

# Specifications for Grid-Connected Solar PV Systems

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In partnership with:



**Climate Change Central**



[www.lassothesun.ca](http://www.lassothesun.ca)

## DISCLAIMER

Climate Change Central is providing these Specifications as an information resource to organizations that are designing, supplying, installing and commissioning solar photovoltaic (PV) systems.

These Specifications were developed for the Alberta Solar Municipal Showcase project (2005 – 2009) and do not necessarily represent technical, policy or procedural guidelines set out by Climate Change Central, its funders or its project partners.

All of the information contained herein is provided to assist municipalities, businesses and individuals interested in developing their own grid-connected solar PV systems.

The Specifications, which are intended to be used as a complete package, are technically complete to our best understanding at the time of printing and are believed to be technically accurate.

Application of this information and results obtained are the responsibility of the user. No warranty for the accuracy of the information or its subsequent use is represented or implied by Climate Change Central or its partners.



# Introduction to Owners: How to Use these Specifications

This document is not intended to be sent to bidders.

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**Specifications for  
Grid-Connected  
Solar PV Systems**

# Grid-Connected Solar PV System Specifications

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## Introduction to Owners

### 1. Purpose of this Introductory Document

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The purpose of this document is to introduce these specifications to prospective owners of grid-connected solar electric generating (photovoltaic, or PV) systems.

This document is not intended to be sent to any bidders to these systems.

These specifications were originally written for the Alberta Solar Municipal Showcase (a project of Climate Change Central <[www.climatechangecentral.com](http://www.climatechangecentral.com)> and the Federation of Canadian Municipalities <[www.fcm.ca](http://www.fcm.ca)>) for the purpose of assisting a number of stakeholders in gaining experience with grid-connected solar photovoltaic (PV) technology and its process of procurement and regulatory approvals.

The stakeholders in the Showcase included municipalities and designers, suppliers, installers, electricians, building operators, funders, governments, electric utility companies, electricity industry regulators, the media, and the public.

The solar equipment in the Showcase consisted of 20 one to two kilowatt grid-connected solar PV systems mounted on municipal buildings across Alberta.

### 2. Solar PV System Specifications – What Are They?

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These specifications documents follow the format, configuration and numbering system developed in 1962 by the Construction Specifications Institute and Construction Specifications Canada as a uniform system for filing technical information and organizing project specifications.

The numbering system has been upgraded over the years and developed into the National Master Specification (NMS) by Public Works and Government Services Canada. The Government of Canada uses the NMS for specifications for projects including the construction and renovation of buildings. These specifications follow a new numbering system introduced in 2000.

The NMS is divided into a consistent numbering system of "divisions", "sections", and "parts". The Sections are each numbered as XX YY ZZ, where

- XX is the number of a "Division",
- YY is a "sub-division", and
- ZZ is the number of a Section within the Division.

Each Section contains three parts:

- Part 1 – General (containing general information for that Section),
- Part 2 – Products (describing the products to be provided through that Section), and
- Part 3 – Execution (describing the services to be provided through that Section).

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## **Introduction to Owners**

Each Section references the other sections to which it is relating.

The specification sections are organised so that they can be used in retrofitting an existing building or as part of the specifications for a new building.

The specification sections contain all of the PV system design, equipment supply, installation, and commissioning details and the qualifications regarding the Design Contractor, Supply Contractor, Installation Contractor (who may be the same or separate). These also include the proper documentation for the system.

The specifications were intended to be used by a team consisting of a Supply Contractor and Installation Contractor working together. The Design Contractor may or may not also be the Supply Contractor. The specifications require that the Installation Contractor work closely with the equipment Supply Contractor in order that the installation is done according to industry standards.

Although the specifications are very detailed and thorough, an experienced Design Contractor, Supply Contractor and Installation Contractor should find them easy to meet because they strive to describe "best" rules of practice for PV systems.

