohibited products. Note that the participants clearly indicated that all substances that circulate within the ground should be regulated. Furthermore, the creation of a list of antifreezes currently authorized by the various levels of government would be highly useful to the participants. To accomplish this, better coordination of the various regulations would be required.

A significant part of the discussions dealt with methanol. What emerged from the discussions was that the low cost of methanol constitutes its principal advantage, and that this economic aspect is non-negligible in the design and installation of a geothermal system. Those who are reluctant to have methanol used in geothermal systems allege that its high inflammability makes it too risky, and that this property is harmful to the “green” system image associated with geothermal energy. Thus many feel that the low cost of methanol should not be used as an argument, and that the argument is in fact misleading. Consequently, many of the participants were in favour of a universal banning of methanol at the national level. Its toxicity and inflammability and the contamination of ground water and soil were just some of the reasons cited to justify its prohibition.

However, in a similar proportion, other participants call for the prohibition against methanol in Ontario and in certain Canadian municipalities to be reviewed and reconsidered. This group of observers thinks that when methanol is used safely and appropriately, the risks relating to its inflammability are negligible. In addition, in the opinion of those who support the general use of methanol, the performance efficiency the fluid provides greatly exceeds the environmental risks it entails. We note once again a considerable lack of knowledge regarding this fluid, as contradictions concerning its properties are frequent and generally without foundation.

The participants also frequently discussed the use of propylene glycol. Although some cited the fluid’s low environmental impact, several negative comments were expressed: it is too expensive and too viscous, it requires a larger heat pump, pumping and maintenance costs are high, etc. Furthermore, some people even suggested that it is unnecessary to inject a bentonite filler throughout the entire length of the well given that the product is non-toxic and that, in case of a leak, the consequences on the environment would be minimal or zero.

Finally, certain participants made some comments about ethanol. Among these, it was noted that the “flash point” of ethanol is situated exactly within the temperatures and concentrations used in geothermal systems. This characteristic, combined with the fluid’s denaturation during transportation and its carcinogenic potential, could pose a problem in certain installations, particularly with regard to manipulation of the product and to the safety of workers and occupants in the building.

With regard to refrigerants, some people suggested that propane might be an interesting alternative in certain applications. Despite the product's high inflammability, its performance in terms of heat transfer and its low greenhouse gas emissions should be investigated. Furthermore, the participants noted that more intensive research on CO_2 as a refrigerant would be useful to the geothermal industry. Synthetic fluids such as R-410A and R-407C were also discussed. What emerged was that these are transitional fluids, in particular because of their high potential impact for global warming. A certain number of participants suggested that the industry should pay particular attention to natural refrigerant liquids, seen as a solution of the future, by eventually replacing the synthetic fluids currently used in the geothermal industry.

The general opinion is that more clarity is needed in the regulations for refrigerant liquids. The participants also indicated that it would be useful to investigate the compatibility of antifreezes with various materials, more specifically the inhibitors which might react with water, heat and the materials used in the circuit.

Furthermore, safety is deemed to be a priority factor when using and transporting the various fluids. Since the potential risk of accidents involving the use of the various fluids has not been sufficiently considered, several participants maintain that there remains considerable work to be done in increasing awareness and educating the various parties. In this context, the concept of responsibility was also frequently raised during the discussions on fluids. There is no doubt that a certain confusion exists concerning the responsibilities of the various parties in the installation of a geothermal system. The question "who should be responsible?" was a recurring theme, but no clear response emerged from the discussions.

What did emerge was that it would be of primary importance to establish clear, precise directives on the limits of each party's responsibility, stating when each one's responsibility begins and when it ends. In other words, establishing guidelines would be appreciated. Some participants saw a role for municipal inspectors in this matter.

Finally, the CGC also collected numerous comments on contradictions and ambiguities relating to standard C448. Following is an example:

> **C448.1-02**
>
> « 5.5.2 The heat-transfer fluid shall consist of water, an acceptable antifreeze if protection against freezing is required, and **acceptable corrosion inhibitors** […] ».
>
> **C448.2-02**
>
> « 11.7 Closed-loop recirculating pumps shall be corrosion-resistant ans suitable for the ancitipated operating temperature rrise. »

There is a certain ambiguity here. Several manufacturers of circulating pumps offer various models on the market. The three most common types have rotors of cast iron, stainless steel or bronze. In reality, if the heat-transfer liquid is composed of a rust inhibitor and a biocide (an agent that essentially attacks iron bacteria in this case), the circulating pump will not rust. An anti-corrosion pump signifies that no part of the pump in contact with the heat-transfer liquid should be composed of steel (except stainless steel). In the CGC's best practices, it is recommended that a biocide be added to the geothermal system in order to combat the formation of iron bacteria. Based on this fact, it would make sense to recommend the addition of a biocide in Article 5.5.2 of commercial standard C448.1-02.

A.3 Piping

The discussions dealing with piping all focused on the gaps and confusions of the current regulations, particularly standard C448. The obsolescence of standard C448, and of other standards to which it refers, rapidly became a consensus. According to many participants, the regulations no longer responds to the geothermal industry's current needs, and it limits the evolution of new products in the marketplace. Many participants mentioned the lack of relevance of standard C448, which mentions specific products rather than focusing on design and installation criteria. For example, the standard mentions only PE3408, although several other types of piping have already proven their worth (PE100, PE4710). With regard to the dimensions of the piping, a significant number of participants state that SDR 13.5 should be acceptable in certain circumstances, especially with the arrival of new types of piping, but also because they consider that the safety factor currently in force is exaggerated. Based on this fact, a thinner wall thickness in the piping should be tolerated in geothermal systems.

