

Arena Buildings and CBIP

1. Introduction

In June of 2002, the Retail Food Stores (RFS) were included in the Commercial Building Incentive Program (CBIP) using a new approach for compliance demonstration based on a simplified modeling tool called the EE Wizard. This Internet-based tool simulates the energy performance of a RFS for CBIP submission following a simplified Performance Path method that requires the user to input a reduced amount of project data. This tool was developed since refrigeration equipment is not included in EE4-CBIP.

The EE Wizard has now been extended to include arenas (e.g. ice rinks, skating rinks, curling sheets). The Arena EE Wizard has been developed along the same guidelines as those used for the RFS EE Wizard, namely:

- the Arena EE Wizard is a Web-based compliance tool,
- the Arena EE Wizard offers credits for refrigeration equipment improvements,
- the Arena EE Wizard must be used to submit and arena-type building to CBIP

This document provides a detailed description of the Arena EE Wizard, presents its different features and gives summary technical descriptions of the energy efficiency measures that are offered for potential CBIP compliance credits.

2. Overview of EE Wizard

As for the RFS EE Wizard, the Arena EE Wizard is an hourly-based simulation program that uses the same DOE-2.1 run-engine than its cousin EE4. Unlike EE4, the Arena EE Wizard is only available through the Internet, where all input data is entered, saved and the results are presented in an official compliance report.

The main advantage of the Arena EE Wizard is that it offers a much quicker and easier way to model the building. Furthermore, the Arena EE Wizard incorporates a number of special refrigeration modeling routines not available elsewhere, including EE4 or DOE2.1e.

To allow a faster modeling of the building a number of parameters have been predefined through the use of a building archetype. The building archetype is based on the most commonly encountered building geometry, layout and

systems for a given vocation. The use of an archetype enables the user to concentrate on defining only the parameters that have the most impact on the energy efficiency of the building while the Wizard automatically constructs the rest.

Many aspects of the Arena EE Wizard are similar to those seen in EE4-CBIP. For example, the Arena EE Wizard always generates a reference building that must adhere to MNECB. The Wizard also insures that the proposed building respects minimal MNECB rules similarly to what is done by EE4-CBIP. Also, all of the Performance Path related issues stated in Part I of CBIP Technical Guide equally apply to EE Wizard.

The Arena EE Wizard can be accessed at <http://oee.nrcan.gc.ca/cbip> (french address is <http://oee.nrcan.gc.ca/pebc>) through most standard Web Browsers. Using the Arena EE Wizard does not require any special software to be installed on a computer, other than a Web browser and an Adobe Acrobat™ Reader.

Starting a Project

Starting a project using the Arena EE Wizard only requires registration so that all data can eventually be saved in a user account. The projects opened under a user account can only be accessed by that user. A new user must first register before entering its projects. Figure 1 illustrates the data required for registration. Registration is only required in order for the Arena EE Wizard to save projects under a password protected user account.

Both Arena and RFS EE Wizard share the same user account manager. Therefore, if a user already has an account for the RFS EE Wizard, this same account can and should be used to access the Arena EE Wizard.

Figure 1: Registration for all EE Wizards

Natural Resources Canada / Ressources naturelles Canada

Canada

Français	Contact Us	Help	Search	Canada Site
OEE Home	Publications	Text View	Print View	NRCan Site

Welcome to the Retail Food Store Compliance Analysis Web Wizard!

Create Your Account!

Please provide the following information to create your account *NOTE: you will use your email address and password to gain access to your account.*

*(Required fields are indicated by *)*

Company/Organization Name

Contact First Name *

Contact Last Name *

Email Address *

Phone Num.

Address Line 1

Address Line 2

City

Province *

Postal Code

Account Password *

Confirm Password *

After registering into the EE Wizard, users can create new Arena or RFS projects or edit existing ones by simply following various links.

Before Entering Data

The EE Wizards provide a fairly simplified data entry process. However, the users are still asked to enter a large number of parameters. To simplify the data entry process and to minimize the chances of errors, an Excel Help sheet is available to the user. This spreadsheet can be downloaded and completed prior to entering the data in the Wizard. The Help Sheet presents all the data required to perform an EE Wizard simulation in a concise format.

Figure 2: Defining projects in EE Wizard

The screenshot shows the EE Wizard interface. At the top, there are logos for Natural Resources Canada and Ressources naturelles Canada, along with the Canada wordmark. A navigation menu includes: Français, Contact Us, Help, Search, Canada Site, OEE Home, Publications, Text View, Print View, and NRCan Site. Below the menu, the text 'signed on as' is visible. The main heading is 'Welcome to the EE Wizards' followed by a 'Welcome' message and a list of steps: 1) Start a new project by entering the required information. An EOI (Expression of Interest) number is required for a CBIP submission. 2) Enter all required project data for space definition, windows & doors, lighting system, schedules, heating & cooling, ventilation, dehumidification, refrigeration and utility rates. 3) Generate a compliance report. A note states: 'Once the compliance report is generated and the project meets the CBIP requirements then you are ready to submit your project to Natural Resources Canada for verification.' At the bottom, a section titled 'The following files are available for download to aid in gathering your project data requirements:' lists two files: 'RFS - Help Sheet (xls)' and 'Arena - Help Sheet (xls)'. Annotations in yellow boxes with arrows point to 'My Projects', 'Start a New Project', and 'Arena - Help Sheet (xls)'.

List all existing projects

Home
Account Management
My Projects
Start a New Project
CBIP Home Page
Sign Off !!

Creating a new project

signed on as

Welcome to the EE Wizards

Welcome

The EE Wizards allow you to quickly generate a report that analyzes whether or not your project is eligible for a CBIP incentive.

The following steps outline how to use the EE Wizards:

- 1) Start a new project by entering the required information. An EOI (Expression of Interest) number is required for a CBIP submission.
- 2) Enter all required project data for space definition, windows & doors, lighting system, schedules, heating & cooling, ventilation, dehumidification, refrigeration and utility rates.
- 3) Generate a compliance report.

Once the compliance report is generated and the project meets the CBIP requirements then you are ready to submit your project to Natural Resources Canada for verification.

The following files are available for download to aid in gathering your project data requirements:

- [RFS - Help Sheet \(xls\)](#)
- [Arena - Help Sheet \(xls\)](#)

Help Sheet to simplify and accelerate the data gathering process

Creating the Project

Once the introductory page of Figure 2 is displayed, the user can create a new Arena or RFS project or edit an existing one. Figure 3 presents the page displayed when a new project is created.

Figure 3: Creating new projects in EE Wizard

The screenshot shows the top navigation bar with the Canadian flag, 'Natural Resources Canada' and 'Ressources naturelles Canada' logos, and the 'Canada' logo. Below this is a menu with 'Français', 'Contact Us', 'Help', 'Search', and 'Canada Site'. A secondary menu contains 'OEE Home', 'Publications', 'Text View', 'Print View', and 'NRCan Site'. The main content area is titled 'signed on as' and features a sidebar with links: 'Home', 'Account Management', 'My Projects', 'Start a New Project', 'CBIP Home Page', and 'Sign Off !!'. The main heading is 'Start a New EE Wizard Project', followed by the instruction 'Please select the type of project you would like to create.' Two options are listed: 'Retail Food Store Project' and 'Arena Project', each with a plus icon. At the bottom, there is contact information for the Administrator, a 'Back to top' link, and 'Important Notices'. The page footer indicates 'Last Modified 2002 06 17'.

As mentioned earlier, the same user account serves to access and create Arena and RFS projects. To create an Arena project, the user only has to select the Arena Project option.

Figure 4 presents the information needed to define a new Arena project. Only the fields indicated with an asterisk are actually required for starting a new project. However, for a formal CBIP submission, additional information on the Applicant will be required, such as an EOI number¹.

Once the information has been entered a confirmation page is displayed, as shown in Figure 5.

From that point, the user is directed to the main page used in defining an Arena project, as shown in Figure 6. On this page, an overview of the four (4) available zones for the Arena is displayed along with a number of general data entry fields. These general fields include the various utility



¹ EOI numbers can be obtained by contacting OEE

rates for the building, the weather location and a global data entry button.

The user can now proceed with the detailed definition of the building. However, this process is easier when the Help Sheet shown in Figure 2 has been filled-in beforehand.

The data can be entered in any order in the EE Wizard. It is however important for the user to understand how the data is saved and managed by the EE Wizard before continuing with the definition of a project.

Figure 4: Defining a new Arena Project

 Natural Resources Canada / Ressources naturelles Canada 

Français	Contact Us	Help	Search	Canada Site
OEE Home	Publications	Text View	Print View	NRCan Site

signed on as



[Home](#)
[Account Management](#)
[My Projects](#)
[Start a New Project](#)
[CBIP Home Page](#)
[Sign Off !!](#)

[? CBIP Help](#)
Start a New Arena Project

To start a new Project, please provide the following information. After you provide the following information, the EE Wizard will be launched.

*(Required fields are indicated by *)*

Project Name *


Energy Efficiency Measures  

EOI Number


Building Location

Address

City

Province 

Postal Code

Building Region 

Project Designer

First Name

Last Name

Title

Organization Name


Phone

Email

Project Designer Address

Address

City

Province 

Postal Code

Figure 5: Confirming a new Arena Project

[Home](#)

[Account Management](#)

[My Projects](#)

[Start a New Project](#)

[CBIP Home Page](#)

[Sign Off !!](#)

Start a New Arena Project

Please Confirm Your Project Information

Please confirm the data you have provided below. If all the information is correct, select "Continue". If you need to make any changes to your data, please select "Edit My Project Info".

Project Name : Example
Project Description :
EOI Number :

Building Location

Address:
City:
Province :
Code Postal :
Building Region :

Project Designer

First Name :
Last Name :
Title :
Organization :
Phone :
Email Address :

Project Designer Address

Address:
City:
Province :
Postal Code :

[Edit My Project Info](#) [Continue](#)

Figure 6: Main page for defining an Arena Project

[Home](#)

[Account Management](#)

[My Projects](#)

[Start a New Project](#)

[Change to Imperial Unit of Measurement](#)

[CBIP Home Page](#)

[Sign Off !!](#)

ARENA PROJECT : Example

The following diagram illustrates each zone of the Arena that you will need to define for the compliance analysis. Select the "Modify..." button in each zone, and the EE Wizard will lead you through the data entry.

Project Definition.

Define Building Zones
If a zone is not applicable to your Arena Project, please leave the box unchecked within that zone.

Global Data

incomplete

Bleachers

incomplete

Number of Ice Sheets:

Ice Sheet #1
incomplete

Lockers/Change Rooms/ Washrooms/ Showers

incomplete

Check if applicable

Entrance/Cafeteria/Snack Bar

incomplete

Check if applicable

Multipurpose Space :

incomplete

Check if applicable

Building Region

Define Utility Rates
In order to define the utility rates associated to this project, please place a check mark in the box next to each utility that applies.

<input type="checkbox"/>	<input type="button" value="Modify..."/>	Electricity - Energy Rates	n/a
	<input type="button" value="Modify..."/>	Electricity - Demand Rates	n/a
<input type="checkbox"/>	<input type="button" value="Modify..."/>	Natural Gas Rates	n/a
<input type="checkbox"/>	<input type="button" value="Modify..."/>	Propane Rates	n/a
<input type="checkbox"/>	<input type="button" value="Modify..."/>	Fuel Oil Rates	n/a

For all OEE Internet related inquiries, please contact the [Administrator](#)

[Back to top](#) ↑
[Important Notices](#)

Last Modified 2002 06 17

Global data applicable to every zone

4 available zones

Applicable utility rates

Saving your Project's Data

The EE Wizard allows you to save the data you entered in a project at any point in the data entry process. The data saved is recorded in the EE Wizard database server and can be retrieve later on by the user to continue or modify a given project. No data is saved on the user's computer at any point in the analysis process.

The data is saved by clicking on the *Save* or *Save & Continue* or *Save & Go Back* buttons, as shown in Figure 7. Changing tabs using the upper tab buttons also allows saving any data entered by the user, as long as each data entry was followed by an ENTER key.

Figure 7: Saving a project's data

The screenshot displays the 'ARENA PROJECT : Example' interface. On the left is a navigation menu with links: Home, Account Management, My Projects, Start a New Project, Change to Imperial Unit of Measurement, CBIP Home Page, and Sign Off !!. The main content area is titled 'ZONE: Bleachers' and features a 'Space Definition' tab, which is highlighted in orange. Other tabs include 'Windows & Doors', 'Lighting System', 'Temp Control', 'Heating & Cooling', 'Ventilation', 'Dehumidification', and 'Refrigeration'. A yellow callout box labeled 'Save by changing tab' has arrows pointing to the 'Space Definition' tab and the 'Temp Control' tab. Below the tabs are several data entry fields: '* Floor Area : [input] (m²)', 'Exterior Walls' section with '* Total Exterior Wall Area: [input] (m²)' and '* Average Exterior Wall R-Value: [input] (m² - °C / W)', 'Roof' section with 'Total Roof Area: [input] (m²)' and '* Average Roof R-Value: [input] (m² - °C / W)', and 'Floor On-ground' section with 'Total Floor Area: [input] (m²)' and 'Insulation Type: [Uninsulated dropdown]'. At the bottom, a yellow callout box labeled 'Saving using command buttons' has arrows pointing to three buttons: 'Save', 'Save & Continue >>', and '<< Save & Go Back'.

