



Solar Thermal Incentive Program Program Opportunity Notice (PON) 3221

**Solar Thermal (ST) Incentive Project Applications and Solar Thermal Installer/Contractor Applications Accepted March 1, 2016 through December 30, 2016
By 5:00 PM Eastern Time***

The New York State Energy Research and Development Authority (NYSERDA) requests applications from qualified Solar Thermal (ST) Installers/Contractors to participate in the Solar Thermal (Hot Water) Incentive Program (Program). Qualified Solar Thermal system installers/contractors are required to submit participation applications to become eligible installers/contractors. Participation applications will be accepted at any time while the program is open.

Funding available through PON 3221 is \$2,900,000.00

NYSERDA may at its discretion elect to extend and/or add funds to any project funded through this solicitation.

To be considered for participation in the Program, ST installer/contractor applicants must submit one [1] clearly labeled, completed and signed application package as detailed in the *Solar Thermal Installer/Contractor Eligibility Application Instructions and Application* to NYSEDA. The application package can be emailed to STForms@nyserda.ny.gov or may be mailed to the address provided below.

After receiving notification of approval from NYSEDA, an Eligible installer/contractor can submit projects to the Program for consideration of incentives. Program incentives are available on a first-come, first-served basis. The Program offers the following incentive for eligible projects:

- *Displaced kWh incentive:* Incentive applied to the total project cost based on displaced electric energy associated with the production of domestic hot water (either exclusively or as part of a combination system), expressed in kWhs. The full value of the incentive must be credited to the total project cost (cost of project before incentives).

To access incentives, Eligible Installer/Contractor must submit a completed and signed incentive application package into PowerClerk as detailed in Program Manual for each project.

**Solar Thermal Installer/Contractor Application PON 3221
NYS Energy Research and Development Authority
17 Columbia Circle
Albany, NY 12203-6399**

Installer/Contractor applicant questions should be directed to (518) 862-1090, ext. 3056 or stforms@nyserda.ny.gov.

Please indicate that you are calling in reference to PON 3221.

*Late, incomplete, or unsigned applications will be returned. Faxed or e-mailed applications will not be accepted. Applications will not be accepted at any other NYSEDA location other than the address above. If changes are made to this solicitation, notification will be posted on NYSEDA's website at www.nyserda.ny.gov.

I. INTRODUCTION

WHAT IS THE SOLAR THERMAL INCENTIVE PROGRAM?

The New York State Energy Research and Development Authority (NYSERDA) provides financial incentives for the installation of new Solar Thermal (ST) systems that displace electrically heated domestic hot water (DHW). Incentive funding for ST systems that displace electrically heated DHW has been allocated by the New York State Public Service Commission through the Clean Energy Fund (CEF), and is available only for ST systems within the service territories of the State's investor-owned utilities. Incentives funded through the CEF will be granted on a first-come, first-served basis, and applications will be accepted through December 31, 2016, or until funds are fully committed, whichever comes first.

HOW DOES THE PROGRAM WORK?

Financial incentives are available for qualified customers who wish to install Solar Thermal (Hot Water) systems through applications submitted by a Participating Contractor. A Participating Contractor has demonstrated technical competence in the Solar Thermal field and agrees to follow all Program terms and conditions, including the Participation Agreement with NYSERDA. Incentives are paid directly to the Contractor, and must be applied, in full, to the cost of the Solar Thermal (ST) system, thereby reducing the customer's out-of-pocket cost.

The Eligible Installer (individuals who have demonstrated technical competence in the ST (Hot Water) field) or Contractor is responsible for preparing and submitting all necessary project application and incentive paperwork to NYSERDA. To become an eligible installer, an individual must fulfill one of the following credentialing requirements.

1. Hold the NABCEP Certification (North American Board of Certified Energy Practitioners) Solar Heating Installer Certification
2. Journeyman who has completed an approved NYS DOL Apprenticeship Program through the United Association of Plumbers, Fitters, Welders, and HVAC Service Techs Apprentice Program including UA approved solar thermal training.
3. Completed a Solar Thermal Manufacturer's certification which includes 18 hours of manufacturer's specific training and demonstration of equivalent experience.