The participants call for piping regulations that would be specific to geothermal systems. This standard should ensure a maximum of flexibility and latitude so as not to restrict users to one type of piping in particular. Instead, the regulations should establish minimum technical specifications in order to encourage innovation and to eliminate entry barriers to new products on the market. From this perspective, the participants maintained that standardization based on the mechanical resistance of the piping would be both necessary and sufficient. While not very numerous, comments on the markings on piping were nevertheless expressed. The first half don't see any problem with current practice for marking of piping, while the second underlines the importance of establishing a standard for identification of piping, a standard that would be specific to the geothermal industry and that would therefore consider the conditions specific to geothermal systems. The idea of having an exclusive piping colour (green for example) in geothermal systems made the rounds among the participants. Finally, the visibility of the markings on piping is also an issue. Contrasting colours between the marking and the piping would facilitate reading the information and avoid potential errors.

Several participants raised the importance of implementing a permanent committee that would be able to verify the conformance of the various products and, most importantly, ensure continuous updating of knowledge with regard to new technologies. Proponents of this idea specify that such a committee could issue regular technical notices that reflect innovation.

Furthermore, according to the comments received, consistency in the quality of the material leaves much to be desired. In addition, from an environmental perspective, many participants maintain that scraps of piping are abundant on work sites. Consequently, a recycling program should be instituted to facilitate management of these wastes.

The discussions on piping equipment concluded with the methods for installation and fusion of piping. Few comments were received, except to reiterate the importance and the value of training. The existing training and accreditations were deemed adequate. In addition, the participants agree on the importance of fusion, which is, in their opinion, the only valid method of joining two pipes together. The rules in this regard are in place, but better supervision was seen as required to make sure these rules are applied.

B Guidelines on System Design

Subjects raised during the second section of the sessions related to geothermal system design. The principal objective remained the identification of problems with the existing standards, codes and regulations. To achieve this objective, the discussions covered three (3) categories: (1) heat loss, (2) loop length and (3) design *per se* and sizing of the heat pump.

B.1 Heat Loss

A major part of the discussions on heat loss focused on the use of software. The advantages cited relating to the use of such software come down to its precision and speed of execution, but they are generally deemed to be incomplete and not user-friendly. Several software packages have restrictions, such as the exclusion of certain materials and other technical specifications, factors that would tend to bias the results obtained.

Most of the participants focused on the human factor and the key role that the user of the software plays in the validity of the results obtained. According to several participants, the principal difficulty encountered with the software is the expertise and education of the users. According to some, users do not pay enough attention to the quality and exactness of the technical data they enter into the software. The result is a significant margin of error that could have a considerable impact on the design of the geothermal system, in particular with regard to the capacity of the heat pump and the length of the exchangers.

The participants were invited to propose a new initiative for determining the heat loss of a house. Annual and monthly simulation tools based on the design peak load and on regional climatic conditions were suggested. Along the same lines, a compulsory comparison with the consumption history would be an appropriate method for installations in existing buildings. It was proposed to perform an initial summary calculation of heat losses in order to provide the client a global idea. Then if the client accepts the submission, a second more detailed calculation could be performed and used in the design process. Detailed calculations of heat losses should also be recorded in the client's file, which is specified in standard C448, but is not always respected.

Another suggestion raised for the CGC concerns production of a reference manual that would provide more accurate "R" values. The idea of assigning the load calculations to a specialized third party was also suggested during the sessions.

The method providing the greatest precision in evaluating heat losses is without doubt thermal imaging. This technique should be included in a guide to best practices. Also, a new approach in the calculation of heat losses including the ecological footprint would help to improve the image of geothermal systems. Finally, note that several participants are comfortable with the existing methods and that, in their opinion, these methods already cover everything required.

The standards concerning calculations of load loss should be revised, according to the majority of participants. Several of them are of the opinion that standard F280, which is referred to by standard C448, is obsolete. It was suggested that the new ASHRAE standards be used instead.

Finally, from the perspective of promoting the technology and possibly even associating various subsidies with it, the impact of greenhouse gases would be an issue to consider in the design process. This opinion is certainly shared by many participants, but some would prefer that this apply only at the commercial level and not in residential installations. However, the manner of arriving at a precise calculation of these emissions remains complex, and essentially relies on the quality of the heat loss calculation. Based on this fact, a third party could be in charge of determining these figures or of validating them. Also, the subject of hour counters resurfaced in this section. The participants are of the opinion that these counters would enable precise calculation of greenhouse gas emissions. Implementation of a program directly linked to emission reductions is recommended.

B.2 Loop Length

Loop sizing software was also a concern to the participants. Here again, several of them emphasized the importance of the data entered into the software, but also on programming elements and reference databases contained in the software.

The human factor remains a concern to most of the participants; the role of the user was seen as being critical with respect to the results obtained using software. This time, other than the speed and the practical aspect, few positive comments were expressed with regard to the available software for calculating loop length.

The current software packages seem basically to be little appreciated by the users. Some of them think that they are too complex, leading therefore to a high error rate. Others think that they are not user-friendly enough. In addition, the current software packages do not offer sufficient flexibility in data entry. Clearly, the participants think that such software is too limiting, and is behind the times with respect to the available technologies.