All data in a project is available only to the user through his password protected account.

Getting your Results

Results from an Arena EE Wizard run typically consist of a Compliance Report in the form of a single Acrobat (pdf) file. The file can be downloaded from the Wizard Web site, following a successful run, by clicking on the indicated link.

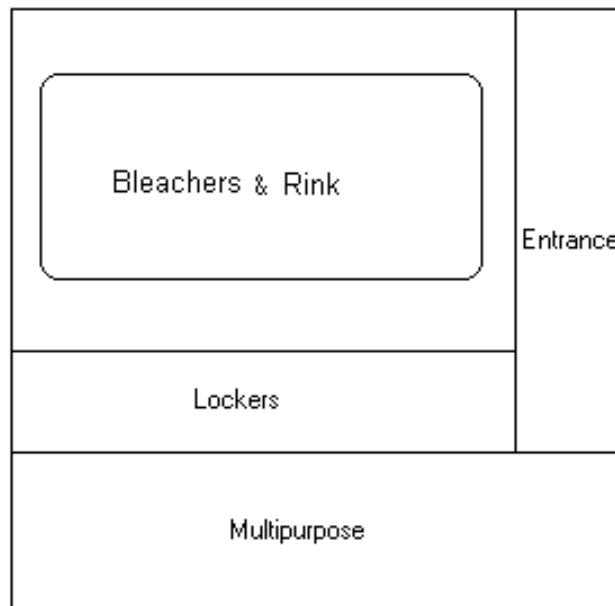
The summary Compliance Report is similar to what is produced by EE4-CBIP. A message at the bottom of each page indicates if the report can be used for a CBIP compliant submission. The Wizard also displays summary results directly on the Results Web Page for preliminary analysis.

Zoning of arenas in the EE Wizard

The building archetype adopted for arenas is based on a four-zone model as shown in Figure 8. Each zone represents a thermal block with similar periods of heating and cooling, occupation, space use, and mechanical systems.

The arena archetype has been established based on the more commonly encountered arena layout. However, each of the archetype zones, except the Bleachers/Rink zone, can be ignored if it is not present in a given building, as will be shown in section 3.1.

Figure 8: The Arena EE Wizard zones



The actual physical location of each zone relative to one another is unimportant in the EE Wizard. Therefore, the floor layout shown in Figure 8 is for illustration purposes only. Each zone in the EE Wizard can be treated as an internal zone or completely external simply by defining the amount of exterior walls for the zone. For example, any zone with no exterior walls will be treated, implicitly, as internal.

The EE Wizard can account for heat transfer between the Bleachers/Rink zone and any other zones since the temperature set points for the Bleacher zone can be significantly lower than for any other zone.

Projects Management


The EE Wizard allows performing a number of operations on the projects saved in a user account. Hence, a user can create a copy of an existing project, delete an obsolete project or send a project for review to NRCan. The latter option is covered in more details in section 5. These options are available by selecting the “My Projects” menu item in the left hand side menu bar.

To copy a project under a new name, the user has only to select the “Duplicate Project” icon on the appropriate project line, as shown in Figure 9. Doing so will bring up a page requesting the new name for the duplicated project. This option is very useful when analyzing similar buildings or when doing various scenarios on a given building for which the final design is not yet defined.

Project can be deleted using the “Delete Project” icon. A deleted project is permanently erased from the user’s account. To protect against accidental deletion of projects, the EE Wizard requires a confirmation before deleting any project.


Finally, this page also enables the user to consult the results of the latest simulation ran for a given project by selecting the “View Report” link.

Figure 9: Managing projects in the EE Wizard



Natural Resources
Canada

Ressources naturelles
Canada



Français

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Home Français

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View

Print
View

NRCan
Site

signed on as

Home

Account Management




My Projects










Start a New Project

CBIP Home Page

Sign Off !!

My Projects

 Send Project to NRCan for Review
 Duplicate Project
 Delete Project

Project Name	Last Modified	
RFS - Exemple	07-26-2002	  
RFS - Exemple	07-26-2002	   View Report
RFS - Toto	07-22-2002	   View Report

For all OEE Internet related inquiries, please contact
the [Administrator](#)

Last Modified 2002 06 17

[Back to top](#) ↑

[Important Notices](#)

3. Using the Arena EE Wizard: Step-by-Step

Using the Arena EE Wizard does not require any knowledge of DOE or EE4. It is simply a matter of filling in the required input data. The data can be entered in almost any order, with the exception of a few values. There is, however, a few rules and work-arounds that must be known and considered when using the EE Wizard. The following presents a step-by-step description of the data input sections in EE Wizard:

3.1 Space Definition

Floor Area

As shown in Figure 8, the arena EE Wizard offers up to 4 zones when defining an arena. The normal first step required when defining a zone in the EE Wizard is to enter a *Floor area* as shown in Figure 10.

The value entered for the *Floor area* must be the summation of the conditioned floor areas for all the rooms comprised in a zone (as defined in MNECB article 1.1.3.2). The spaces in an actual arena may not correspond exactly to those available in the EE Wizard. In these cases, the user must assign each of his actual spaces to one and only one of the EE Wizard space.

Some general guidelines on how to assign actual spaces to the pre-established EE Wizard spaces are provided in the *User's Tips* section.

It should be noted that the zone identified as Bleachers in the EE Wizard also comprises the ice rink or rinks, if there is more than one. Thus, the sum of all bleachers area and ice rink area MUST be entered.

NOTE: Whenever the *Floor area* is left at 0, the EE Wizard ignores the zone. Thus, if a zone is completely defined but its *Floor area* is left at 0, it will NOT be modeled.

Figure 10: Defining a Space in the arena EE Wizard

Home
Account Management
My Projects
Start a New Project
Change to Imperial Unit of Measurement
CBIP Home Page
Sign Off !!

ARENA PROJECT : Example
CBIP Help

ZONE: Bleachers

Space Definition

Windows & Doors Lighting System Temp Control
Heating & Cooling Ventilation Dehumidification Refrigeration

* Floor Area : (m²)

Exterior Walls

* Total Exterior Wall Area: (m²)
* Average Exterior Wall R-Value: (m² - °C / W)

Roof

Total Roof Area: (m²)
* Average Roof R-Value: (m² - °C / W)

Floor On-ground

Total Floor Area: (m²)

Insulation Type:
Uninsulated

Save Save & Continue >>
<< Save & Go Back

Total Exterior Wall Area

The next step in defining a zone consists in entering its external wall area. This wall area is the summation of all walls exposed to ambient conditions, including unconditioned spaces, for all the spaces comprised in that zone. The wall area entered must be the gross wall area, including any doors and windows.

NOTE: If windows or doors are to be defined in a zone, the value for *Total Exterior Wall Area* must be defined first.

The Wizard does not require opaque walls orientation. Only window elements require defining an orientation.

Average Exterior Walls R-value

If a value is entered for the exterior wall area, its average overall R-value must be defined. This R-value corresponds to the area-weighted average of all the overall R-values which includes all thermal bridging, for all the exterior walls in that zone. Refer to MNECB Appendix C for the accepted method for calculating overall R-value.

Total Roof Area

The gross surface area of the roof, defined as the opaque roof area plus the areas of any skylights contained in the roof.

Average Roof R-value

The R-value is the area-weighted average of all the overall R-value which includes all thermal bridging, for all the roofs in that zone. Refer to MNECB Appendix C for the accepted method for calculating overall R-value.

Floor-on-ground area

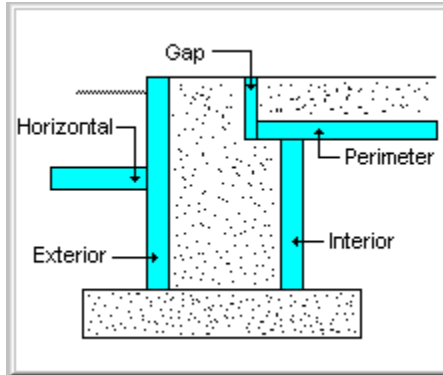
The floor-on-ground area includes any floor area that is in contact with the ground. Rules on how to consider below ground floors and walls are presented in the “*Special Cases and Workarounds*” section of this guide.

For the Bleachers’ zone, the floor-on-ground area EXCLUDES the ice sheet(s) area. The ice sheet(s) area is defined separately as will be seen in section 3.8.

Floor-on-ground Insulation Type

The level of insulation for floor-on-ground must be selected from a drop-down menu. The following diagram illustrates the meaning of each of the insulation placement referred to in that list.

Figure 11: Floor-on-ground insulation placement



NOTE: Insulation levels for floor-on-grounds does not give rise to any CBIP credits but are subjects to mandatory requirements in the MNECB.

Finally, for all zones except the Bleachers' zone, the user can define a partition wall between the current zone and the Bleachers zone. To do so, the user must defined the area common to the bleachers zone as well as the insulation level of the partition wall. Any floors separating a zone from the Bleachers zone must also be define as a Partition Wall and NOT as a floor-on-ground component (e.g. a cafeteria floor above part of the bleachers).

Figure 12: Defining a Partition Wall in the arena EE Wizard

Home ARENA PROJECT : Example
 Account Management CBIP Help Back To Main Diagram

My Projects

Start a New Project

Change to Imperial Unit of Measurement

CBIP Home Page

Sign Off !!

ZONE: Change Rooms

Space Definition Windows & Doors Lighting System Temp Control

Heating & Cooling Ventilation **Partition Walls**

Area common to ice shed: m² ← Wall AND floor area common to bleachers zone

Wall insulation: m² - °C / W

Save Save & Continue >>

<< Save & Go Back

3.2 Windows and Doors

Defining windows in the Arena EE Wizard consists in entering their gross area, including framing, their orientations and types from drop-down menus.

NOTE: The sum of all windows area and door area cannot exceed the *Total Exterior Wall area* for the zone.

It is not possible to define skylights or non-vertical glazing elements.

The characteristics of the windows in the pre-defined list are provided in Table 1.

Table 1: Windows characteristics

Window Type	U-value W/(m ² -K) / BTUH/(ft ² -°F)	SHGC
Standard double/Vinyl	2.84/0.50	0.52
Standard double/Alum	3.22/0.57	0.61
Standard low-e/Vinyl	2.15/0.38	0.28
Standard low-e/Alum	2.50/0.44	0.33

Only one type of door can be defined in each zone. The total exterior door area is the sum of all opaque doors in that zone. Opaque doors are defined as doors with less than 50 % glazing.

Figure 13: Defining Windows and Doors in the EE Wizard

Home ARENA PROJECT : Example
 Account Management CBIP Help Back To Main Diagram
 My Projects
 Start a New Project
 Change to Imperial Unit of Measurement
 CBIP Home Page
 Sign Off !!

ZONE: Bleachers

Space Definition **Windows & Doors** Lighting System Temp Control
 Heating & Cooling Ventilation Dehumidification Refrigeration

Windows

Orientation	Area (m ²)	Type
<input type="text"/>	0.00	Standard double/Vinyl
<input type="text"/>	0.00	Standard double/Vinyl
<input type="text"/>	0.00	Standard double/Vinyl
<input type="text"/>	0.00	Standard double/Vinyl

Up to 4 orientations or window types per zone

Exterior Doors

* Total Exterior Doors Area: 0.00 (m²)
 Type: Insulated Metal

Save Save & Continue >>
 << Save & Go Back

3.3 Lighting System

The Arena EE Wizard only requires three data entry to define a zone's lighting system.

Average Lighting Power Density

The only mandatory element is the average lighting power density (LPD). This LPD is the area-weighted average of the LPD of each spaces comprised in the zone.

IMPORTANT: The LPD defined for the Bleachers zone must NOT include the lighting fixtures serving the ice sheet(s). These elements are defined separately as will be shown in section 3.8.

Type of Lighting Control

Automatic lighting control strategies can be defined in the Arena EE Wizard by selecting from a drop-down menu. Choices range from

occupancy control to daylight sensing (DS) control with continuous dimming, multiple step dimming or on/off control. Only one type of control strategy is possible in a zone.

Percentage of Lights Controlled

After defining the type of control strategy used in a zone. The user must specify what percentage of the lights these sensors control. The percentage entered is the power-weighted average of the lights controlled to the total lighting power in the zone (ballasts included).