More information on how to become an Eligible Installer/Contractor can be found in the ST *Installer/Contractor Application and Instructions Package*.

In addition to financing that may be offered by an Installer/Contractor, the Program currently offers financing through Green Jobs-Green New York (GJGNY). Availability and conditions of GJGNY financing is subject to change. Information on financing options, terms and qualification criteria can be found on NYSERDA's web site at the following link:

<http://www.nyserd.ny.gov/About/Green-Jobs-Green-New-York>

II. GENERAL PROGRAM REQUIREMENTS

Projects must identify the method used for establishing the existing thermal load, and displaced electric energy usage calculated in kWh. System offset cannot exceed 80% of existing DHW load.

Installers must calculate all potential system output losses per direction in the Program Manual (kWh generated after all losses associated with shading, system orientation, tilt angle, etc. are applied)

System must be installed in accordance with the design and solar hot water system components submitted in the application and approved by NYSERDA

Incentive highlights:

Incentive Rates (effective 3/1/2016)

- Residential installations: \$1.00/kWh offset per year up to \$5,000.
- Commercial/Industrial: \$0.30/kWh offset per year up to \$75,000.
- Agricultural/Not-for-Profit/Government: \$0.40 per kWh offset per year up to \$75,000.

Incentives may be adjusted in the future, based on market uptake, system costs and funding availability. NYSERDA may at its discretion elect to extend and/or add funds to any project funded through this solicitation.

- Incentives are paid directly to the Contractor and must be passed on in the full amount to the customer. Incentives are not provided directly to customers purchasing or installing ST Systems.
- Incentives are only available for new equipment and ST Systems that have not been installed (partially or completely) prior to NYSERDA receiving a project application.
- Incentives are calculated based upon estimated displaced electric kWh usage. Incentives are available to residential (single and multifamily), commercial, agricultural and non-profit customers who use a Contractor participating in the Solar Thermal Program. Equipment and systems must be certified by the Solar Rating and Certification Corporation (SRCC). Incentives are based on SRCC output calculations for OG 300 systems. For systems that do not have an OG 300 rating, a system performance estimate based on Solar Pathfinder Thermal, RETScreen or other approved methods are acceptable. As a typical Solar Thermal system displaces between 50-80% of a site's DHW load, the Program does not incentivize systems that are designed to offset more than 80% of the DHW load.
- NYSERDA reserves the right to establish and enforce a monthly capacity limit on Eligible Installers and Contractors. Should a monthly capacity limit be established, applications received after a limit is reached will not be accepted.

Limitation - This solicitation does not commit NYSERDA to award a contract, pay any costs incurred in preparing any application. NYSERDA reserves the right to accept or reject any or all applications received, and to cancel in part or in its entirety the solicitation when it is in NYSERDA's best interest.

III. ADDITIONAL INFORMATION AND ATTACHMENTS

Associated Documents

Program Manual – Solar Thermal
Participation Agreement – Solar Thermal
Customer Guide

Existing Installer/Contractor Forms

Incentive Request Form
Change Request Form
Addendum to Agreement

How to Become an Eligible Installer / Contractor

Installer / Contractor Application Package
Field Inspection Guidelines Solar-Heating Systems

GJGNY

[Green Jobs - Green New York Financing Contractor Application Process](#) (link)

ProForma Tools
Residential
Non-Residential
Building Owner Release Form



Solar Thermal Incentive Program
Program Opportunity Notice PON 3221, Rev 01
REVISED March 2016

Program incentives are available for qualified
Solar Thermal Incentive projects through December 30, 2016

SUMMARY OF REVISIONS

The following changes have been made to PON 3221:

- PON 3221 has been modified to state the current funding availability of \$2,900,000.00.
- The following language was added: NYSERDA may at its discretion elect to extend and/or add funds to any project funded through this solicitation