Furthermore, certain participants emphasized that performing simulations of the fluid entry and exit temperatures over a period of several years should be required in order to guarantee an appropriate design to the client. In addition to adding this data analysis over a longer period, the availability of data on an hourly basis would enable an increase in the precision of all calculations. Several participants looked favourably on the idea of a single software package being used as a reference, and of having this software updated frequently.

One questions asked of the participants was intended to determine the level of interest in including the loop length calculations in the client's file for future reference. A response clearly in favour of this practice was expressed; furthermore, it was added that "any explanations or considerations that (could) have the effect of modifying the length calculation should be included in the client's file". The reasons given were many, but essentially consisted of avoiding the short-cuts some people take, and of its usefulness for future reference during any replacement of the heat pump or for any unforeseen problem that might arise. In order to improve the precision of the details provided to clients, some suggested that a photo record of the site including the location of piping should be obligatory in evaluating certification files.

The subject of loops in coils (slinky loops) came up in several discussions in some of the workshops, but few written comments were collected. Although many participants think that this type of loop is not efficient, the CGC, based on the scarcity of complaints received about these systems, believes that this technology has its place within geothermal industry practices. However, as is the case with any other technology, the application of best practices is essential to its success. For example, coiled loops are advantageous in a specific type of soil, in this case damp soils.

Finally, despite the wide variability in the thermal properties of soils, the participants were mostly in favour of a reference that establishes the properties specific to each type of soil. Obviously those who call for such a reference specify that the creation of a soil conductivity map is intimately tied to the various regions and should therefore take into account these differing conditions. Furthermore, some participants emphasized that there now exists software that provides *in situ* data during drilling, such as temperature, pH, soil type, conductivity and other information. Consequently these data could serve to identify particular information that could influence the loop length calculation.

B.3 Other Design-related Issues

The third section on the design theme was intended for discussions on economic aspects of geothermal systems. To begin with, Article 10.3 of standard C448 was the subject of long discussions, but without any clear consensus emerging. Article 10.3 requires that the capacity of the heat pump respond to 70% of the calculated thermal charge in order to respond to 90% of the annual heating requirements. It is remarkable that few of the participants were able to explain the technical reasons behind this requirement, which is why opinions were divided.

It also emerged from the discussions that this requirement, which concerns heating, should rather be interpreted taking into account the need for air conditioning. Certain participants think that over-sizing could cause problems in air conditioning mode. Most of the heat pumps installed in Canada operate in two stages. Over-sizing risks causing numerous “stop-starts” in air conditioning mode, which would lead to discomfort for the occupants and unnecessary stress on the heat pump, reducing its useful life. Also, several participants think that the standard should reflect these air conditioning needs just as much as heating needs. Some even propose that designs should always be made in air conditioning mode in order to avoid this problem.

To the majority of participants, the requirement should be to respond to 90% of the annual heating needs, without regard to a minimum for the calculated heat charge of the building. Some spoke of a minimum of 85%, other of 95%. The requirement of 70% seems generally poorly understood, many preferring to focus on heating needs (energy) rather than capacity needs (power).

Several participants also raised problems of under-sizing of geothermal systems, while others spoke of over-sizing. These statements, like several other interventions, are not always supported by specific cases. In many cases, it is simply veiled criticisms of a competitor.

Finally, participants highlighted the lack of vision of Article 10.3, which limits innovation. To them, requirements of this type make the installation of hybrid systems difficult since the geothermal portion may not meet the standard. They criticized the fact that this narrow vision in standard C448 causes numerous regulatory problems relating to the application of the National Building Code (which refers to standard C448) and to the issuing of construction permits in many municipalities.

Several participants also criticized the frequently incomplete and confusing language of standard C448, particularly with regard to the types of filler and to the various methods of calculation. It was also suggested that a table dealing with turbulence in the piping be included in the standards, just like the requirement to provide an analysis of the life cycle for commercial systems. Some request that the standards be clearer and require that conductivity tests be strictly reserved to engineering firms.

In addition, a recurring theme during the discussions on the various subjects was application of the existing regulations and the need to have “police” for inspections. Basically, the subject seems to be a priority in the eyes of participants, who explain that having a standard without surveillance has no real value.

C The Various Technologies and the way in which they are Approached and Handled in the Codes, Standards and Regulations

The third section of the workshops dealt with the various technologies in the geothermal industry. The first part of this section covered all of the technologies, assigning particular importance to new technologies that are not yet regulated. The second part concentrated on drilling technologies.

C.1 The Types of Systems

The discussions dealing with the technologies gave rise to several criticisms of standard C448. Generally speaking, the participants deemed this standard too incomplete and too restrictive with regard to the acceptable technologies. These animated discussions led the participants to suggest a major modification to the structure of the standard as a whole – or rather its complete replacement by a document similar to that of the Plumbing Code (NRC), that is, a series of flexible standards based on objectives, guidelines and minimum criteria.

The participants also insisted on the importance of the inspection and of supervision of work sites by a project manager. Basically, supervision is essential to the industry and should even focus on the CGC's global quality program. It is thought that such a measure would ensure the application of the standard with certainty. In addition, the implementation of "police" in the industry is a wish frequently expressed during the discussions. Similarly, several participants propose offering training to municipal inspectors to facilitate the obtaining of permits and tighten up certain sometimes tortuous regulations.