Figure 14: Defining the Lighting System in the EE Wizard

The screenshot shows the 'ARENA PROJECT : Example' interface. On the left is a sidebar with links: Home, Account Management, My Projects, Start a New Project, Change to Imperial Unit of Measurement, CBIP Home Page, and Sign Off !!. The main area has a breadcrumb trail: ARENA PROJECT : Example > CBIP Help > Back To Main Diagram. Below this is the 'ZONE: Bleachers' configuration. A grid of buttons includes Space Definition, Windows & Doors, Lighting System (highlighted), Temp Control, Heating & Cooling, Ventilation, Dehumidification, and Refrigeration. The 'Lighting System' section contains three fields: '* Average Lighting Power Density: : [] (W / m²)', 'Type of lighting control: [None] (dropdown)', and 'Fraction of lights controlled: [0.00] %'. A yellow callout box with an arrow pointing to the LPD field contains the text: 'Area-weighted average NOTE: Ice sheet(s) lighting excluded from this average LPD'. At the bottom are three buttons: Save, Save & Continue >>, and << Save & Go Back.

3.4 Temperature Control

Each zone in the Arena EE Wizard can have its own temperature set points for heating and cooling. These set points must be greater than 12.8 °C. Since the Arena EE Wizard may account for heat transfer between the bleachers zone and any other zone, it is important to enter the correct set points. Furthermore, the heating set point for the Bleachers zone has a very significant influence on the refrigeration load. Therefore, caution must be used when selecting a set point superior to 15 °C in this zone as it may lead to unrealistic refrigeration loads.

If there is no cooling capacity defined in the zone, the cooling set point is ignored and can be left as is.

If heating set back is present in the zone, The arena EE Wizard will automatically reduce the temperature set point by 4 °C according to the temperature schedule shown in Tables 2. If cooling control is selected, the cooling temperature set point will be set to 35 °C (95 °F) during unoccupied periods.

The arena EE Wizard imposes a predefined daily and weekly schedule for all the zones in the building. This pre-defined schedule cannot be modified. However, the user is able to impose the yearly operating schedule by defining the number of weeks of operation for the ice sheet(s), as presented in section 3.8. The weekly schedule will be repeated during each week of operation defined by the user in section 3.8.

The weekly schedule determines the hourly profiles for lighting use, ventilation and outside air schedule, equipment use and eventual set back periods. The hourly profiles corresponding to the predefined schedule is provided in Table 2.

The fan schedules in Table 2 apply to ventilation, outside air and exhaust fan control.

Figure 15: Defining the Temperature Set Points in the EE Wizard

Home ARENA PROJECT : Example
Account Management CBIP Help Back To Main Diagram

My Projects

Start a New Project

Change to Imperial Unit of Measurement

CBIP Home Page

Sign Off !!

ZONE: Bleachers

Space Definition	Windows & Doors	Lighting System	Temp Control
Heating & Cooling	Ventilation	Dehumidification	Refrigeration

Heating Set Point: (Min. 12.8 °C)

Heating Setback: Set Back

Cooling Set Point: (Min. 12.8 °C)

Cooling Control: Stopped

Save Save & Continue >>

<< Save & Go Back

Bleachers set point is usually no more than 15 °C.

Table 2: Arena Default Schedule Details

	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p	12	
Occupants																									
Mon - Fri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Sat	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.20	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50
Sun	0.00	0.00	0.00	0.00	0.00	0.10	0.10	0.20	0.50	0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50
Lighting																									
Mon - Fri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sat	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sun	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Receptacle																									
Mon - Fri	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sat	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sun	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fans																									
Mon - Fri	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On	On	On	On	On
Sat	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On
Sun	Off	Off	Off	Off	Off	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On	On
Cooling																									
Mon - Fri	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB
Sat	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB
Sun	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB
Heating																									
Mon - Fri	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB
Sat	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB
Sun	SB	SB	SB	SB	SB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB	NSB

SB: Set back possible

NSB: no set back possibility

3.5 Heating and Cooling

The Arena EE Wizard simplifies the definition of the mechanical system by setting up most of its parameters and by predetermining the systems type. The EE Wizard allows two different configurations for the building HVAC system. These configurations are:

- A- Integrated geothermal system for HVAC and refrigeration
- B- Standard single zone systems for the 4 zones with separate refrigeration system.

The selection of integrated geothermal system is made in the “Global Data” section, as shown in Figure 16 (see Global Data button in Figure 6).

Figure 16: Selecting HVAC System Type in the EE Wizard

The screenshot shows the 'Global Data' section of the EE Wizard. On the left is a navigation menu with links: Home, Account Management, My Projects, Start a New Project, Change to Imperial Unit of Measurement, CBIP Home Page, and Sign Off !!. The main content area is titled 'ARENA PROJECT : Example' and includes a 'CBIP Help' icon. Under 'Global Data', there are two checkboxes: 'Geothermal (all zones):' and 'Radiant in-floor option (only applicable if Geothermal is checked):', both with 'Yes' labels. A yellow callout box with arrows pointing to these checkboxes contains the text: 'These boxes are used to select geothermal system and radiant in-floor'. Below these options is a text input field for '* Total Installed Lighting Power over ice sheets (> 0) (kW)'. A 'Service Hot Water' section contains a dropdown for 'Energy source for SHW' (set to Electricity), an input for 'Efficiency (25-100%)' (100.0 %), and two input fields for 'Nominal flow rate (L / s)' for Showers (0.1577) and Faucets (0.1389). It also has checkboxes for 'Motion activated faucets' and an input for 'Percentage of motion activated faucets (0-100%)' (0.0 %). At the bottom are two buttons: 'Update Info' and 'Update Info & Return to Diagram'.

While selecting geothermal system in the “Global Data” page, the user can also select the Radiant in-floor heating option for the Bleacher zone. This option is ONLY available for geothermal system and only for the bleacher

section. The radiant in-floor option may give rise to compliance credits by allowing maintaining a lower set point in the bleachers zone compared to that of a conventional forced-air system. However, some of that gain may be partially offset by additional radiant gain from the warm floor to the ice through reflection on the ceiling. The EE Wizard automatically adjusts the Reference building set point to credit the presence of the radiant in-floor system.

Once the system type is selected, either geothermal or conventional, the user must define the system's heating and cooling capacity capacities, heating source, and any terminal or baseboard heating used in a zone.

For the conventional system option, the heating and cooling systems, and their equivalent, defined by the EE Wizard for the arena zones are:

- 1- Bleachers zone: Unit heaters/force flow heaters/duct heaters with possible baseboards and cooling, fresh air from a make-up air unit and exhaust OR roof-top unit with possibility of cooling. Possibility of packaged dehumidification units.
- 2- Entrance: Roof top unit(s) with possibility of cooling and possibility of baseboards.
- 3- Lockers zone: Baseboards or force flow heaters, possibility of cooling.
- 4- Multipurpose zone: Roof top unit(s) with cooling and possibility of baseboards.

All roof-top units described above are single-zone/constant-volume packaged units. A combination of furnace or boiler and air-conditioner can also be treated as equivalent to one of these RTU as long as the system brings in the minimum outside air required by MNECB.

All RTUs are equipped with a dry bulb controlled economizer in the Proposed building. This configuration cannot be modified.

Similar to the assignation of an arena's actual spaces to those in EE Wizard, the user will have to assign actual systems of an arena project to those in EE Wizard. Some general guidelines on how to assign actual systems to the pre-established Arena EE Wizard systems are provided in the *User's Tips* section.

Figure 17: Defining the Heating&Cooling System in the EE Wizard

Home ARENA PROJECT : Example CBIP Help Back To Main Diagram

Account Management

My Projects

Start a New Project

Change to Imperial Unit of Measurement

CBIP Home Page

Sign Off !!

ZONE: Bleachers

Space Definition Windows & Doors Lighting System Temp Control

Heating & Cooling Ventilation Dehumidification Refrigeration

Total installed capacity

Heating System

Central Baseboard

* Capacity: (kW) (kW)

* Source:

* Heating Efficiency (> 25% & <= 100%): % Same as Central

Cooling System

* Capacity: (kW)

* Cool Efficiency (COP): (W/W)

Save Save & Continue >>

<< Save & Go Back

Heating Capacity

These values represent the total heating capacity both for baseboards (and/or terminal) equipment and for central equipment (e.g. roof-top units, force flow heaters, duct heaters). However, when only one type of equipment is present in a zone (such as baseboards), it is better to define this capacity as central instead of terminal. In the simulation, all terminal/baseboard heating equipment has priority over any type of heat recovery system (e.g. VRCs, refrigeration heat recovery).

NOTE: The “Central Heating Capacity” field is unavailable for geothermal system type. In this case, the EE Wizard automatically sizes the heating capacity for the zone.

Heating Source

These fields are used to determine the source for heating for central and

baseboard equipment. The “Central Heating Source” is unavailable when geothermal system is selected. Selecting “Heat Pump” has the effect of using an air-to-air type heat pump for the zone.

Heating Efficiency

This value refers to the instantaneous efficiency and not the annual fuel utilization efficiency (AFUE). The value is specified in % for combustion type system and as COP for geothermal system. The COP must be entered at standard test conditions (CSA-446).

Cooling Capacity

This value represents the total cooling capacity for the zone from any cooling equipment (e.g. window air-conditioners, roof-tops). Enter 0 if no cooling equipment is present.

NOTE: The “Central Cooling Capacity” field is available for geothermal system type. In this case, the EE Wizard does not automatically sizes the cooling capacity for the zone.

Cooling Efficiency

This value is specified in terms of EER or COP. The efficiency must be entered at standard rating conditions (e.g. such as CSA-446 for geothermal systems or ARI conditions for other type of equipment).

3.6 Ventilation

The second part of defining the mechanical system involves describing its ventilation components.

Supply fan

The first set of entries serves to describe the supply fan(s). The supply system is described by the total air flow assigned to the zone, its design static pressure and the combined fan/motor efficiency or the fan motor(s) power. If multiple fans serve the zone, the flow is the summation of all air flows from each fan. The static pressure is set by default identical to that of the reference building at 325 Pa/1.3 in. wg. For multiple fans, the static pressure is calculated as the flow-weighted average of all fan static pressure.

Whenever the “Supply Fan Power” is entered, it has priority over the static pressure and motor efficiency data.

The Arena EE Wizard does not allow defining a return fan system.

Outside air

Two entries serve in defining the outside air flow to a zone: the total design outside air flow rate and the total local exhaust flow rate.

The value entered for the total design outside air flow rate must be greater than that specified by the MNECB for CBIP Compliance. This minimum required value is provided on the screen by the EE Wizard. Also, the amount of local exhaust should be smaller or equal to the specified total design outside air flow rate. If the total outside air flow rate is below that required by MNECB, the Wizard will perform the simulation but the Compliance Report will indicate an error and will not be for CBIP Compliance.

If a heat recovery ventilator (HRV) is present on the ventilation system, its effectiveness must be specified here (entered in term of %). The value entered must be from formal accredited tests using a recognized standard (e.g. such as CSA or ARI). Appropriate documentation must be provided attesting the HRV performance. The increased static pressure drop due to an HRV must be included in the ventilation system design static pressure defined earlier. Whenever heat recovery is specified, it is important to know that all local exhaust is rejected directly to the outside, by-passing the HRV. Whenever local exhaust are ducted back to the HRV, these exhaust must not be defined and should only be considered in the total design outside air flow value.

Intermittent exhaust fans should only be defined in proportion of their actual usage compared to that presented in the schedule of Table 2 (e.g. a 100 CFM fan used for 2 h/day should be defined as having $100 * 2 / 10 = 20$ CFM since the fan schedule in Table 2 indicates a 10 h/day schedule for all fans).

Figure 18: Defining the Ventilation System in the EE Wizard

[Home](#)

[Account Management](#)

[My Projects](#)

[Start a New Project](#)

[Change to Imperial Unit of Measurement](#)

[CBIP Home Page](#)

[Sign Off !!](#)

ARENA PROJECT : Example

[CBIP Help](#) [Back To Main Diagram](#) ↩

ZONE: Bleachers

Space Definition

Windows & Doors

Lighting System

Temp Control

Heating & Cooling

Ventilation

Dehumidification

Refrigeration

Supply Fan

* Total Air Flow Rate: (L / s)

Design Static Pressure: (Pa)

Combined Motor/Fan Efficiency (> 25%, < 100%): %

Supply Fan Power: (kW)

Outside Air

* Total Outside Air Flow Rate: (L / s)

* Total Local Exhaust Flow Rate: (L / s)

Heat Recovery Ventilator Efficiency: %

Save

Save & Continue >>

<< Save & Go Back

This entry has priority over the fan efficiency and static pressure entries

Must meet MNECB minimum for compliance

3.7 Dehumidification

Only the *Bleachers* zone offers the possibility of defining dehumidification. This is attributable to the potentially significant impact that high humidity levels can have on the refrigeration system energy use. Other zones follow CBIP rules, which do not allow credits for dehumidification.