**NEW YORK STATE CONTRACT REPORTER INSERTION FORM
NYSERDA - CONTRACTS DEPARTMENT**

PON/RFP/RFQ Number:
Title:
Description of goods to services to be bid:
If goods or services are made to this solicitation notification will be posted on NYSERDA's website at: www.nysesda.ny.gov/funding-opportunities
These goods or services have been purchased from an out-of-state vendor within the past 3 years: _____ Yes _____ N/A
Eligibility/Qualifications Requirements/Preferences:
Subcontracting provisions: Minority business sub-contracting goal: _____ % Woman-owned business sub-contracting goal: _____ %
Proposal due date:
Contract term:
Location where goods to be delivered or services performed:
Contract Category/Classifications: On the next page select at least one, and up to four categories that you would like your PON/RFP/RFQ to appear in.

Choose at least one, and up to four categories in which you want your solicitation to appear in the contract reporter. **For each category selected choose only one classification.**

For explanation of a category or classification, see the [Explanation of Contract Classifications and Categories](#) document.

Categories (choose at least one, and up to four)	Classifications			
	Commodities	Consulting /Other Services	Construction Prof. Services	Construction
Administrative & Technical				
Advertising, Graphic Arts, & Marketing				
Agriculture, Forestry, Gardening, Landscaping, Lawn Maintenance & Snow Removal				
Apparel, Textile & Leather				
Architectural, Engineering & Surveying				
Construction Horizontal: Highways & Roadways; Maintenance, Repair & New Construction				
Construction Vertical: Building Construction; Rehabilitation & New Construction				
Educational & Recreational				
Environmental				
Facilities, Maintenance, Repair & Building Operations				
Financial				
Food, Beverages, Commissary & Vending				
Freight, Moving & Warehousing				
Fuels & Lubricants				
Information Technology				
Legal & Investigative Services				
Medical & Health Care				
Medical & Laboratory Equipment				
Miscellaneous				
Office Furniture, Supplies & Equipment				
Photography & Video				
Printing				
Real Property, Office, Hotel, Conferences & Meeting Space				
Safety & Security				
Telecommunications				
Transportation, Bus, Rail, Marine & Aviation				
Utilities				
Vehicles & Equipment				

Identify which of the above selected **categories** is the primary: _____



NYSERDA

Please complete the following:

Technical Contact:

Name & Title:

Department:

Address:

Phone: Ext. _____

Fax:

Email:

Primary Contact (if technical and primary are same person just write same as above):

Name & Title:

Department:

Address:

Phone: Ext. _____

Fax:

Email:

Secondary Contact - Assistant Contract Administrator (choose the ACA for your program area):

Nancy Marucci Ext. 3335

Venice Forbes Ext. 3507

Elsyda Ahmed Ext. 3232

Doreen Knudsen Ext. 3216

Submit to:

Name:

Title:

Department:

Address:

Phone: Ext. _____

Fax:

Email:

Solar Thermal Program Manual

March 2016, v.1.1 (PON 3221)



NYSERDA's Promise to New Yorkers:

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

Mission Statement:

Advance innovative energy solutions in ways that improve New York's economy and environment.

Vision Statement:

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

New York State Energy and Research Development Authority

17 Columbia Circle

Albany, NY 12203-6399

(518) 862-1090

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1.0 PROGRAM SUMMARY

1.1 What Is The Solar Thermal (ST) Program?

The New York State Energy Research and Development Authority (NYSERDA) provide financial incentives for the installation of new Solar Thermal (ST) systems that displace electrically heated domestic hot water (DHW). Incentive funding for ST systems that displace DHW has been allocated by the New York State Public Service Commission through the Clean Energy Fund (CEF), and is available only for systems within the service territories of the State's investor-owned utilities. Incentives funded through the CEF will be granted on a first-come, first-served basis, and applications will be accepted through December 31, 2016, or until funds are fully committed, whichever comes first.