These specifications consist of the following documents:

1. Invitation to Bid
2. Project Specifications Sections:
  - a) 00 20 00 – Instructions for Procurement
  - b) 00 41 53 – Bid Submittal List
  - c) 01 00 00 – General Requirements
3. Technical Specifications Sections:
  - a) 48 14 00 – Solar PV System Introduction
  - b) 48 14 01 – Solar PV System General Conditions
  - c) 48 14 02 – Solar PV System Design
  - d) 48 14 03 – Solar PV System Equipment
  - e) 48 14 04 – Solar PV System Installation
  - f) 48 14 05 – Solar PV System Commissioning
  - g) 48 14 06 – Solar PV System Background Narrative
4. Bid Drawings:
  - a) Drawing S1: The Site Plan
  - b) Drawing PV1: Grid-Connected PV Power Plant Electrical Single-Line Drawing
  - c) Drawing PV2: System Interconnection Drawing (to meet CE Code Rule 84-030)

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### 5. Photographs:

- a) Photo P1: Photograph of south side of building or site showing possible array location and attachment slopes, shapes, and any PV array obstructions or shading
- b) Photo P2: Photograph of the south view from the possible array location showing trees, obstructions and other buildings
- c) Photo P3: Photograph of possible mechanical room showing possible inverter and switchgear locations, space and shape
- d) Photo P4: Photograph of electrical breaker panel

The specifications reference the following optional Canadian Construction Documents Committee (CCDC) documents ([www.ccdc.org](http://www.ccdc.org)):

- a) CCDC 02e, "Stipulated Price Contract document" (37 pages);
- b) CCA-CSC-RAIC Standard Construction Document 14e "Design-build Stipulated Price Contract" (35 pages) (Canadian Construction Association, Construction Specifications Canada, Royal Architectural Institute of Canada);
- c) CCDC 10 "Stipulated Price Bid Form". This is part of CCDC 23 "Guide to Calling Bids and Awarding Construction Contracts";
- d) CCDC 11, "Contractors Qualification Statement".

### 3. PV System Procurement – Order of Work (summary)

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Having a PV system installed on your building or site includes the following steps:

- Step 1.** Prepare information on the building or site where you want the solar PV system mounted.
- Step 2.** Some of the Sections have places where you need to fill in information.
- Step 3.** Send the specifications out to a number of bidders.
- Step 4.** Get the proposals from the bidders on PV system design, equipment supply, installation, and commissioning.
- Step 5.** Award the contract to design, supply, install, and/or commission the PV system to one or more Contractors.
- Step 6.** Obtain the regulatory grid-connection approvals.
- Step 7.** Get the PV system designed, supplied, installed, and commissioned.
- Step 8.** Arrange for bragging opportunities (optional but fun to do).

Note: Alternately you can get the system designed separately.

These steps are described in detail in the following section.

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## Introduction to Owners

### 4. PV System Specifications – Order of Work (detailed)

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**Step 1.** Prepare some information on the building where you want the solar PV system mounted.

a) Make a simple site plan (Dwg S1) that shows the following information (as per Section 48 14 06, paragraph 1.9.9):

- The location and address of the building or site on which the PV system will be mounted;
- The location on the building or the building site where the PV array will be located (this can be approximate or exact);
- The location where the inverter and disconnect switches will be mounted inside the building (this can be approximate or exact);
- The location of the breaker panel in the electrical room where the PV system will connect to the building wiring;
- Reasonable accurate distances from the PV array to the DC disconnect switch to the inverter to the building's breaker panel;
- Any major array or inverter mounting decisions.
- If you have any architectural or construction plans for your building, it would be great to make these available to the bidders.

b) It is good to include photos of your building to show the bidders. This makes their job easier in bidding and your job easier in evaluating the bids. Here are suggestions of photos to take.

- A photo of the south side of the building;
- A photo from the west or east of the building showing the south-facing roof-line or wall profile;
- A photo of the proposed location of the PV array on the roof or wall of the building showing any locating issues;
- A photo from the approximate location of the PV array looking east, south-east, south, south-west and west to show the exposures that the array will see, particularly showing any trees, foliage, poles, buildings, vent pipes and other potential shading obstructions;
- A close-up photo of the roof or wall of the building where the PV array will be mounted showing any mounting issues;
- A photo if possible of the wall or roof construction, materials and assembly (if possible);
- Photos of the path that the wiring will take on its way from the PV array to the DC disconnect switch, and on to the inverter and to the breaker panel. If at all possible, these photos should show any details of wall and ceiling spaces and their assembly or construction through which the wires will need to pass.



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- A photo of the likely place where the DC and AC disconnect switches, the inverter and any metering or monitoring equipment will be mounted showing how much space is available, showing the equipment surrounding the space and any locating issues. This equipment can be located in a mechanical room or a public space.
- A close-up photo of the wall construction and assembly details (if possible) where the DC and AC disconnects and the inverter and other equipment will be attached, and where any optional internet access will be provided;
- A close-up photo of the electrical breaker panel showing the space available for the PV system's breaker.
- A photo of the location where any public display panel will be located.