Several participants also emphasized the lack of knowledge in the industry regarding the handling and use of bentonite. It seems that few people pay attention to the importance of the mixing recipes recommended by the manufacturers. All of bentonite's "chemistry", in particular the reactions according to ambient temperature or the pH of the water used, causes numerous technical problems during the filling of wells. This aspect should be added to the training and a pocket reference document should be available for loop installers so that they can easily refer to it when on work sites.

Various elements were identified as requiring improvement in the regulations; the tests of soil thermal conductivity are among the contentious issues raised by the participants. Basically, a profound review of the methods of evaluating soil thermal conductivity seems to be required. To achieve this, the establishment of a procedure to follow would enable better standardization of the data collected. More specifically, several participants believe that data entry should be standardized and used by everyone in order to obtain a bank of data that is both precise and broad enough for the geothermal industry. Evidently, some participants emphasize that to make such a data bank valid and functional, data collection procedures must be implemented and standardized.

The participants also mentioned a lack of clarity with regard to the regulations dealing with open loops. One participant notes that it would be important to properly define the various waterways based on the regulatory requirements specific to each: ponds, lakes, rivers, retention basins, artificial lakes, etc. Based on this fact, a better cooperation among the various regulatory organizations is required to consolidate the various opinions and expertise in order to establish a clear standard on this subject. Also concerning systems installed on a body of water, the regulations on lake and ocean loops should be reviewed and improved, according to the participants.

A very large majority of the participants poorly explain the exclusion from standard C448 of direct expansion systems and column systems, technologies which, however, have been known and recognized for several years. The participants seemed satisfied to learn that direct expansion systems are the subject of an amendment to standard C448, but some criticized the long and expensive process of this update to the standard. The participants also think the development of a standard for column systems is essential.

The participants also mentioned the absence of standards dealing with the installation and design of natural gas geothermal systems. Several also noted that new technologies and drilling approaches do not conform to standard C448. The same goes for piling technologies. Finally, standardization – or the absence of appropriate guidelines – for hybrid systems was raised once again. Participants spoke about solar systems among others, but also about the combination of geothermal systems with combined production systems for heating and electrical energy.

Generally speaking, the education of individuals, whether professionals in the industry or property owners, is a recurring subject in all of the themes broached during the workshops. Based on this fact, according to various observers, an apprenticeship program is essential to the industry's proper functioning and credibility. College programs are a target of choice for the geothermal industry, compared to training offered by the manufacturers which is often biased. On a note addressed directly to the CGC, certain participants believe that accreditation should be valid for a period longer than 2 years.

Finally, but not exhaustively, several isolated comments were also collected concerning the inclusion or improvement of regulations in the standard: multiple-speed compressors, hydronic heating, radiant floors, horizontal systems, etc.

C.2 Drilling Techniques

Several interesting points were raised during the discussions on drilling. The participants think that a geographic database presenting the results contained in drilling reports would enable better regional understanding of soil properties. Similarly, improvement of geological maps and better access to geological information would also be appropriate to increase the precision and performance of drilling.

The drilling footprint on the environment also seems to be a major issue for the participants. Several emphasized that environmental protection should outweigh additional costs. Based on this fact, a reduction in the pollution from the drilling unit and promotion of drilling technologies with low greenhouse gas emissions would enable the industry to promote the green aspect of geothermal systems. High fuel consumption, the use of used and contaminated oils as lubricants, the diameter of bore holes, the re-using of tubing, oil spills and water recuperation are only some of the aspects that concern the participants. In addition, protection of ground water seems clearly to be a major issue with regard to drilling, and with regard to geothermal systems as a whole. A multitude of questions were received on this subject, essentially with regard to cross-contamination of aquifers and control on the surface during drilling. Several participants point out that regulations on protection of ground water exist in each province, and that the industry standards should therefore be harmonized with this regulation.

The lack of training of drillers and of the teams that install geothermal loops was also raised on several occasions. To the participants, controlling the work of the drillers is directly related to the final quality of the work performed. Consequently, additional efforts are required in training the drillers, and this training should be supported by legislative and regulatory measures that would enable better conformance of the particular work of geothermal bore holes. In the education section, a national training program for inspectors would be required, as has previously been called for.

However, with regard to the current regulations on drilling activities in general, and geothermal bore holes in particular, few participants had a clear idea of the codes, standards and regulations that govern the industry. To many, the regulations and the drilling activities are obscure. For example, with regard to the provincial regulations on ground water, closed-loop systems seem to have been forgotten or poorly defined, creating a certain freedom with regard to the techniques that can be used. Also, better education dealing with the regulations specific to drilling is required.

The regulations should also include a minimum conductivity ratio for fillers, a point that has already been raised. In addition, in the opinion of a large proportion of participants, the current minimum standards are not appropriate. The current standard, 95% concrete/5% bentonite, makes no sense in the eyes of some and should therefore be reviewed. In the same vein, standardized references on the properties of fillers (permeability, conductivity, methods) should also be included in the standard. Furthermore, bentonite has been the subject of questions as to its utility in the system as a whole.

Several participants also questioned the relevance of injecting a bentonite-based filler throughout the entire length of the well when the well is largely within solid rock. Some suggested leaving it up to the system designer to decide on the way in which the well should be constructed. Several participants state that bentonite is not needed throughout the entire length of the well; others think that it is. It emerged from the discussion that exhaustive educational work is necessary, as the participants have fixed and polarized opinions on the use of fillers.

Finally, geoclips are part of the regional issues. The principal advantage of this technology concerns the increase in system performance. Based on this fact, several participants consider that this technology should be included in the regulations. Furthermore, horizontal (or directional) drilling is another regional issue and should on all evidence be defined in the regulations.