Only one type of dehumidification system is currently offered for arenas, namely packaged units dehumidification. These units are pre-assembled dehumidifiers, often hung on the ceiling, which rejects all their condenser heat to the Bleachers zone.

Whenever a dehumidification system is defined in the Proposed design,

the Reference building will have dehumidification based on packaged units. The minimum set point allowed in the Reference building is 40 % RH (relative humidity). If the proposed building has a set point lower than 40%, the Reference will remain at 40 % otherwise it will adopt the same as that of the Proposed.

Figure 19: Defining the Dehumidification System in EE Wizard

Home ARENA PROJECT : Example CBIP Help Back To Main Diagram →

Account Management

My Projects

Start a New Project

Change to Imperial Unit of Measurement

CBIP Home Page

Sign Off !!

ZONE: Bleachers

Space Definition	Windows & Doors	Lighting System	Temp Control
Heating & Cooling	Ventilation	Dehumidification	Refrigeration

Space has dehumidification

System Definition

Control Set Point: %

Type:

Save Save & Continue >>

<< Save & Go Back

Whenever multiple ice sheet are presents but only some of them have dehumidification, the user **must not** define any dehumidification for the Bleachers zone.

3.8 Refrigeration

Accurately defining the refrigeration system and its loads is very important for arenas since refrigeration can account for more than 50% of the total arena energy use. For an arena to be compliant with CBIP, it is an absolute necessity to incorporate a number of energy efficiency measures to the refrigeration system.

In order to completely define the refrigeration system and its loads in the EE Wizard, the user must access three different data entry pages.

1- Global Data Page

This page is used to define the total installed lighting power over all the ice sheets. This lighting power not only uses energy for its primary lighting purpose but also represent a significant load to the refrigeration system since up to 60% of the lighting power is picked up as a thermal load by the ice surfaces. Its is important for the user to know that the Reference building will have a lighting power density of only 13 W/m² over the ice for arenas with bleachers of less than 500 occupants of capacity and of 28 W/m² for larger arenas. Thus, any lighting power over and above these values will doubly penalize a CBIP submission since it will use more electricity for lightning AND for refrigeration.

Figure 20: Defining the Total Lighting Power over the ice sheets

The screenshot displays the 'Global Data' page for an 'ARENA PROJECT : Example'. The left sidebar contains navigation links: Home, Account Management, My Projects, Start a New Project, Change to Imperial Unit of Measurement, CBIP Home Page, and Sign Off !!. The main content area includes a 'Back To Main Diagram' link and a 'Global Data' section with the following fields:

- Geothermal (all zones): Yes
- Radiant in-floor option (only applicable if Geothermal is checked): Yes
- * Total Installed Lighting Power over ice sheets (> 0) [] (kW)

The 'Service Hot Water' section includes:

- * Energy source for SHW: Electricity (dropdown)
- * Efficiency (25-100%): 100.0 %
- Nominal flow rate (L / s): Showers [0.1577], Faucets [0.1389]
- Motion activated faucets: Yes
- Percentage of motion activated faucets (0-100%): 0.0 %

At the bottom, there are two buttons: 'Update Info' and 'Update Info & Return to Diagram'. A yellow callout box with an arrow pointing to the lighting power field contains the text: 'This value applies to all ice sheets in the building.'

2- Ice Sheet Page

The EE Wizard allows defining up to 4 separate ice sheets in an arena, as shown in Figure 21. Each ice sheet share a number of common

attributes, namely:

- all sheets are in the same zone (same heating set point);
- all sheets have the same LPD;
- all sheets share a common refrigeration system. However, if multiple compressors are used, the compressors are staged according to the number of operating ice sheet.

Other attributes are specific to each ice sheet and allow the user to define multiple usage ice-sheet buildings, as shown in Figure 22:

- ice sheet area;
- emissivity of ceiling above ice sheet;
- ice sheet usage;
- ice sheet temperature;
- number of resurfacing per week;
- number of week of operation;
- number of seats for ice sheet's bleachers.

Each of these parameters has an influence on the refrigeration load or energy use of the refrigeration system. Some of these parameters can also give rise to compliance credits.

NOTE: If a building comprises multiple ice sheets sharing identical or almost identical characteristics, such as multiple hockey rinks operating for the same number of weeks, they can be defined as only one larger ice sheet.

Ice Sheet Area

Enter the total ice sheet area. The total area for all ice sheets must be smaller than the area specified for the Bleachers/Rink zone (see Figure 10).

Ceiling Emissivity

Infrared radiant heat load is a significant component in an ice sheet refrigeration load (up to 35%). A good part of this load comes from the radiative heat emitted from the ceiling.

The emissivity of the ceiling above the ice sheet is usually about 0.85 unless a low emissivity ceiling is used. In such cases, the emissivity normally varies between 0.05 and 0.2. This entry can provide compliance credits since the Reference building always has a standard ceiling with a 0.85 emissivity.

Number of resurfacing per week

This value represents the average number of resurfacing per week. A typical hockey rink will have about 65 resurfacing per week. The Reference building will always have the same number of resurfacing as the Proposed building. The EE Wizard calculates the total water volume required for a resurfacing based on $0.0075 \text{ usgal/ft}^2$ (0.3 L/m^2) of ice surface.

Number of seats

The number of seats in the bleachers associated with the ice sheet serves in determining the lighting power density over the ice for the Reference building. Any sheet with more than 500 seats will have 28 W/m^2 while any sheet with less than 500 will have 13 W/m^2 .

Ice sheet temperature

Default values are provided depending on the ice sheet usage. This value serves in determining the convective and radiative loads to the ice sheet. The Reference building always has the same temperature as the Proposed building.

Number of weeks of ice usage

This entry serves in defining how many weeks per year the ice sheet will operate. Each ice sheet may have different operating periods. The weekly schedule of Table 2 is used for every operating week. If a building has many ice sheets operating for different periods, the HVAC system will operate as per the longest operating period of any ice sheet. However, the refrigeration system operation and the refrigeration load will be adjusted as per each ice sheet operating period. The EE Wizard automatically adjust the operating period so that any off-time will be centered around the summer month (with mid-July being the actual center of any off period).

Ice sheet usage

The ice sheet usage only serves, in the current version, to set the default ice temperature value.

Figure 21: Defining Multiple Ice Sheets

[CBIP Home Page](#)
[Sign Off !!](#)

Define Building Zones
If a zone is not applicable to your Arena Project, please leave the box unchecked within that zone.

Global Data. <input type="button" value="Modify..."/> **incomplete**	
Bleachers <input type="button" value="Modify..."/> **incomplete**	
Number of Ice Sheets: <input type="text" value="4"/> <input type="button" value="Save"/>	
Ice Sheet #1 **incomplete** <input type="button" value="Modify..."/>	
Ice Sheet #2 **incomplete** <input type="button" value="Modify..."/>	
Ice Sheet #3 **incomplete** <input type="button" value="Modify..."/>	
Ice Sheet #4 **incomplete** <input type="button" value="Modify..."/>	
Lockers/Change Rooms/ Washrooms/ Showers <input type="button" value="Modify..."/> **incomplete** (<input checked="" type="checkbox"/> Check if applicable)	Entrance/Cafeteria/Snack Bar <input type="button" value="Modify..."/> **incomplete** (<input checked="" type="checkbox"/> Check if applicable)
Multipurpose Space : <input type="text" value="Community Centre"/> <input type="button" value="Save"/> <input type="button" value="Modify..."/> **incomplete** (<input checked="" type="checkbox"/> Check if applicable)	

Up to 4 different ice sheet per building.

Figure 22: Specific Ice Sheet Parameters

Home ARENA PROJECT : Example
Account Management CBIP Help Back To Main Diagram →
My Projects
Start a New Project
Change to Imperial Unit of Measurement
CBIP Home Page
Sign Off !!

ICE SHEET: # 1

* Ice Sheet Area: (m²)
* Ceiling emissivity:
* Number of resurfacing per week:
* Number of Seats (Bleacher Capacity):
Ice sheet average temperature: °C
* Number of weeks of ice operation:
* Ice sheet usage:

Save Save & Continue >>

Applies only to this sheet's bleachers.

3- Refrigeration Page

The last page used in defining the refrigeration system can be found in the Bleachers zone under the “Refrigeration” tab. This page serves in defining the actual refrigeration plant and the secondary (i.e. brine) refrigerant loop. Many items in this page provides CBIP compliance credits and it is more than likely that any successful CBIP submission will need to exploit some of these energy efficiency measures.

As previously mentioned, the refrigeration equipment defined in this page serves all the ice sheets defined for the building. Whenever ice sheets do not operate, compressors will be staged off, if multiple compressors are used.

Compressors EER

This value represents the average compressor EER at specified rating conditions of 100 °F condensing, 5 °F evaporating and 10 °F superheat. When multiple compressors are present, this value should be the capacity-weighted average of the EER.

Compliance credits are available for high efficiency compressors since the Reference building always has compressors with EER = 9.

Compressor nominal total capacity

The capacity specified here represents the total installed compressor **MOTOR** capacity at the following rating conditions: 100 °F condensing, 5 °F evaporating and 10 °F superheat.

The EE Wizard splits this capacity evenly when there are multiple compressors. The resulting refrigeration capacity is obtained from this motor capacity and the previously defined compressor EER.

Number of compressors

Identified the number of compressors in the refrigeration plant. The Reference building has the same number of compressors than the Proposed design. The EE Wizard considers every compressor to be identical.

Floating Head Pressure

Checkmark this box if the refrigeration system's condensing pressure is allowed to fluctuate with exterior conditions. The Reference building does not have floating head pressure control and performance credits are available for this measure.

Discharge Pressure Control Setting

This value identifies the temperature setting for the floating head pressure control. Therefore, it is only active when the previous checkbox is selected. The Reference building has a constant head pressure setting of 100 °F. Any value below 100 °F will provide potential compliance credits since a lower setting reduces the compressors energy use.

Type of Subcooling

Subcooling the liquid refrigerant leaving the condenser can also help reduce the compressor energy use and increase the system's capacity. Two types of subcooling are offered, either mechanical or natural. The Reference building does not have a subcooler.

Type of Condensers

Select from the available list of condensers. The Reference building always has an air-cooled condenser.

Type of Evaporator

Select from the available list of evaporators. The Reference building always has an direct expansion evaporator.

Number of Brine Circuit Pass

This value represents the number of brine circuit pass under the ice sheet before returning to the heat exchanger. Systems with 4 or 5 passes are more efficient since they operate with a greater temperature drop across each loop, which allows reducing the pump motor power. Ice temperature uniformity must however be insured when using more passes. The Reference building always uses a 2-pass circuitry and performance credits are available for systems using 4 or 5 pass.

Brine Pump Motor Capacity

This value represents the total capacity (in kW or hp) of the brine pumps used in daily operation. If different pumps are used for nighttime operation, these should not be included in that total capacity.

Brine Pump Control Strategy

Select one of the three available options: none, Day/Night, Two speed/Two pumps.

The default is to have no brine pump control strategy and have the pumps running continuously. This is the option always used in the Reference building.

The Day/Night option consists of turning off the brine pumps during off-hours. This option must be used with caution in order to maintain adequate ice conditions.

The last option consists of having either two pumps or a two-speed pump where the smaller pump or lower speed is used for off-hours operation. In such case, the capacity of the smaller pump is automatically set by the EE Wizard as 1/8 of the entered pump capacity.

Brine Pump Motor Efficiency

Represents the average efficiency of the brine pumps motors. If more than one main motor is used, the value entered is the power-weighted average efficiency. The Reference building has an efficiency of 80%.

Heat Recovery – Nominal Coil Capacity – Air Side

The EE Wizard allows the user to define a refrigeration heat recovery system to heat the Bleacher zone (and only the Bleacher zone). This heat recovery replaces some or all of the condenser capacity and represent a potentially significant compliance credit since the Reference building does not have air side heat recovery for the Bleachers zone.

The value entered here must be the nominal coil capacity at normal operating conditions both on the air-side and the refrigeration-side of the coil. Refrigeration and HVAC specifications and drawings must indicate how this recovery system is implanted and controlled.

IMPORTANT: When the geothermal system option is selected, the EE Wizard automatically incorporates air-side heat recovery to the Proposed design. The Wizard would then disregard any value entered for this parameter.

Heat Recovery – Nominal Exchanger Capacity – SHW

Refrigeration heat recovery can also be used to preheat the arena's service hot water (SHW). The service hot water load is made up of the resurfacing water need and the general building needs, as defined in section 3.9. This heat recovery also replaces some of the condenser capacity and usually takes the form of a desuperheater. The Reference building always has a desuperheating heat recovery system for SHW.