**Step 2.** Fill in information on some of the Sections of the specifications.

- a) Fill in the blanks and checkboxes electronically or on paper. The notes below will point you to where you need to fill in information.
- b) Enter your name and your project name in the header line at the top of each Section document.

c) PV System Specifications – Invitation to Bid

This document describes the bid documents to prospective bidders.

Fill out the information as required in it.

d) 00 20 00 – Instructions for Procurement

This Section is part of Division 00. It describes the bid logistics.

Fill out the information and select the checkboxes listed in the section.

1.2 Form of the Contract: Likely you would select checkboxes 1.2.1 or 1.2.2. Checkbox 1.2.3 requires that the designer have professional Errors and Omissions insurance, which is more appropriate for larger projects.

1.3 Form of the Bid: Checkbox 1.3.2 is one of your own that you may want to use.

1.4 Bid Closing Time and Submissions

1.6 Contract Time

1.7 Bidders' Inquiries

1.8 Contractor's Qualifications

1.9 Examination Of Documents, Site Inspection & Site Conditions

1.10 Omissions and Discrepancies

1.12 Insurance Policies

1.13 Work Schedule



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# Grid-Connected Solar PV System Specifications

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1.16 Award Contract

1.17 Duration and Availability of Pricing

e) 00 41 53 – Bid Submittal List

This Section is part of Division 00. It provides a fill-in-the-blank form and checklist for bidders to present their bid information to you if you wish to use it.

f) 01 00 00 – General Requirements

This Section is part of Division 01. It describes general requirements for the work.

Fill out the information and select the checkboxes in paragraphs:

1.1 Work Summary

1.5 Hours of Work

1.6 Interruption of Existing Facilities

1.7 Cost Allowance

g) 48 14 00 – Solar PV System Introduction

This Section is part of Division 48 14. It introduces the solar PV system to the bidder.

Fill out the information in paragraph:

1.1 Project Introduction

**Step 3.** Send the specifications out to a number of bidders.

- a) It is highly recommended that your Design Contractor (Section #48 14 02, paragraph 1.7) and your Equipment Supply Contractor (Section #48 14 03, paragraph 1.7) should be members in good standing of the Canadian Solar Industries Association (CanSIA, [www.cansia.ca](http://www.cansia.ca)). The background for this is described in Section # 48 14 06, paragraph 1.17.6 and paragraph 1.18.3.
- b) It is recommended that your Contractors follow these specifications regardless of whether you sole source them or not, to ensure that your system is properly designed, supplied, installed and commissioned.
- c) If you are e-mailing your specifications to your bidders, you can use Adobe Acrobat to make them into one big pdf file.

**Step 4.** Get the proposals from the bidders on PV system design, equipment supply, installation, and commissioning.

- a) Section 00 41 53, the Bid Submittal List describes the complete information that the Bidders will need to provide.
- b) Note that wherever the word "Owner" is used in the specifications, the intent is that this would mean "Owner in consultation with any Consultant".

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**Step 5.** Award the contract to design, supply, install and/or commission the PV system to one or more Contractors.

- a) The specifications are set up so that the design, equipment supply and installation can be awarded to the same or to different contractors.
- b) It is recommended that the supply of all the equipment be awarded to one contractor and not parted out to several contractors.
- c) It is recommended that the awarding of the contract follow the information described in the bid documents.

**Step 6.** Obtain the regulatory grid-connection approvals.

- a) These can be done at the same time as the equipment is being designed and supplied.
- b) Drawings PV1 and PV2 are of a generic small PV system. If they are not sufficient for your system they can easily be re-drawn and modified by your Design Contractor.
- c) Your Design Contractor needs to either fill out the information on electrical single-line drawing, Dwg PV1, for you or supply you with the information for you to fill it out.
- d) Drawing PV1 needs to be professionally stamped. The purpose of the electrical stamp on PV1 is also to warrant to the Wires Service Provider that the proper inverter is being used on your system.
- e) Drawing PV1 is to be submitted to your Wires Service Provider for approval.
- f) Drawing PV2 is to be placed by your Installation Contractor at the correct location on your system as described in the Canadian Electrical Code.

**Step 7.** Get the PV system designed, supplied, installed, and commissioned.

**Step 8.** Arrange for bragging opportunities (optional but fun to do). Your local media may likely be very interested too.