D Open Discussion

To conclude the workshops, an open discussion was planned in order to cover all of the issues concerning the regulation of geothermal systems. Three subjects had previously been selected in order to initiate the discussion: (1) guidelines concerning the replacement of a heat pump, (2) protection of soils and ground water and (3) issues relating to interconnections. Few new subjects were raised, the participants preferring to explore in more depth certain subjects raised previously.

The replacement of heat pumps is an issue that seemed to concern several participants. In their view, the replacement of these pumps must provide for cleaning of the loop, refilling with fluid and revised calculations of heat loss. The importance of preserving the data and including it in the client file is thus once again underscored by this issue. In addition, a publication dealing with the steps to be followed during replacement of a heat pump would be greatly appreciated by the various participants.

Generally speaking, the participants think that there is a great deal of confusion within the industry with regard to knowledge of the environmental laws appropriate to geothermal systems. The participants think that the provincial environmental laws are very well defined, and that the standards should refer to them rather than proposing criteria that apply discontinuously almost everywhere in Canada. In this context, concerns were raised about lubrication of drilling equipment, the use of certain heat-transfer liquids (particularly methanol) and the use of copper in direct expansion systems. In the opinion of many participants, work on awareness and information is needed.

The interconnections between geothermal systems and other renewable-energy systems were raised again at this step in the consultation, and everyone recognized the absence of relevant standards. Several participants would like to see specific subsidies for hybrid systems as well as adjustable subsidies based on system performance. This performance could be measured by the addition of counters on geothermal systems.

System controls are also a major issue frequently raised during the discussions. According to some participants, what is deemed adequate is not at all clear. For example, systems with two compressors or those with two stages are not appropriately dealt with in the standard. Based on this fact, a consensus within the industry should lead to the establishment of clear, precise definitions on this subject.

From the perspective of increasing the quality of installations, several observers think that all geothermal systems installed in Canada should be certified, whether or not there is a subsidy available to the clients. With regard to subsidies, these unsurprisingly arouse enthusiasm among the participants, who see in them an essential incentive for the geothermal industry. These subsidies should also apply to new construction and could be linked to system efficiency. From this perspective, the installation of hour counters is gaining in popularity, and would be a proof of uniformity in determining system performance.

Finally, generally speaking, many specifics on various subjects are required in the standard: tracer wires, various minimum distances, etc. In addition, education in general, and more specifically that of property owners, remains a major issue for the industry.

Once again, the CGC has over time noted certain contradictions and ambiguities in the existing regulations. Following are other examples:

C448.2-02

« 6.4 The segment of the surface water in the vicinity of the proposed submerged heat exchanger shall be investigaged for potable water intakes and minimum water levels. A **minimum distance** of 2m (6.6 ft) is required between any part of the submerged heat exhanger system and a potable water intake. »

« 7.2.6 In addition to Clause 7.2.5, a submerged system shall be desgined with due consideration given to the following :

[…]

d) a **minimum distance** between any part of the collector system and the lot line or potable water intakes of 10 m (33 ft); […] »

C448.2-02

« 9.1. The installing contractor shall ensure that the **sytem** is pressure-tested for 1 h at 690 kPa (100 psi) pressure with no leaks and that the requirements of Clauses 9.2 to 9.4 are strictly fulfilled.

Comparing Articles 6.4 and 7.2.6 clearly illustrates a contradiction in standard C448 with regard to the minimum distances to be respected. Furthermore, the word "**system**" is not among the definitions provided in the standard. This omission raises a great deal of questioning with regard to the interpretation of Article 9.1 of standard C448.2-02: is the heat pump an integral part of the system? Won't the flexible tubes connecting the heat pump deform and cause a pressure drop? According to the commercial standard (C448.1-02), pressure tests at 690 kPa (100 lb/in^2) are not performed on the heat pump. Therefore, should the process of conducting testing be the same for residential and commercial installations? The CGC notes that the steps are much better defined in the commercial standard than in the residential standard.

Finally, the participants were invited to formulate specific recommendations to the attention of the various government authorities. These have been communicated to concerned parties.

Conclusions

The consultations conducted in June and July 2009 formed part of the process of transformation of markets initiated in 2007 by the implementation of the CGC's training, accreditation and certification programs. In addition to the comments collected during these consultations, the CGC has received numerous suggestions concerning codes, standards and regulations since the beginning of its Global Quality GeoExchange program in 2007. In addition, CGC personnel have since 2007 collected numerous problems with the application of the existing standards, in particular standard C448.

This document provides a summary of the seven consultation sessions held in Canada. These sessions provide the tone with regard to industry opinion with regard to the codes, standards and regulations currently in effect. Basically, according to the participants present at the sessions, the existing regulatory framework poses a colossal challenge to the geothermal industry. Standard C448 was the subject of particularly serious criticisms due to its multiple gaps, its contradictions and the too-numerous cross-references between the residential section and the commercial section. Finally, standard C448 frequently contradicts other codes, standards or regulations.

In this context, recommendation No. 25, which suggests replacing standard C448 with a guide to exemplary practices based on objectives rather than on a list of prescriptive measures, takes on its full meaning; firstly because geothermal systems should not be the only heating and air conditioning technology to be subject to a specific design and installation standard; and also because standard C448 is fundamentally rigid and outmoded, and the updates, which are long and costly, do not reflect the evolution of science, R&D and innovation.