The value entered here must be the nominal exchanger capacity at normal operating conditions both on the water-side and the refrigeration-side of the exchanger. Refrigeration and SHW specifications and drawings must indicate how this recovery system is implanted and controlled.

Whenever air-side and SHW heat recovery are simultaneously specified, the SHW heat recovery exchanger has priority over the air-side heat recovery coil.

Heat Recovery – Nominal Exchanger Capacity – Subfloor heating

Most arenas have some form of heating under the ice sheets to prevent frost heaving of the floor slab. In the EE Wizard, this subfloor heating is predefined as electric heating with an average value of 0.1335 W/ft² and is constantly operating throughout the ice sheet operating period.

Specifying refrigeration heat recovery for subfloor heating displaces this electric load by recovered energy from the condensers. The Reference building does not have subfloor heat recovery.

Whenever air-side and/or SHW heat recovery are simultaneously specified with subfloor heat recovery, they both have priority over the subfloor heat recovery exchanger.

Figure 23: Refrigeration System Data

* Compressors average nominal EER:	<input type="text" value="9.00"/>	Btu / h - W
* Compressor nominal total capacity:	<input type="text"/>	kW
* Number of Compressors:	<input type="text"/>	
* Floating Head Pressure:	<input type="checkbox"/>	Yes
* Discharge pressure control setting:	<input type="text" value="37.80"/>	°C
Type of subcooling:	<input type="text" value="None"/>	▼
Type of condensers:	<input type="text" value="Air-cooled"/>	▼
Type of evaporator:	<input type="text" value="Conventional DX"/>	▼
Number of brine circuit pass:	<input type="text" value="2"/>	▼
Brine pump capacity:	<input type="text"/>	kW
Brine pump control strategy:	<input type="text" value="None"/>	▼
Brine pump motor efficiency:	<input type="text"/>	%
Heat Recovery - Nominal Coil Capacity - Air Side:	<input type="text"/>	kW
Heat Recovery - Nominal Exchanger Capacity - SHW:	<input type="text"/>	kW
Heat Recovery - Nominal Exchanger Capacity - Subfloor Heating:	<input type="text"/>	kW

Save

Save & Continue >>

<< Save & Go Back

3.9 Service Water Heating

The “Global Data” page presented earlier also serves in defining the SHW system for the arenas (with the exception of resurfacing loads and refrigeration heat recovery). Defining the SHW system mainly consist of specifying the energy source, other than heat recovery, for the SHW and the efficiency of the system. Optionally, the user may elect to define the average nominal flow rate for the showers and faucets used in the arena in order to obtain compliance credits. The default values shown in the EE Wizard are the values used in the Reference building. Finally, additional credits can be obtained if motion activated faucets are used. In all cases (i.e. low flow devices or motion activated faucets), supporting documentation must be provided.

Figure 24: Defining the SHW System in EE Wizard

The screenshot shows the 'Global Data' configuration page in the EE Wizard. On the left is a navigation menu with links: Home, Account Management, My Projects, Start a New Project, Change to Imperial Unit of Measurement, CBIP Home Page, and Sign Off !!. The main header reads 'ARENA PROJECT : Example' with a 'CBIP Help' icon and a 'Back To Main Diagram' button with a right-pointing arrow. The 'Global Data' section includes two checkboxes: 'Geothermal (all zones):' and 'Radiant in-floor option (only applicable if Geothermal is checked):', both currently unchecked. Below these is a text input field for '* Total Installed Lighting Power over ice sheets (> 0) (kW)'. A 'Service Hot Water' section contains a dropdown menu for 'Energy source for SHW' set to 'Electricity', an 'Efficiency (25-100%)' input set to '100.0 %', and a table for 'Nominal flow rate (L / s)' with columns for 'Showers' (0.1577) and 'Faucets' (0.1389). It also has a 'Motion activated faucets:' checkbox (unchecked) and a 'Percentage of motion activated faucets (0-100%)' input set to '0.0 %'. At the bottom are two buttons: 'Update Info' and 'Update Info & Return to Diagram'.

Home ARENA PROJECT : Example
Account Management CBIP Help Back To Main Diagram →
My Projects
Start a New Project
Change to Imperial Unit of Measurement
CBIP Home Page
Sign Off !!

Global Data

Geothermal (all zones): Yes

Radiant in-floor option
(only applicable if Geothermal is checked): Yes

* Total Installed Lighting Power over ice sheets (> 0) (kW)

Service Hot Water

* Energy source for SHW:

* Efficiency (25-100%): %

	Showers	Faucets
Nominal flow rate (L / s)	<input type="text" value="0.1577"/>	<input type="text" value="0.1389"/>

Motion activated faucets: Yes

Percentage of motion activated faucets (0-100%) %

3.10 Multipurpose Zone

A final element available in the main diagram page is the vocation for the Multipurpose zone. This zone serves to represent any space located within the arena building and not covered by any of the three other zones. The user can select from a list of 4 possible vocations:

- Community Center
- Recreation
- Auditorium
- Offices

Selecting the various vocation changes the default and Reference building parameters associated with that zone, as shown in Table 3.

Table 3: Multipurpose Zone Default Values

Vocation	Occupant Density (ft ² /occ.)	Plug Load (W/ft ²)	SHW Load (gpm/ft ²)	Minimum OA (CFM/pi ²)	LPD (W/ft ²)
Community Center	53.8	0.09	2.785e-5	0.295	1.80
Recreation	107.7	0.09	5.571e-5	0.59	0.70
Auditorium	53.8	0.23	5.571e-5	0.295	1.60
Offices	215.3	0.70	4.186e-5	0.098	1.80

4. Defining the Arena Reference Building

A series of additional compliance rules were necessary in order to integrate arenas to CBIP. These rules serve in defining the Reference building and, at the same time, indicate where additional CBIP credits can be obtained.

The rules for arenas are presented in Appendix B of this guide. It should be noted that all other CBIP rules also apply to arenas, including the “Performance Compliance for Buildings – Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Buildings Using Whole Building Performance” [Canadian Commission on Building and Fire Codes (CCBFC), May 1999].

5. CBIP Submission Procedure using EE Wizard

Submitting an arena project to CBIP follows basically the same step as that for a standard Performance Path submission, as described in the CBIP Technical Guide.

The initial steps consists in obtaining an Expression of Interest (EOI) number. The next step requires gathering all the information needed to complete a The Arena EE Wizard run, although intermediate and preliminary runs can be performed to guide the design.

Once the design is complete and all information collected, a final EE Wizard run is performed and the CBIP Compliant report is downloaded by the Applicant. The report needs to be printed for eventual signing and submission to CBIP with all other required documents (refer to Performance Path Worksheet of the CBIP Technical Guide).

The final run **MUST** also be sent by the user to NRCan using the indicated link in the project management page (refer to Figure 9).

It is important for the Applicant to send all the required documents to NRCan, specifically the technical documents justifying any measures modeled using the EE Wizard.

6. Overview of possible energy efficiency measures available to Arenas through the EE Wizard

The following list presents a non-exhaustive review of energy efficiency measures providing potential compliance credits (or penalties) and that are available to Arenas through the EE Wizard:

1. Envelope
 - Better wall insulation (above grade walls only)
 - Better roof insulation
 - Better windows (usually of little significance for arenas)
2. HVAC
 - Improved thermal efficiency for combustion-type heating system
 - Use of heat pump loop heating system with possible earth-loop connection (GSHP)
 - Radiant in-floor heating (geothermal only)
 - Use of conventional HRV's
 - High efficiency (i.e. EER) dehumidification system
 - Heat recovery for space heating from refrigeration system
 - High efficiency fan/motors
 - High efficiency cooling system, if applicable.
3. Refrigeration/Brine loop
 - High efficiency compressors
 - Optimised discharge pressure control (head pressure)
 - Water and evaporative condenser
 - Flooded evaporator
 - Brine Pump Control
 - Refrigerant subcooling (mechanical or natural)
 - Reduced refrigeration load from lighting elements
 - Reduced load from pumping elements
 - Reduced load from humidity control
 - Multistage pumps/multiple pumps for the brine loop
 - Optimised brine pump control (day/night control)
 - 4 or 5 pass brine circuits
 - High efficiency pump/motors
4. Service Hot Water
 - Heat recovery for water heating or preheating from refrigeration system (above desuperheating)
 - Low flow shower heads and faucets
 - Motion activated faucets
5. Lighting
 - Reduced lighting levels (below MNECB)
 - Occupant sensors
 - Daylight controls

The following sections provide summary descriptions of the principal measures available in the EE Wizard.

6.1 Building Envelope

The Arena EE Wizard offers potential credits for improved envelopes compared to the MNECB prescriptive values for the region specified (as stated in Appendix A of MNECB). Thus, similarly to what is offered by EE4, the user can specify higher wall, roof and window R-values. Note that the windows R-values are pre-established.

Windows in the Reference building will always have the same solar heat gain coefficient (SHGC) and the same orientation as those in the Proposed building.

6.2 Lighting

Lighting credits are available whenever the proposed building has a lower LPD than the Reference building. The values for LPD in The Arena EE Wizard are given in Table 4.

Table 4: LPD in the Reference arena building

Zone	Lighting Power Density (W/m ²)
Bleachers	13 or 28
Lockers	8.6
Entrance	10.8
Multipurpose	7.5 or 18.3 or 19.4

Additional credits can be obtained through the use of automatic controls. The Reference building does not have any kind of automatic control. The credits for each type of control can be translated in a reduction in LPD for the proposed building, for the fraction where the control is applied, as per Table 5.

Table 5: LPD reduction for each automatic control strategy

Control Type	LDP credit
Daylight sensing control (DS) - continuous dimming	30 %
DS - multiple step dimming	20 %
DS - ON/OFF	10 %
Occupancy sensor	30 %
Occupancy sensor and DS - continuous dimming	40 %
Occupancy sensor and DS - multiple step dimming	35 %
Occupancy sensor and DS - ON/OFF	35 %

6.3 Mechanical System

CBIP Credits for the mechanical system are basically the same as those available for the standard Performance Path method, with the significant exception concerning the possibility to select the integrated geothermal system which provides automatic refrigeration heat recovery capabilities to the HVAC system.

Otherwise, credits for HRVs, high efficiency mechanical cooling, high efficiency heating (fuel-fired units), and high efficiency supply fans are all available. Furthermore, significant credit can still be obtained from conventional refrigeration heat recovery for space heating purposes in the Bleachers zone.

The Reference building will always have a 80% efficiency fuel-fired heating system (if Proposed if fuel-fired), a 40 % combined fan/motor efficiency with 325 Pa/1.3 in wg static pressure and a cooling system with COP of 3.4. The Reference building has no HRV and no refrigeration heat recovery coil.

6.4 Dehumidification

As mentioned in the Dehumidification Section of the Step-by-Step presentation of EE Wizard, potential credits are available for arenas regarding dehumidification. These credits are only available for the *Bleachers* zone. Whenever the Proposed building has dehumidification, the Reference building will also have dehumidification (see Additional Rules in Defining the Arena Reference Buildings section).

Having a more efficient dehumidifying system is only part of the credits that can be gained from dehumidification. Other credits from a lower refrigeration load.

Dehumidification can only be defined if all the ice sheets and associated bleachers are served by a dehumidification system.

6.5 Refrigeration

The refrigeration system offers many opportunities for energy efficiency improvements in an arena. Through EE Wizard, a number of measures are available and provide CBIP credits.

Heat Recovery

A arena refrigeration system usually rejects more heat than it needs for heating purposes. This heat can be used in great part to offset this heating load or the SHW load.

Various levels of heat recovery are possible. The more common type is called desuperheating. In this system, the hot refrigerant gas leaving the compressors is sent to a heat exchanger that is used to preheat the service hot water. The hot gas is cooled but does not condensate in the heat exchanger. The cooled gas can then be directed to the system's condensers for complete condensation. This type of system allows recovering typically between 15 % to 30 % of the total energy in the refrigerant stream.

Another common type of heat recovery is a condensing-type recovery system. In this system, the hot gas from the compressors is sent to the heat exchanger located in the ventilation system where it is cooled and condensed. When the gas fully condenses, the system is termed a full-condensing recovery system. Many designs achieve high levels of condensation but do not get full recovery. An auxiliary condenser is usually needed to insure that liquid refrigerant is always available at the expansion devices.

The reference system has desuperheating heat recovery for SHW needs.

Floating Head pressure control

When the compressors send hot refrigerant gas to the condenser, the pressure in the condenser is usually maintained to a minimum value in order to insure proper operation of the expansion devices. However, keeping a higher condensing pressure requires more work from the compressors. Systems can be designed to operate adequately even at low condensing pressures, these systems offer significant energy performance gains. It should be noted that when heat recovery is used, the condensing pressure is maintained higher, even with such systems, in order to allow the heat recovery.