1.2 How Does the Solar Thermal Program Work?

Financial incentives are available for qualified customers who install a Solar Thermal system using a Participating Contractor. A list of Participating Contractors can be found at:

<http://www.nysERDA.ny.gov/Contractors/Find-a-Contractor/Solar-Thermal-Installers>.

Participating Contractors are those who have demonstrated to NYSERDA that they fulfill the minimum requirements for participation in the Solar Thermal Program. By submitting a project application, the Participating Contractor agrees to abide by the terms and conditions of the Solar Thermal Program, including the Participation Agreement.

Participating Contractors are required to use an Eligible Installer in order for systems to qualify for Program incentives. The Eligible Installer also agrees to follow the terms and conditions of the Solar Thermal Program, including the Participation Agreement. The customer purchase agreement (contract) for installation of an ST system is between the customer and the Participating Contractor.

The Program incentive is paid directly to the Participating Contractor, who must apply the full value of the incentive to the cost of the ST System. For purchased (direct sale) systems, the incentive must be applied to the gross (pre-incentive) contract as a direct reduction to the customer's out-of-pocket cost. For Lease or Power Purchase Agreement systems, the incentive must be used to reduce the customer's lease or PPA payments. Eligible Installers and their Contractor are responsible for preparing all necessary project application documents and submitting them to NYSERDA.

Customers purchasing a Solar Thermal may be eligible to finance the purchase through NYSERDA's Green Jobs/Green New York (GJGNY) Program using either a Smart Energy Loan or On-Bill Recovery. Further information on GJGNY financing can be found at the links provided below.

Residential Customers: www.energyfinancesolutions.com.

Commercial Customers: www.nysERDA.ny.gov/small-commercial-financing

1.3 INSTALLER QUALIFICATIONS

Interested qualified Installers may apply to participate in the Program at any time while the program is open. To qualify to participate as an Eligible Installer, an individual must have fulfilled one of the credentialing paths detailed below and fulfill all other participation requirements.

- a. *NABCEP Certification (North American Board of Certified Energy Practitioners):*
Installers who choose to become credentialed through NABCEP and hold the Solar Heating Installer Certification.
- b. *Journeyman:*
Installers who choose to become credentialed through the “Journeyman path” must fulfill the following requirements to be eligible to participate in the Program:
 1. Be a Journeyman, and
 2. Completed an approved NYS DOL Apprenticeship Program through the United Association of Plumbers, Fitters, Welders, and HVAC Service Techs Apprentice Program including UA approved solar thermal training.
- c. *Solar Thermal Manufacturer’s Certification:*
Installers who choose to become credentialed through a Solar Thermal Manufacturer’s must have fulfilled the following requirements to be eligible to participate in the Program:
 - A. Completed 18 hours of manufacturer’s specific training, and
 - B. Demonstrate equivalent experience.

Additional participation qualifications are based on the following:

Experience – Installer/Contractor will be evaluated on past performance in this or other NYSERDA programs, if applicable; installation experience; experience in performing shading analysis; other relevant credentials; employment history; customer satisfaction; and other relevant experience.

Customer References – Provide three (3) verifiable solar customer references (Customer name, address, phone, and email) for completed, grid-connected PV installations, along with the installed system size (kW), interconnection date and the Applicant’s role in the project.

Performance in other NYSERDA Programs – An Installer Application will not be processed if the applicant is listed as the Installer or Contractor on a delinquent system, or where customer unresolved or performance issues exist with respect to this or other New York State programs.

1.4 Contractor Qualifications

Interested qualified companies may apply to participate in the Program at any time while the program is open.

To become a Participating Contractor and maintain that status, contractors must employ, or hire subcontractors that employ eligible installers as detailed in Section 1.3. The Eligible Installer and the Contractor will be jointly responsible for the compliance of each system.