As a follow-up to this report, the CGC is now beginning summary work that will include an analysis of all of the comments received since the beginning of the market transformation process in 2007. Added to this summary will be an exhaustive list of problems encountered by the CGC during the technical analysis of more than 12,000 geothermal systems from 2007 to 2010.

The results of this in-depth analysis and specific recommendations will then be presented to the CGC Board of Directors for evaluation and direction. CGC staff has put together a preliminary report which contains more than 200 pages and includes 39 recommendations.

Appendix 1 – Workshop Agenda

8h00 – 8h30	Registration
8h30 – 9h00	Introductory remarks: workshop format and objectives

Part A – Equipment

9h00 – 10h20	**GeoExchange equipment and installation norms**

9h00 – 9h05	Topic presentation: A.1 – HEAT PUMPS
9h05 – 9h15	Guided group discussions – written formulation of recommendations for CGC and regulators
9h15 – 9h20	Topic presentation: A.2 – FLUIDS
9h20 – 9h30	Guided group discussions – written formulation of recommendations for CGC and regulators
9h30 – 9h35	Topic presentation: A.3 – PIPING EQUIPMENT
9h35 – 9h45	Guided group discussions – written formulation of recommendations for CGC and regulators
9h45 – 10h15	Group reports in plenary – Formulation of recommendations for CGC and regulators
10h15 – 10h20	Section wrap-up
10h20 – 10h40	Break

Part B – Design

10h40 – 12h00	**Current guidelines on designing**

10h40 – 10h45	Topic presentation: B.1 – HEAT LOSS
10h45 – 10h55	Guided group discussions – written formulation of recommendations for CGC and regulators
10h55 – 11h00	Topic presentation: B.2 – LOOP LENGTH
11h00 – 11h10	Guided group discussions – written formulation of recommendations for CGC and regulators
11h10 – 11h15	Topic presentation: B.3 – GENERAL DESIGN QUESTIONS
11h15 – 11h25	Guided group discussions – written formulation of recommendations for CGC and regulators
11h25 – 11h55	Group reports in plenary – Formulation of recommendations for CGC and regulators
11h55 – 12h00	Section wrap-up
12h00 – 13h00	Lunch

Part C – Technology

13h00 – 14h20	**Different technologies and how they are treated in codes, standards and regulations**

13h00 – 13h05	Topic presentation: C.1 – GEOEXCHANGE SYSTEMS
13h05 – 13h20	Guided group discussions – written formulation of recommendations for CGC and regulators
13h20 – 13h35	Group reports in plenary – Formulation of recommendations for CGC and regulators
13h35 – 13h40	Topic presentation: C.2 – TYPES OF DRILLING TECHNOLOGIES
13h40 – 13h55	Guided group discussions – written formulation of recommendations for CGC and regulators
13h55 – 14h15	Group reports in plenary – Formulation of recommendations for CGC and regulators
14h15 – 14h20	Section wrap-up
14h20 – 14h40	Break

Part D – Open Discussion

14h40 – 16h00	**Current guidelines on pump replacement, soil and ground water protection, interconnections and other issues**

14h40 – 14h45	Topic presentation: Open discussion
14h45 – 15h40	Group reports in plenary – written formulation of recommendations for CGC and regulators
15h40 – 16h00	Workshop wrap-up and next steps

Appendix 2 – List of Participants

Saint-Hyacinte
June 22 / 22 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Sébastien	Lajoie	Gaz Métro
David	Grenier	NextEnergy
André	Fry	Concept R. Inc.
Jean-Yves	Paquette	Synergie
Michel	Marquez	Enviroair Industries Inc.
Richard	Labelle	Climatisation Labelle 1996 Inc.
Jean-Guy	Ferland	Les Consultants CSE Inc.
Stephan	Vosburg	Groupe Master
Christophe	Stordeur	GeoTech Marcel Racine & Fils
Jacques	Fontaine	Geothermie Boréale Inc.
Marc	Sider	DP Ingénieurs-Conseils Inc.
André	Rotondo	Géo-Energie inc.
Jacques	Rotondo	Géo-Air Industries inc.
Patrick	Lambert	Géo-Energie inc.
Angelo	Lazaris	Ameresco
André	Laplante	Les Entreprises XMF
France	Sergerie	Lys Air Mécanic inc.
Eric	Drouyn	E.D. Refrigeration
Sébastien	Gauthier	Solutions Géothermie MC2 Inc.
François	Tremblay	Excel Climatisation
Eric		GeoPros
Henri	Bouchard	CMMTQ

Burnaby
June 23 / 23 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Daniel	Booy	Altum Engineering Ltd.
Ali	Sajjadi	MEG Geothermal Corp
Shahram	Sandatmandi	MEG Geothermal Corp
Brian	Saadatmandi	MEG Geothermal Corp
Fred	Feige	ExchangEnergy Inc.
Juh Nam	Ho	Protech Entreprises Ltd.
Howard	Dahl	Innovative Heating Ventilation Air Conditioning Ltd.
Joachim	Fleischer	Green Geothermal Installations Inc.
Bernie	Ramm	Greenray Geothermal
Jim	Croken	Okanagan Geothermal Ltd
Jeff	Quibell	Okanagan Geothermal Ltd
Jason	Rockson	Mercury Refrigeration
Mel	Zabolotniuk	NextEnergy
Geoff	Turner	Ministry of Energy, Mines & Petroleum Resources
Rachel	Bolongaro	Hemmera Energy
Rick	Saari	TR3 Geothermal Services Inc.
Barry	Hart	Geo-Tech
Noah	Dennis	Geo-Tech
Matt	Dennis	Geo-Tech
Tim	Wiens	4Life Utility Locates
Ben	Kapusta	Vanguard Pipe & Fittings Ltd.
Mark	Metzner	Corix Utilities Inc.
Scott	Martin	West Coast Geothermal
Doug	MacForlane	
Rick	Cronin	Ground Force Systems Inc.
Troy	Issigonis	Horizon Engineering Inc.
Wes	Reusse	BC Geothermal Solutions