The reference system does not have floating head pressure control and has a setting of 100 °F.

Liquid Refrigerant Subcooling

Mechanical subcooling and natural subcooling are effective methods of cooling liquid refrigerant below its saturation pressure in order to increase system capacity and improve efficiency. Subcooling the refrigerant increases the cooling capacity and may decrease the compressor power (depending on the subcooling technology), thereby increasing the overall efficiency of the system.

Mechanical subcooling consist in having a secondary vapor compression system, which only purpose is the cool down the liquid refrigerant coming out of the condenser. On the other hand, natural subcooler consist only of an additional heat exchanger located in cold ambient air. This subcooler takes advantage of the usual cold climate during which arenas operate to further cool down the liquid refrigerant.

The Reference building does not have a subcooler.

Type of condenser

The most common condenser used in arena refrigeration system is the air-cooled finned-tube condenser. Other types of condensers are also possible and may provide energy efficiency benefits. A water-cooled or an evaporative condenser can often maintain a lower condensing pressure. However, spraying down a conventional air-cooled condenser with water to turn it into an evaporating condenser is strongly discouraged, as it will significantly shorten its durability. Specifically designed evaporative condensers must be used.

The Reference building uses a conventional air-cooled condenser.

Type of evaporator

The EE Wizard offers the choice of a direct expansion evaporator (DX) or a flooded evaporator.

In a direct expansion evaporator, the liquid refrigerant is evaporated and significant portion of the exchanger is in contact only with a mixture of mainly gas and a small fraction liquid. The heat exchange in these portions of the evaporator is very degraded given the lower heat transfer characteristics of the refrigerant gas compared to that of the liquid. Therefore, such systems have lower overall efficiencies.

In a flooded evaporator, the exchanger is mostly filled with liquid refrigerant to enhance the heat transfer between the refrigerant and the brine loop. This type of design significantly improves the system overall efficiency.

The Reference building uses a DX evaporator.

High efficiency Compressors

Refrigeration compressors are characterized by the Energy Efficiency Ratio (EER). EERs are identical to COPs (coefficient of performance) and only their units are different (COP = EER / 3.413). The higher the EER, the more efficient is the compressors.

CBIP credits are available if high efficiency compressors are used in the Proposed design (EER above 9 at specified rating conditions).

Brine pump control

Many arenas have brine pumps that operate continuously during the ice season. This type of operation causes a double energy efficiency penalty. On the one hand, the pumps use electricity 24 hours per day to operate at their nominal load and on the other hand, this load is transferred in great part to the refrigeration system as an additional refrigeration load.

By adjusting the pump capacity to the actual load on the ice sheet provides a significant energy efficiency opportunity. Various methods are available to achieve a reduction in pumping energy use, such as variable speed drives, two speed pumps, multiple pumps, or even stopping the pumps at night time. The EE Wizard offers two pump control strategy, namely:

- 1- Stopping the pumps at nighttime.
- 2- Using two pumps or a two-speed pump

User should be cautious about stopping the pump at nighttime in order to insure that ice conditions will not be deteriorated.

7. Special Cases and Workarounds

- Basements: The wizard assumes that all arenas have a slab-on-ground. For cases where there are below ground spaces, a special workaround has been adopted. In such cases, the zone's *Floor area* must include all the conditioned floor area, including that of the below ground space. The

ground floor area must also be the sum of all floors in contact with the ground, regardless of their depth. The underground wall area must be included in the *Total exterior wall area*. The *Average exterior wall R-value* must be calculated as the area weighted average of all exterior AND below ground walls R-values. However, the below-ground walls R-value can be estimated as the actual below-ground wall R-value PLUS a value of R-10 to account for the ground insulating and dampening effect.

8. User's Tips

Spaces assignment guidelines:

- Any spaces within the ice shed not explicitly covered by the EE Wizard's zones (either Bleachers or Lockers) should be put into the Bleachers zone.
- Vestibules should be included into the Entrance zone.
- Manager office, employees' rooms and restrooms should be assigned to the Entrance zone or Multipurpose zone

System assignment guidelines are:

- When multiple units serve a single EE Wizard zone, the total heating and cooling capacity must be entered.
- The equipment efficiency must be defined as a capacity-weighted average of all the units in that zone.
- The fuel source for terminal/baseboard heating cannot be of a combustible-type source unless the central system is also of the same source.
- Baseboard heaters in the Wizard include unit heaters, standard baseboards heaters, duct heaters, or any other heating devices not installed in the RTU.
- Only one central heating source can be chosen. If a zone is served by units with different sources, the source with the greatest energy source adjustment factor (ESAF, see MNECB 1.1.3.2) and representing more than 10% of the installed capacity must be selected.
- When a single unit serves more than one EE Wizard zone, its capacity must be divided between each zone in proportion of their respective thermal loads (not provided by the Wizard).

General tips

- It is generally better to compile all the required data off-line before entering it into the Wizard.
- Using an Excel Spreadsheet, such as the one provided on the Wizard Web Site, can greatly facilitate the data compiling effort and minimize the

- risks of errors.
- After 30 minutes of inactivity, the Wizard will automatically log you off.
 - The Wizard can perform preliminary evaluations even if the final data is not entirely known. This may guide the Applicant in the selection of energy efficiency measures prior to final design.
 - Units in the Arena EE Wizard can be changed on the fly. Some pages can be filled in SI mode while others in IP.
 - When the Arena EE Wizard reports an insufficient heating error, there are two possible ways to fix it. Either the heating capacity in the zone must be increased OR the ventilation air flow must be increased to better match the specified heating capacity.

9. Example: Defining a CBIP Compliant Arena in EE Wizard

This example serves in demonstrating measures required for an Arena Project to comply with CBIP using the EE Wizard. The main project's data is presented summarily in this section. All the necessary information to complete a EE Wizard simulation is provided below. Most of this information should be available directly from the architectural, mechanical, and electrical drawings. Additional information could be obtained from equipment manufacturer standard data sheets.

Description

This arena has a total floor area of 40 500 ft² which includes 25 000 ft² for the ice shed. Walls and roofs are of similar construction throughout the building. The great majority of the building's fenestration is located in the Entrance and Multipurpose sections. A section of this arena serves as a small auditorium and has been defined as such in the Multipurpose zone.

Total Floor Space: 40 500 ft²

Walls: R-20

Roof: R-30

Fenestration: Standard insulating glass with aluminium frames

As presented in Figure 26 and 27, this arena complies with CBIP and achieves a 28.7% reduction in energy use compared to the Reference building. For the rates used in this example, this performance leads to a possible incentive of 33 036 \$. This results was achieved without using many energy efficiency measures, such as refrigeration heat recovery for air heating or the use of geothermal energy systems.

Bleachers Zone:

This area represents the bulk of the arena and houses its single ice sheet. All other rooms located within this space, namely the small mechanical room and the ice resurfacer room, where combined with the bleachers area. The ice sheet occupies 17 000 ft² out of the total entered area of 25 000 ft². In the actual design, the space is served by force flow heaters over the bleachers and a large exhaust fan coupled with a relief damper for outside air. These heaters will be merged into one equivalent unit for modelling purposes and defined as central heating. The total air flow includes the flow from the heaters and that from the exhaust fan and the motor capacity represents the sum of all the motors.

The refrigeration system for this arena incorporates a number of features providing CBIP compliance credits, namely:

- a low emissivity ceiling

- high efficiency compressors
- a flooded-type evaporator
- a 4-passes brine loop
- a two-speed brine pump
- a desuperheater for service water heating
- a natural subcooler
- a floating head pressure control strategy

The arena does not have any refrigeration heat recovery for air heating or subfloor heating for the ice sheet.

The main data required for this zone are presented below. Figure 25 presents the detailed data input summary for the entire building as presented in the EE Wizard's compliance report.

Floor area: 25 000 ft²
Exterior walls: 11 000 ft²
Roof area: 25 000 ft²
Floor-on-ground area: 8000 ft² with R-10 interior wall insulation – excludes the ice sheet floor area.
Windows: 60 ft² North, 60 ft² North-East
Doors: 200 ft² (ice resurfacing machine)
Lighting: 0.8 W/ft² (EXCLUDES lights over ice sheet)
Heating set point: 60 oF
Packaged units dehumidification with 50 % RH set point

Heating and Ventilation: Heated (natural gas, 82% eff.) no cooling
 Natural gas heating: 500 000 Btuh
 Heat Recovery: none
 Supply air : 17 000 cfm
 Outside air : 11 000 cfm
 Exhaust: 11 000 cfm

Refrigeration: EER = 10.5
 Compressor motor capacity = 27 kW (or 80 Tons nominal refrigeration capacity -> $27 \times 3413 \times 10.5 / 12000$)
 Natural subcooling system
 Floating head pressure, 60 oF
 Flooded evaporator
 4 passes brine circuit
 25 hp main pump, 2 speed
 200 000 BTUH desuperheater for service hot water

Lockers Zone:

This area includes all the locker rooms, access corridors, washrooms and showers. This space is served by electric baseboards as well as a natural gas duct heater in the fresh air system. The required data for this zone are presented below. This space is located inside the ice shed and does not have an exposed roof. Therefore, it has no exterior roof but this roof must be defined as a partition wall with the Bleachers zone.

Floor area: 5000 ft²
Exterior walls: 2000 ft²
Roof area: 0 ft²
Partition wall area: 6700 ft²
Floor-on-ground area: 5000 ft² with R-10 interior wall insulation
Windows: none
Lighting: 0.8 W/ft², 90% controlled by occupancy sensors
Heating set point: 71.6 oF

Heating and Ventilation: Heated with a natural gas (82% eff.) duct heater and electric baseboards
Natural gas heating: 150 000 Btuh
Baseboards : 29.3 kW
Standard HRV, 65% effectiveness
Cooling: none
Supply air : 4600 cfm
Outside air : 2500 cfm
Exhaust: 250 cfm

Entrance Zone:

The entrance zone defined for this arena includes a small snack-bar and eating area, a number of small offices, the entrance lobby and the vestibule. This zone has a significant common wall with the ice shed.

Floor area: 3 500 ft²
Exterior walls: 3 000 ft²
Roof area: 3 500 ft²
Partition wall area: 2 000 ft²
Floor-on-ground area: 3 500 ft² with R-10 interior wall insulation
Windows: 210 ft² South (including the glazed vestibule doors), 70 ft² East, standard double glazed/aluminium frames
Lighting: 1.5 W/ft² (area weighted average of all rooms)
Heating set point: 71.6 oF
Cooling set point: 75.2 oF

Heating and Ventilation: Heated (natural gas, 82% eff.) with roof-top unit and some electric baseboards
Natural gas heating: 170 000 Btuh
Baseboards: 7.3 kW
Heat Recovery: none
Cooling: 36 000 BTU/h, EER = 12
Supply air : 3 500 cfm
Outside air : 700 cfm
Exhaust: 500 cfm (kitchen hood and washrooms)

Multipurpose Zone:

This last area represents an additional room located within this arena and serving mainly as an auditorium. It has no common wall with the ice shed.

