

Solar Photovoltaic System Design

The City of Concord has requested design and engineering services for a Roof Mount Photovoltaic (PV) installation for the Beede Swim and Fitness Center located at 498 Walden Street Concord, MA. Solar Design Associates (SDA) will be responsible for developing the construction documentation and specifications required to bid the PV system, as well as coordinating final documentation such as “As-Built” drawings and O&M manuals. Optional Services include PV System Structural Analysis.

System Information: The proposed PV system, a **60 - 90 kWdc** Roof Mount array for power production, will be engineered for installation on the 498 Walden Street facility, with design input from SDA. The proposed solar array shall meet the requirements of The City of Concord, as well as all applicable State and local codes. The electric utility currently supplying the building is the Concord Municipal Light Plant. The project schedule is not yet established, but once determined; it is recommended that roughly ~2 months be allotted for design engineering and bid document development.

The PV array design for the Beede Swim and Fitness Center will address mounting options, layout, and system production estimates during the design process. The array will seek to maximize solar energy production while minimizing system costs.

The system will interface with the building's existing electrical distribution, and will have a 30-year design life expectancy.

The DC electricity produced by the PV array will be fed into an inverter(s) that will be located outside, or in the main electric room, where it will be converted to utility-grade AC electricity to be consumed by the loads in the building.



Example Thin Film Roof Mount.

The PV system design will include a data acquisition system (DAS) with a weather station with web interface.

Estimated Installed System Costs: Based upon current pricing for roof mount systems of similar size, the final installed cost for the Beede Swim and Fitness Center will likely be in the range of \$5.90 - 6.40 per Watt.

Scope of Work

Construction Documents Phase (CDs): SDA will develop and finalize PV system engineering and produce construction documents and specifications for three submissions; 30% CDs, 60% CDs, and 100% CDs. SDA will develop a Bill of Materials for the major components in the PV systems and will identify key long-lead-time items.

SDA will also facilitate discussions with the building code officials and utility representatives having jurisdiction over the project as required regarding the installation and interconnection of the system. SDA will work with the customer to define the requirements for data acquisition and performance monitoring of the system.

SDA deliverables under the Construction Documents Phase will be construction drawings, system specifications and a Bill of Materials of the key components for the systems. System performance estimates will also be included in the system documentation.

Construction Period Support: Once the design work, construction documents and specifications described above are complete and approved, SDA will provide support to the City of Concord during the bid process and installation of the systems. This support will include the following: SDA will continue to facilitate discussions with the local code officials and utility representatives having jurisdiction over the project regarding the installation, interconnection and approval of the PV systems. SDA will also assist the City of Concord with the establishing a list of bidders, bid review, and conducting pre-bid / pre-construction meetings as required.

SDA will provide technical support during the system installation on-site, via phone, and e-mail. SDA will review shop drawings, respond to RFIs, review and approve contractors' requests for progress payments. SDA will interface with the code officials having jurisdiction, prepare and submit stamped engineering drawings for issuance of the required permits, and provide stamped as-built drawings and affidavits of completion as required to get the permits signed off and close out the project. SDA will also provide liaison with the local utility to address and satisfy their requirements for the project – including the preparation and submission of the application for interconnection – including signed and sealed engineering drawings as required, with participation in the required on-site system witness testing prior to utility approval. After system acceptance, SDA will help coordinate Owner training and documentation on system operation and maintenance by the installing contractor.

PV System Commissioning: SDA will provide on-site initial start-up and full commissioning of the system by an experienced installer/engineer to verify proper operation and performance. SDA's commissioning protocol involves the use of calibrated field test instruments to define the exact level of system performance and output under the actual field conditions with specific measurements of the solar radiation on the arrays during the commissioning process. Only in this way can the Owner be confident they are actually getting the solar generation capacity that they have contracted. The entire system is correlated with instantaneous solar radiation and a full commissioning report is prepared. This serves as a "performance baseline" for the system against which future warranty claims can be defined and pursued if necessary.