Calgary
June 24 / 24 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Alec	Smith	Ener-West Geo-Energy Services Inc.
Dale	Bateman	Ener-West Geo-Energy Services Inc.
Vern	Lessoway	CleanEnergy
Chris	Mitchell	CleanEnergy
Derral	Orr	CleanEnergy
Michael	Ramsay	Municipal District of Rocky View
Ken	Hykawy	Municipal District of Rocky View
Brad	Meyers	Aaron Drilling Inc.
Allan	Poettcker	M.D. of Rocky View
Marlon	Hellwig	ABC HVAC Services Ltd.
Udo	Kaufmann	Benevan Corp
Don	Macintyre	Alberta Geothermal Energy Association
Denton	Hocking	Clean Energy
Walter	Dunnewold	ATCO Gas
Andrew	Gaetz	Geothermal Drilling Ltd.
Michael	Roppelt	GSS Geothermal Ltd.
Bill	Beaton	Impact Property Inc.
Gerry	Classen	ECCO Heating
Rod	Vaillant	ECCO Heating
Dennis	Terhove	City of Calgary
Joseph	L'Heureux	Earthwise Energy Systems
Chris	Homeniuk	Earthwise Energy Systems
Chris	Lewoniuk	Geothermal Utilities Ltd.
Tyler	Crawford	Aaron Drilling Inc.
Doug	Kinch	Gound Source Energy Ltd.
Shane	Kinch	
Jaysen	Inverarity	Foothills Geothermal Ltd.
Jason	Munro	GeoWest Drilling Services
Melanie	Hamilton	GeoWest Drilling Services
John	Hicks	JayVee Consulting
Gary	Whitesell	Crater Lake Drilling Ltd.
Ralph	Salm	Geofurnace Technologies Inc.
Jim	Bererton	Stantec Consulting Ltd.

Regina
June 25 / 25 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Glen	Reynolds	Reynolds Electric
Robin	Stuart	EMCO Ltd
Randy	Posehn	ECCO Heating Prod.
Dwight	Hayter	GEOS
Shaun	Gettis	Dwight's Drilling & Geothermal Inc.
Greg	Donnelly	Yorkton Geothermal Inc.
Dwayne	Snider	Regina Geothermal & Solar
Don	Morris	Cool Breeze Refrigeration
Heather	Hind-Hluchaniuk	Nippawin Geothermal
Dale	Neuman	Evergreen Energy Solutions Ltd.
Barb	Gilbey	SaskPower
Terry	Deck	Deck's Geo-Electrical
Jean-Marie	Breault	Uponor Ltd.
Grant	McVicar	SRC
Shawn	Wedewer	SRC

Ste-Foy
June 30 / 30 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Denis	Samson	Samson et Frères Inc.
Richard	Samson	Chauffage Géothermique Jean-Guy Samson
Lucie	Monger	Chauffage Géothermique Jean-Guy Samson
Martin	Sanfaçon	Les Forages LBM Inc.
Denis	Bonneville	Uni-Draulik
René	Laroque	Géothermie Boréale
Luc	Beaulieu	Climat Confort LB Inc.
Francine	Brassard	Climat Confort LB Inc.
Jasmin	Raymond	Université Laval
Vasile	Minea	Institut de recherche d'Hydro-québec, laboratoire LTE
Stéphane	Voyer	Golder Associé Ltée
Martin	Bédard	Equipement Environnemental Terra Inc.
Jean-Michel	Leblanc	Université Laval- Laboratoire de Transports Thermiques et d'ener
Michel	Chapdelaine	Forage Technic-Eau

Toronto
June 30 / 30 juin

First Name / Prénom	Last Name / Nom	Organization / Organisme
Greg	Brown	Haliburton Geothermal
Larry	Porter	Porter's Refrigeration Inc.
Peter	Watson	Tranquility Home Comfort Ltd.
Ron	Laird	Laird & Son
Allan	Zacher	Eden Energy Equipment
Joseph	Simon	Premi-Air Heating & AC
Eric	Stephenson	Lighthouse Renewables
Maurizio	Bellone	Trinus Pipes & Tubes Ltd.
Heather	Brodie-Brown	Ministry of the Environment
Don	Murray	Enertran Technologies
Gary	Poyntz	Clean Energy Developments
Jane	Kearns	Clean Energy Developments
Mike	Jantz	Enertran Technologies Inc.
David	Terlizzi	HRAI
Chris	Barry	Terratherma.ca
Rahul	Sharma	AASA Reliable Geo Energy Ltd.
Ken	Sherwood	Comfortwave Heating & Cooling Ltd.
Tony	Chan	MMM Group Ltd.
Leslie	Thomas	GeoXperts Energy
Philip	Gerrard	Municipality of North Grenville
Chris	Wallace	Geothermal Solutions
Michael	Wallace	Geothermal Solutions
J. Robert	Bruce	Ontario MOE
Matt	Irvine	NextEnergy
Joe	Carr	Nottawasaga Mechanical
Bob	Gillier	Geothermal Solutions
Tim	Gillier	Geothermal Solutions
Jack	Laken	Termobuild
Steve	Cunning	Earthheat.ca Inc.
Gord	Bailey	Fleming College
Earl	Morwood	Ontario Ground Water Association
Daniel	Vanhevel	Geo-Teck Heating & Cooling Ltd.
Daniel	Clarke	CS Energy & Mechanical
Michael	Gordon	Geofitters Inc.
Robert	Herriot	New Energy Developments Inc.
Janette	Smith	BRC Mechanical Inc.
Nancy	Dalgard	BRC Mechanical Inc.
Ray	Woo	CSA