Floor area: 7 000 ft²
Exterior walls: 3 500 ft²
Roof area: 7 000 ft²
Floor-on-ground area: 7 000 ft² with R-10 interior wall insulation
Windows: 250 ft², South-West
250 ft², West
Doors: 100 ft²
Lighting: 1.2 W/ft² with occupancy sensors
Heating set point: 71.6 oF
Cooling set point: 75.2 oF
Heating and Ventilation: Heated (natural gas, 82% eff.) and cooled with 1 rooftop unit
Natural gas heating: 200 000 Btuh
No heat recovery
Cooling: 48 000 btuh, EER = 12
Supply air : 6 000 cfm
Outside air : 2 100 cfm
Exhaust: 100 cfm

Figure 25 - A: Detailed input data

Attribute Name	Units (IP)	Zones			
		Bleachers/Ice Sheet	Change Rooms	Entrance	Multipurpose
Floor area	ft ²	25000.00	5000.00	3500.00	7000.00
Exterior Walls					
Total exterior wall area	ft ²	11000.00	2000.00	3000.00	3500.00
Average exterior wall R-value	ft ² -h-°F/Btu	20.00	20.00	20.00	20.00
Exposed Roof					
Total exposed roof area	ft ²	25000.00	1.00	3500.00	7000.00
Average exposed roof R-value	ft ² -h-°F/Btu	35.00	35.00	35.00	35.00
Floor On-ground					
Total floor on-ground area	ft ²	8000.00	5000.00	3500.00	7000.00
Insulation type	n/a	R-10 int.	R-10 int.	R-10 int.	R-10 int.
Windows Definition					
Window #1 orientation (N-S-W-E)	n/a	North	North	North	South-West
Windows area	ft ²	0.00	0.00	0.00	250.00
Windows Type	n/a	Standard double/Vinyl	Standard double/Vinyl	Standard double/Vinyl	Standard double/Alum
Window #2 orientation (N-S-W-E)	n/a	South	North	South	West
Windows area	ft ²	0.00	0.00	210.00	250.00
Windows Type	n/a	Standard double/Vinyl	Standard double/Vinyl	Standard double/Alum	Standard double/Alum
Window #3 orientation (N-S-W-E)	n/a	North	North	East	North
Windows area	ft ²	60.00	0.00	70.00	0.00
Windows Type	n/a	Standard double/Alum	Standard double/Vinyl	Standard double/Alum	Standard double/Vinyl
Window #4 orientation (N-S-W-E)	n/a	North-East	North	West	North
Windows area	ft ²	60.00	0.00	0.00	0.00
Windows Type	n/a	Standard double/Alum	Standard double/Vinyl	Standard double/Vinyl	Standard double/Vinyl
Exterior Doors					
Total exterior door area	ft ²	200.00	0.00	100.00	100.00
Door Type	n/a	Insulated Metal	Insulated Metal	Insulated Metal	Insulated Metal
Partition Walls					
Area common to ice shed	ft ²	0.00	6700.00	2000.00	0.00
Wall insulation	ft ² -h-°F/Btu	0.00	5.00	5.00	0.00
Lighting					
Average lighting power density	W/ ft ²	0.80	0.80	1.50	1.20
Type of lighting control	n/a	None	Occupancy sensor	None	Occupancy sensor
Fraction of lights controled	%	0.00	90.00	0.00	100.00
Temperature Controls					
Heating set point	°F	60.00	71.60	71.60	71.60
Heating Setback (yes or no)	n/a	No	No	No	No
Cooling set point	°F	95.20	95.20	75.20	75.20
Cooling Control (yes or no)	n/a	No	No	No	No
Heating Systems					
Geothermal (yes or no)	n/a	No	No	No	No
Radiant in-floor option (yes or no)	n/a	No	No	No	No
System heating capacity	Btu / h	500000.00	150000.00	170000.00	200000.00
System baseboard capacity	Btu / h	0.00	100000.00	25000.00	0.00
System source (electricity,natural gas etc)	n/a	Natrual Gas	Natrual Gas	Natrual Gas	Natrual Gas
Baseboard source (electricity,natural gas etc)	n/a	Electricity	Electricity	Electricity	Electricity
System Heating efficiency - no geothermal system	%	82.00	82.00	82.00	82.00
System Heating efficiency (COP) - using geothermal system	n/a				
Cooling Systems					
System cooling capacity	Btu / h	0.00	0.00	36000.00	48000.00
System cooling efficiency (EER)	Btu / h-W	11.37	11.37	12.00	12.00
System cooling efficiency (COP)	n/a	3.33	3.33	3.52	3.52


Figure 25 - B: Detailed input data

Attribute Name	Units (IP)	Zones			
		Bleachers/Ice Sheet	Change Rooms	Entrance	Multipurpose
Supply Fan					
Supply flow	CFM	17000.00	4600.00	3500.00	6000.00
Supply static	in H ₂ O	0.00	0.00	0.00	1.30
Combined Supply efficiency	%	40.00	40.00	40.00	40.00
Supply fan power	hp	10.00	3.00	2.50	0.00
Outside Air					
Outside air flow	CFM	11000.00	2500.00	700.00	2100.00
Exhaust flow	CFM	11000.00	250.00	500.00	100.00
Heat recovery efficiency	%	0.00	65.00	0.00	65.00
Dehumidification					
Space has dehumidification (yes or no)	n/a	Yes	No	No	No
Dehumidification control	%	50.00	100.00	100.00	100.00
Dehumidification type	n/a	Packaged units	Packaged units	Packaged units	Packaged units
Ice sheet data					
Number of Ice sheet	n/a	1.00			
Total Installed Lighting Power over Ice Sheets	kW	15.00			
Ice sheet #1 area	ft ²	17000.00			
Ceiling emissivity #1	n/a	0.05			
Number of resurfacing per week #1	n/a	65.00			
Number of seats (Bleacher Capacity) #1	n/a	400.00			
Ice sheet average temperature #1	oF	26.00			
Number of weeks of ice operation #1	n/a	42.00			
Ice sheet usage #1	n/a	Hockey			
Ice sheet #2 area	ft ²	0.00			
Ceiling emissivity #2	n/a	0.85			
Number of resurfacing per week #2	n/a	65.00			
Number of seats (Bleacher Capacity) #2	n/a	200.00			
Ice sheet average temperature #2	oF	24.00			
Number of weeks of ice operation #2	n/a	36.00			
Ice sheet usage #2	n/a	Hockey			
Ice sheet #3 area	ft ²	0.00			
Ceiling emissivity #3	n/a	0.85			
Number of resurfacing per week #3	n/a	65.00			
Number of seats (Bleacher Capacity) #3	n/a	200.00			
Ice sheet average temperature #3	oF	24.00			
Number of weeks of ice operation #3	n/a	36.00			
Ice sheet usage #3	n/a	Hockey			
Ice sheet #4 area	ft ²	0.00			
Ceiling emissivity #4	n/a	0.85			
Number of resurfacing per week #4	n/a	65.00			
Number of seats (Bleacher Capacity) #4	n/a	200.00			
Ice sheet average temperature #4	oF	24.00			
Number of weeks of ice operation #4	n/a	36.00			
Ice sheet usage #4	n/a	Hockey			
Refrigeration Equipment					
Compressor average nominal EER	Btu / h-W	10.50			
Compressor nominal total capacity	kW	26.79			
Number of compressors	n/a	4.00			
Floating Head Pressure	n/a	No			
Discharge pressure control setting	oF	60.00			
Type of subcooling	n/a	Natural (OA)			

Figure 25 - C: Detailed input data

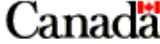
Attribute Name	Units (IP)	Zones			
		Bleachers/Ice Sheet	Change Rooms	Entrance	Multipurpose
Type of condensers	n/a	Air-cooled			
Type of evaporator	n/a	Flooded			
Number of brine circuit pass	n/a	4 passes			
Brine pump capacity	Btu / h	25.00			
Brine pump control strategy	n/a	Two speed/Two pumps			
Brine pump motor efficiency	n/a	80.00			
Heat Recovery - Nominal Coil Capacity - Air Side	Btu / h	0.00			
Heat Recovery - Nominal Exchanger Capacity - SHW	Btu / h	200000.00			
Heat Recovery - Nominal Exchanger Capacity - Subfloor Heating	Btu / h	0.00			
Service Hot Water					
Energy source for SHW	n/a	Electricity			
Efficiency	%	100.00			
Low flow showers - Nominal flow rate	gpm	1.50			
Low flow faucets - Nominal flow rate	gpm	1.20			
percentage of SHW for showers	%	80.00			
percentage of SHW for faucets	%	20.00			
Motion activated faucets (yes or no)	n/a	No			
percentage of motion activated faucets	%	100.00			
Global Data					
Vocation of Multipurpose Zone	n/a				Auditorium

Figure 26: The Arena EE Wizard Summary Results



Natural Resources
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Ressources naturelles
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ARENA PROJECT : Arena Example

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Below are the results of the Compliance Analysis system.

REFERENCE BUILDING Annual Energy Use	PROPOSED BUILDING Annual Energy Use
Electricity: 3608.0 MBTU	Electricity: 2734.0 MBTU
Propane: 0.0 MBTU	Propane: 0.0 MBTU
Natural Gas: 3600.0 MBTU	Natural Gas: 2407.0 MBTU
Fuel Oil: 0.0 MBTU	Fuel Oil: 0.0 MBTU

Annual Reference Building Energy Cost: \$57 159.00

Annual Proposed Building Energy Cost: \$73 677.00

CBIP Target Energy use: 5406.75 MBTU

Percentage Achieved: 71.8 %

Click on the link below to download the Compliance Report:

[Compliance Report \(Adobe Acrobat, pdf\)](#)

Incentive = (73677-57159) x 2, or max. 60000\$

CBIP Target = 75% or lower

Formal CBIP Compliance Report to send with submission

Figure 27 - A: Compliance Report

SUMMARY COMPLIANCE REPORT				
PROJECT NAME		DATE 19/01/2003		
PROJECT ADDRESS		EOI Number		
COORDINATING PROFESSIONAL	TELEPHONE			
DOCUMENTATION AUTHOR				
GENERAL INFORMATION				
ISSUANCE OF BUILDING PERMIT	BUILDING CONDITIONED FLOOR AREA 40 500 ft ²	Percentage Achieved (%) 28.7		
LOCATION Quebec - Region A				
STATEMENT OF COMPLIANCE				
This Certificate of Compliance lists the Building features as per actual building permit drawings and specifications in accordance with Part 8 of the National Energy Code for Buildings.				
DOCUMENTATION AUTHOR	SIGNATURE	DATE		
<p>The Coordinating Professional hereby certifies that the proposed building design represented in the construction documents and modelled for this permit application are consistent with all other forms and worksheets, specifications, and other calculations submitted with this permit application. The proposed building, as designed, meets the mandatory requirements of the Model National Energy Code for Buildings and the energy efficiency requirements for CBIP.</p> <p style="text-align: center;"> <u>Seal</u> <u>Check One</u> </p> <p> <input type="checkbox"/> 1. I hereby affirm that I am eligible, under the provisions of the authorities having jurisdiction, to sign this document as the person responsible for its preparation; and that I am licensed as a civil engineer, mechanical engineer, electrical engineer or architect. </p> <p> <input type="checkbox"/> 2. I affirm that I am eligible to sign this document as the person responsible for its preparation; and for the following reason: </p> <p>_____</p> <p>_____</p> <p>_____</p>				
COORDINATING PROFESSIONAL	SIGNATURE	DATE		
CALCULATION RESULTS - ANNUAL ENERGY CONSUMPTION OF PROPOSED				
Electricity 2 734 MBTU	Natural Gas 2 407 MBTU	Propane 0 MBTU	Fuel Oil 0 MBTU	Total 5 142 MBTU
CALCULATION RESULTS - ANNUAL ENERGY CONSUMPTION OF REFERENCE				
Electricity 3 608 MBTU	Natural Gas 3 600 MBTU	Propane 0 MBTU	Fuel Oil 0 MBTU	Total 7 209 MBTU
BUILDING COMPLIES WITH THE CBIP				
CBIP - Arenas 1.7		Page: 1 of 3		

Figure 27 - B: Compliance Report

SUMMARY COMPLIANCE REPORT

PROJECT NAME	DATE
	19/01/2003

PEAK ELECTRICAL DEMAND

WINTER		SUMMER	
PROPOSED DESIGN	181 kW	PROPOSED DESIGN	230 kW
REFERENCE	198 kW	REFERENCE	295 kW

ENERGY COST SUMMARY

	Electricity	Natural Gas	Propane	Fuel Oil	Total
PROPOSED	\$ 50 557	\$ 6 602	\$ 0	\$ 0	\$ 57 159
REFERENCE	\$ 63 844	\$ 9 833	\$ 0	\$ 0	\$ 73 677

ADVISORY MESSAGES

The CBIP application reviewers should pay special attention to the items specified in this checklist. These items require special written justification and documentation, and special verification to be used with the performance approach. NRCan determines the adequacy of the justification, and may reject a building or design that otherwise complies based on the adequacy of the special justification and documentation submitted.

- Warning: Zone Bleachers has more outside air than the minimum required by the MNECB.
- Warning: Zone Bleachers has a mechanical subcooling system.
- Warning: Zone Bleachers has a floating head pressure system.
- Warning: Zone Change rooms has more outside air than the minimum required by the MNECB.
- Warning: Zone Change rooms has a heat recovery ventilator.
- Warning: Zone Change rooms has an automatic lighting control system.
- Warning: Zone Entrance has more outside air than the minimum required by the MNECB.
- Warning: Zone Multipurpose has more outside air than the minimum required by the MNECB.
- Warning: Zone Multipurpose has a heat recovery ventilator.
- Warning: Zone Multipurpose has an automatic lighting control system.