Following system commissioning, SDA will prepare a comprehensive punch list for the installing contractor to complete prior to project close out and final system acceptance by the City of Concord. SDA will also oversee the completion of this work and review the system's operational performance once again to ensure satisfactory execution.

Optional - PV System Structural Analysis: SDA will perform structural engineering that includes determining the wind speed, exposure and snow load at the site. SDA will also perform a structural analysis of the roof to confirm the maximum load that the roof can handle. Finally, SDA will supply a structural affidavit that states the PV system installed will remain on the roof.

SDA Deliverables: All drawings will be provided in the form of AutoCAD DWG and/or PDF files and written materials will be provided as WORD, Excel and/or PDF files. All deliverables will be transmitted electronically.

City of Concord Responsibilities: The City of Concord shall assign a Project Manager who shall be the coordinator for this solar program and the key contact for SDA. The City of Concord shall provide (or have the facility's architect provide) SDA accurate and up-to-date architectural, electrical and structural drawings, specifications and information on the building design and the roof construction. The City of Concord shall facilitate SDA access to the project and retain the services of civil, structural and electrical engineers as required to support the project overall. SDA will collaborate with the project architects and the civil,

**Engineering Proposal
City of Concord – Beede Swim and Fitness Center**

March 29, 2011

electrical and structural engineers in the development and integration of the solar systems with the building and its conventional systems. SDA will rely on the information provided by the City of Concord and their design team with regards to the building's electrical system and the building's ability to accept the structural loads imposed by the solar systems.

Insurance: SDA shall obtain and carry insurance for the duration of this project for coverages in the following areas and amounts:

- General Liability - \$1,000,000 per occurrence; \$2,000,000 aggregate
- Automobile Liability - \$1,000,000
- Worker's Compensation - \$1,000,000
- Professional Liability - \$1,000,000; \$2,000,000 aggregate
- Excess/Umbrella Liability - \$2,000,000

A Certificate of Insurance shall be provided to the City of Concord upon commencement of work. The City of Concord shall be named additional insured.

Governing Law: This Agreement and the performance of the services hereunder shall be governed by the laws of the Commonwealth of Massachusetts.

Arbitration: All claims, disputes and other matters in question between the parties to this Agreement arising out of or relating to this Agreement or the breach thereof, shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association then obtaining unless the parties mutually agree otherwise. No arbitration arising out of or relating to this Agreement shall include, by consolidation, joinder of, or in any other manner, any additional person not a party to this Agreement. Notice of the demand for arbitration shall be filed in writing with the other party to this Agreement and with the American Arbitration Association. The party initiating the demand shall notify the other party of the intention to arbitrate within ten days from the date when the claim, dispute or other matter in question has arisen. The award rendered by the arbitrators shall be final and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

Fees: SDA proposes to provide the services as defined in Construction Documents above on a fixed fee basis as follows: **Feasibility, 30% CDs, 60% CDs, 100% CDs, Construction Period Support and Commissioning for \$29,250.** Optional Service: **PV System Structural Analysis \$3,500.** Reimbursable expenses such as travel, document production and courier fees are in addition to Construction Document services and will be billed at cost plus 10%.

If additional requirements are added to this proposal, SDA reserves the right to increase the fee to cover them. Progress payments will be required by SDA as set forth below.

Payment: Services shall be invoiced at the completion of each milestone or monthly in proportion to the work then performed. Payments shall be made within 30 days of the submission of invoice. Overdue payments shall incur interest at 1.5% per month.



Engineering Proposal
City of Concord – Beede Swim and Fitness Center

March 29, 2011

Extent of Agreement: This Agreement represents the entire and integrated Agreement between the City of Concord and SDA and supersedes all prior negotiations or agreements. This Agreement may be amended only by written instrument signed by both the City of Concord and SDA.

Submitted by:

Accepted by:

A handwritten signature in black ink, appearing to be "S. Strong", written over a horizontal line.

Steven J. Strong, for
Solar Design Associates, LLC.
March 29, 2011

for the City of Concord

By: _____
(printed name and title)

Date: _____