(To be continued on next page)

Sam	Loggia	CSA
Stan	Marco	GeoSmart Energy
Tom	Cates	HRAI
Vito	Rabbito	Nekison engineering & Contractors Ltd.
John	Kernaghan	LJ Kernaghan Construction Ltd
Shawn	Long	MAK Mechanical
Glenn	Coady	Durham College
Jeremy	Brown	NSF International
Glen	Kaye	Maritime Geothermal
Kejian (Henry)	Li	AAA Electrical & Mechanical Inc.
Ivan	Sirman	Green Energy Initiatives
Carlos	Jurado	Ontario Ministry of the Environment
Richard	Ochnick	Green Energy Initiatives
Scott	Fréchette	MPI Geothermal
Patrick	Carroll	Tili Electrical
Claudio	Spagnuolo	City of Brampton
Chen	Shalita	Diamond & Schmitt
Chip	Loughead	Gravenhurst Plumbing Heating & Electrical
Fraser	Newton	Yanch Geothermal
Brent	Yanch	Yanch Geothermal
Angelo	Macchia	Recochem Inc.
Philip	Coulter	P.E. Coulter & Associates Ltd.
June	Thomson	Norfolk Energy Inc.
Michel	Deschamps	Eastrock Inc.
Dave	Chaffe	Eastrock Inc.
Chris	Dopson	Thake Home Comfort Centre
Bill	Ross	UA Local 663- Sarnia, ON
Cindy	Dopson	Thake Home Comfort Centre
Jim	Link	Link Heating and Air Conditioning Ltd.
Jeff	Link	Link Heating and Air Conditioning Ltd.
Bob	Marshall	Cedaridge Services Inc.
Neil	Martin	Martin Groundworks
?	Du	Mann Engineering Ltd.
Laverne	Coulter	Coulter Heating & Air Conditioning
Tom	Ramage	Northern Heating & Ventilation
?	Pesai	Mann Engineering Ltd.
Tom	Anderson	Comfortwave Heating & Cooling Ltd.
Don	Harkness	Primemax Energy Inc
Steven	Syms	Primemax Energy Inc
Nuno	Duarte	Stantec
Paul	Pisani	
Paul	Catton	Virsare Inc.
Bruce	Sinclair	Virsare Inc.
Gabriela	Grigoriu	Next Project
Elissa	Mai	Four Seasons Geothermal
Stephen	Wilson	Golder Associates Ltd.
Jeff	Zimmerman	HRAI

Truro
July 3 / 3 juillet

First Name / Prénom	Last Name / Nom	Organization / Organisme
Tom	Dooly	Ground Loop Geothermal Systems
Cory	Macnutt	Modern Refrigeration and Air Conditioning Inc.
Robert	Cameron	Gevity Group Inc.
Keith	Doucette	Kerr Controls Ltd.
Stephen	Tweedie	Tweedie & Associates Ltd.
Mark	McCormick	Advanced Heating Solutions
Peter	Henderson	Kerr Controls Ltd.
Rick	Hubbard	Wilson's
Wallace	Myalls	King's Refrigeration & A/C Ltd.
Stanley	McNutt	Kerr Controls Ltd.
Mark	Lennan	Halifax Heating Residential Inc.
Charlie	Redmond	Holland College
Scott	Dunbar	Valley Refrigeration & A/C
George	Watson	Valley Refrigeration & A/C
Christopher	Robar	Christopher Robar Contracting Ltd.
John	Conroy	Conroy Refrigeration Ltd.
Robbie	McLellan	Conroy Refrigeration Ltd.
Kelvin	Martin	Ultra Air Conditioning Ltd.
John	Drage	Nova Scotia Environment
Carson	Greencorn	Versatile Ventilation Inc.
Paul	Wamback	NS Department of Energy
Michael	Bird	NS Department of Energy
Dave	Innes	The Master Group
Neil	Mader	Maders Refrigeration
Sara	Mudge	Efficiency NB
Armand	Cormier	Armlin Geothermal Drilling Ltd
Alyre	Pelletier	Al Refrigeration
Michael	Caudle	Tank Doctor Aquatic Systems Inc.
Dwaine	Brewer	ADI Limited
Bill	Graham	W.R. Graham Services Ltd.
Nicholas	Bellefontaine	BMCI
Bob	Tremblett	TremTech Electrical Systems Inc.
Stephen	Osmond	Atlantic Driling & Blasting
Francis	Gale	Atlantic Driling & Blasting
Patrick	Byrne	BMC Contracting Ltd.
Brandon	Purdy	BMC Contracting Ltd.
Brett	Nelson	BMC Contracting Ltd.
Jim	Wilkie	J. Wilkie Mechanical Inc.
Brian	Nicholl	NSCC
Scott	Newson	Anvil Mechanical Contractors Ltd.