BUILDING COMPLIES WITH THE CBIP

CBIP - Arenas 1.7 Page: 2 of 3

Figure 27 - C: Compliance Report

DETAILED COMPLIANCE REPORT-Summary

Project Name	Date
	19/01/2003

ENVELOPE SUMMARY DATA

	Reference	Proposed	Prescriptive Requirements	
			Exceed	Deficient
Gross Wall Area	19 500 ft ²	19 500 ft ²		
Total Window Area	900 ft ²	900 ft ²	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Gross Roof Area	35 501 ft ²	35 501 ft ²		
Total Skylight Area	0 ft ²	0 ft ²	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Fenestration to Wall Ratio	0.02	0.02	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Overall Thermal Transmittance

	Reference	Proposed	Exceed	Deficient
Wall	1 081 Btuh/°F	0 Btuh/°F	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Window	332 Btuh/°F	513 Btuh/°F	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Door	166 Btuh/°F	166 Btuh/°F	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Roof	1 813 Btuh/°F	0 Btuh/°F	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Skylight	0 Btuh/°F	0 Btuh/°F	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Above Ground Floor	0 Btuh/°F	0 Btuh/°F	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Total	3 394 Btuh/°F	0 Btuh/°F	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Average Heat Loss Coefficient	0 Btuh/(°F-ft ²)	0 Btuh/(°F-ft ²)	<input type="checkbox"/>	<input checked="" type="checkbox"/>

LIGHTING SUMMARY DATA

	Reference	Proposed	Prescriptive Requirements	
			Exceed	Deficient
Total Lighting Power	48 670 W	39 050 W	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Lighting Power Density (LPD)	1.2 W/ft ²	1.0 W/ft ²	<input checked="" type="checkbox"/>	<input type="checkbox"/>

HVAC SUMMARY DATA

Total Heating Capacity by Fuel		Reference	Proposed
Electricity		2 Btuh	125 002 Btuh
Propane		0 Btuh	0 Btuh
Fuel Oil		0 Btuh	0 Btuh
Natural Gas		1 141 437 Btuh	1 020 000 Btuh
Heat Pump		0 Btuh	0 Btuh
Other		0 Btuh	0 Btuh
Total Cooling Capacity by Fuel			
Electricity		89 640 Btuh	84 001 Btuh
Propane			
Fuel Oil			
Natural Gas			
Other			

BUILDING COMPLIES WITH THE CBIP

REQUIREMENTS FOR A CBIP PERFORMANCE PATH SUBMISSION

NRCan Policy Statement

This Policy Statement identifies the base approach for preparing a performance path file & establishes the framework under which variations to the base approach are allowed.

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[EE4 Policy](#)

[BASE APPROACH](#)

[VARIATION 1](#)

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Policy Statement

Background

The EE4 software was created to support the CBIP Performance Path, addressing the following:

- To check the compliance of the proposed building design with MNECB and CBIP requirements,
- To assess the energy performance of the proposed building compared to an MNECB reference building.

EE4 incorporates all the necessary features to conduct these tasks.

All the scenarios specified by the Code are handled in EE4, i.e., EE4 completely mirrors the set of MNECB requirements. EE4 incorporates all the CBIP rules that were developed above and beyond the MNECB rules. In summary, if it is in the MNECB or CBIP, then it is coded into EE4.

Conversely, the rules of EE4 are representative of what is required by MNECB & CBIP, i.e., EE4 is there to assist in the checking of MNECB and CBIP rules. In other words, if it is in EE4, that is because it is required by MNECB or CBIP.

However, there are two scenarios where EE4 rules may not accurately reflect specific technologies or systems. For both scenarios NRCan is willing to develop new CBIP rules for these specific technologies or systems.

Scenario 1. Existing technology or system

This is the case when NRCan decides to change the existing set of MNECB & CBIP rules because it agrees that credits should be awarded, or because it wishes to correct a perceived deficiency in the existing set of rules.

When a rule is made for a specific case, in the form of an EE4 work-around or DOE measure, then NRCan should decide whether that rule should be fully developed into an official new CBIP rule (MNECB rules cannot be changed, but can be overruled) or not. In the affirmative, models should be developed, and then incorporated into EE4.

Scenario 2. New technology or system

This is the case when systems or technologies are recently commercialized or used, and were not covered by MNECB or CBIP. It should be noted that this does not refer to systems or technologies that were already addressed in MNECB and for which neither MNECB nor CBIP give any credit. In this latter case, one should refer to the previous scenario.

NRCan should decide whether & how to model these new technologies or systems. If a model is developed, it should be incorporated into EE4.

In all cases, it should be clear that EE4 is meant to serve as the fundamental basis for verifying compliance with MNECB & CBIP requirements, as well as for establishing the energy credit based on the precise set of rules embedded in MNECB and CBIP.

EE4 Policy

The policy is based on a "base approach", with two variations allowed, one for specific technologies and systems, and the other when all other venues have failed. **Any changes to the EE4-generated files, or any DOE files generated without using EE4, will not be accepted without written permission from NRCAN prior to submitting these files to NRCAN.**

BASE APPROACH

EE4 is used exclusively to prepare a performance path submission. To perform an assessment in the context of the whole building performance, NRCAN is establishing the principle that EE4 should be used as a basis.

VARIATION 1

EE4 must be used first, in accordance to the base approach, to create the reference building. Adjustments of the EE4 outputs are allowed and must be all documented. Modifying EE4-generated building files is not acceptable as a standard procedure, however NRCAN recognizes that this may be the most appropriate solution in some particular cases.

The EE4 outputs can be either supplemented with engineering data or edited through changes to the DOE files. Instructions for performing modifications of EE4 outputs for which special CBIP rules have been developed are available from NRCAN. **If the proposed modifications do not have established CBIP rules then the proponent shall notify NRCAN prior to application submission.**

The engineering data used to directly modify the EE4 results can be generated by manual calculations or software outputs such as RETScreen. Changes made to the DOE files generated by EE4 are allowed with the use of a DOE-2 software version authorized by NRCAN.

VARIATION 2

The building take-off is performed directly with DOE including the development of the reference building. **This is acceptable only when it is demonstrated that the other options were exhausted, and requires prior permission from NRCAN to proceed with this approach.**

This approach will require the extensive checking of compliance to MNECB and CBIP requirements for both reference & proposed buildings. As a result, full documentation of the process and assumptions made is required. Files must be submitted in a version of the DOE-2 software authorized by NRCAN.

Work-around information requirements

Software work-arounds are used for energy efficiency measures that cannot be modelled directly in EE4 or DOE-2. When work-arounds are used in a submission, supporting documentation must be incorporated in the file documentation.

For cases for which special CBIP rules have been developed the proponent will follow the documentation requirements set in place by NRCAN.

If the proposed modifications do not have established CBIP rules, then full documentation of the work-around must be submitted.

Confidentiality

NRCAN recognizes that, under special circumstances and for commercial reasons, the applicant may request that some information should remain confidential and that its dissemination be strictly controlled.

It is the responsibility of the applicant to specify which pieces of information should be protected, for instance certain information on drawings or specific software or software modules. Information deemed by the applicant to be confidential information must so be marked.

NRCan will take reasonable measures to treat the confidential information in a confidential manner and unless required by law to do so or unless we have the applicant's written consent, will not divulge it to any third party, except as specified in this Policy Statement.

NRCan will ensure that this information is only shared with parties within NRCan that need to have access to it. In the case the file is reviewed by a qualified member of Assessors Network, NRCan will require that this information be treated in confidentiality through the establishment of non-disclosure agreements or through specific provision otherwise provided for in contracts with this party.

Annex B

Reference Building Rules for the Arena compliance tool.

The development of a compliance tool for Ice Rinks (Arenas) requires defining a reference building, similarly to what is done in EE4. Generally, the definition of a reference building for MNECB compliance purposes is dictated by the “Performance Compliance for Buildings – Specifications for Calculation Procedures for Demonstrating Compliance to the Model National Energy Code for Buildings Using Whole Building Performance” [Canadian Commission on Building and Fire Codes (CCBFC), May 1999].

However, some aspects of Arenas are not specifically covered by the CCBFC Specifications. For these items, a standard has to be established in order to define the reference building. Through previous work on modeling arenas to CBIP, namely the Val-des-Monts case, combined with expertise available at NRCan and CETC-Varenes, it was possible to establish the missing specifications, be based on the industry’s current practice.

Arenas require additional specifications for its refrigeration equipment, subfloor heating for the ice sheet, brine pumping system, resurfacing hot water needs, and dehumidification requirements. All other aspects of Arenas, such as envelope, lighting levels, fresh air volumes, domestic hot water load, occupant density and mechanical systems will be based upon the CCBFC specifications already in use in EE4.

Reference Building HVAC system

- The Reference building HVAC system will be forced flow heaters in the Bleachers zone with a make-up air unit using the heating source as prescribed by CCBFC.

Reference Building Refrigeration system

Defining the reference building refrigeration system is by far the most significant addition to be made for Arenas. It is proposed that the following rules be applied when defining a Reference building refrigeration system:

- The Reference system refrigeration equipment shall be defined in the same zone as that of the proposed building.
- The Reference building shall use a 5 oF evaporating temperature, regardless of refrigerant type.
- The Reference system shall use a non-flooded evaporator

- The reference system refrigeration equipment shall have the same sizing ratio as that of the Proposed system with a maximum of 30 % oversizing.
- The Reference building shall NOT have a low emissivity ceiling.
- The reference system shall have a heat recovery system for domestic hot water only. The heat recovery capacity shall be set at 25% of the nominal condensing capacity. The nominal condensing capacity shall be estimated as the peak design evaporator load of every refrigeration compressors multiplied by the following factor: $(EER+1)/EER$, where EER is the compressor energy efficiency ratio at design evaporating and condensing temperatures. The evaporator load shall be estimated using the method presented in "2002 ASHRAE Handbook – Refrigeration ch.34". The load imposed by resurfacing will be based on identical volumes of water in the Reference and in the Proposed with a 150 F water temperature. The following load components will be allowed to differ between the Reference and the Proposed buildings and possibly provide conformance credits: System pump work, ceiling radiation, Rink humidity level, Lighting radiation gains. The following loads will not give rise to conformance credits: Ground heat gain/losses, header heat gain, rink air temperature, ice thickness, skaters, number of ice resurfacing.
- The Reference building compressors EER shall be 9 for R-22 systems at a saturated suction temperature of 5 oF, a saturated discharge temperature of 100 oF, and for 10 oF superheat as per AHSRAE Standard 30. The Reference building compressors EER shall be 9 for R-717 systems at a saturated suction temperature of 5 oF and a saturated discharge temperature of 100 oF.
- The Reference building shall use the same compressors part load performance curves than that of the Proposed building for non-modulating compressors.
- The number of compressors in the Reference building shall be identical to that in the proposed building.
- The Reference building compressors shall have no capacity modulation capabilities.
- The subfloor heating system shall be electric.
- The Reference building shall set its heat recovery temperature to 90 oF.
- The Reference building minimum condensing temperature shall be set at 100 oF.
- The Reference building condenser shall be air-cooled.
- The Reference building condensers fan motor power shall be set to 0.125 kW per ton of compressor capacity.) (i.e. 10 kW / 80 ton)
- The Reference refrigeration system shall have no mechanical subcooling system. The Reference refrigeration system shall have no subcooling system using the snow melting pit.
- The Reference refrigeration system shall have no natural subcooling system.

Reference Building Secondary Coolant system

It is proposed that the following rules be applied when defining a Reference building secondary refrigerant (brine) system:

- The Reference system shall have one (1) single speed pump for the brine loop.
- The pump's head and flow rate will be based on a two-pass piping layout and the peak design load of the ice sheet. A sizing factor identical to that of the Proposed building shall be used with a maximum of 30% oversizing.
- The motor efficiency for the Reference building shall be set at 80%.
- The Reference building Brine pump shall be continuously operating.
- The Reference building brine loop shall be of 2-pass type.

Reference Building Dehumidification system

CBIP does not normally allow modeling dehumidification for compliance purposes. However, since humidity levels in the ice rink zone can have a significant impact on the refrigeration system energy use and on the quality of the ice, this rule excluding dehumidification must be revised for arenas. Therefore, it is proposed that dehumidification be incorporated in the Arena compliance tool. Adding dehumidification requires defining rules for its inclusion in the Reference building. The following rules, based on typical designs, are proposed:

- The Reference building shall have a dehumidification system if the Proposed building has one. Dehumidification shall only be allowed in the Bleachers and Ice sheet zones.
- The Reference building dehumidification system shall be based on a self-contained mechanical refrigeration unit.
- The capacity of the Reference building dehumidification system shall be the same as that of the Proposed building with an SHR of 0.55.
- The minimum humidity set point used for control the dehumidification system shall be set at 40 %. If the Proposed set point is higher, the Reference building will use the latter.
- The unit shall be equipped with an electric defrost system.
- The dehumidification system COP shall be set in accordance to CCBFC specifications concerning reciprocating direct expansion cooling equipment.

Reference Building Appliances loads

It is proposed that any loads considered as Appliances be ignored both in the Proposed and Reference building. Appliances loads for Arena exclude the central refrigeration system but include, without being limited to, the following:

- Baking equipment load;
- Cooking and roasting equipment load;
- Stand-alone refrigeration equipment, such as soft drink dispensers;
- Snow melting load for the snow pit

This exclusion is consistent with the current approach used for the RFS Wizard.