A Participating Contractor may use any business structure that is legal for conducting this type of business in the State of New York (corporation, LLC, sole proprietorship,

etc.). To become a Participating Contractor, the Contractor must meet all Program requirements including required insurance coverage, and have the capability to provide warranty services on all ST systems installed, as required by the Program and NY State law.

A Participating Contractor must comply with all local authority requirements for registration and licensing that apply to the installation of ST systems.

Once a contractor has been approved to participate in the Solar Thermal Program, the systems they install will be eligible to receive financial incentives through the Program. An ST system installed by a Contractor who is not a participant in the Program is not eligible for Program incentives.

1.5 Participation Status and Status Review Process

Participating Installers and Contractors shall be classified in one of the following designations: Provisional, Full, Probationary, Suspended or Terminated. Each designation shall be subject to limitations, or requirements associated with that designation. NYSERDA reserves the right to modify the definition, limitations, and requirements of these designations. An Installer's or Contractor's progression into and/or through any designation will be determined at NYSERDA's sole discretion.

Provisional Status: All new Installers and Contractors will initially be classified as Provisional.

Applications submitted by Installers and Contractors in provisional status will receive enhanced review of both the Project Application and the Design Review; completed installations will be subject to enhanced Quality Assurance (QA) oversight.

Provisional Installer:

- A. Provisional Installers will be listed on NYSERDA's website and may be denoted as such. The listing must identify the Contractor that employs or subcontracts the Installer.
- B. Provisional Installers are limited to three (3) Project Applications at a given time. Additional Project Application(s) may be submitted after previous application(s) have passed NYSERDA design review, such that no more than three Project Applications are in design review at any given time.
- C. Provisional Installers must be onsite during the first three scheduled QA field inspections.
- D. Following the completion of the third project and the related QA field inspection, NYSERDA will conduct a formal review to evaluate a change in status. Evaluation for a change in status to Full Installer will be based upon the quality and consistency of all work submitted to the program and full compliance with ST Program rules including meeting credentialing requirements as described above.

After one calendar year as a Provisional Installer, a review of all work submitted to the ST Program will be conducted. The installer will be reviewed for a change in status, continuation as a Provisional Installer or termination from the Program.

Provisional Contractor:

- A. **Provisional** Contractors will be listed on NYSERDA's website.
- B. **Provisional** Contractors are limited to three (3) pending Project Applications at a given time as long as all Installer requirements are followed for each submitted

- application. Additional Project Application(s) shall not be submitted to and will not be accepted by NYSERDA.
- C. Provisional Contractor's staff must be onsite during the first three scheduled QA field inspections.
 - D. Following the completion of the third project and the related QA field inspection, NYSERDA will conduct a formal review to evaluate a change in status. Evaluation of a change in status to Full Contractor will be based upon the quality and consistency of all work submitted to the program and full compliance with ST Program rules.
 - E. To be considered for a change in status to **Full** Contractor, a Provisional Contractor is required to maintain on staff or through a subcontract at least one Full status Installer.

After one calendar year as a Provisional Contractor a review of all work submitted to the ST Program will be conducted. The contractor will be reviewed for a change in status, continuation as a Provisional Contractor or termination from the Program.

Full Status: Installers and Contractors who have successfully completed the terms of the provisional period and current Installers and Contractors who have demonstrated through past performance that they provide quality services through the Program will be placed in Full Status.

Full Installer:

- A. Full Installers will be listed on NYSERDA's website and may be denoted as such. Listing must designate the Contractor that employs or subcontracts the Installer.
- B. Full Installers must consistently deliver projects which fully pass QA field inspections.
- C. Full Installers must meet Program standards in terms of timely responses to NYSERDA communications and QA field inspection corrective action requests.
- D. Full Installers must take effective corrective actions to deficiencies in performance as identified by NYSERDA.
- E. Full Installers are required to maintain one of the credentialing standards referenced in the ST Program Manual: Failure to satisfy this ST Program requirement and present appropriate documentation will result in an automatic change to **Probationary** status.

Full Contractor:

- A. Full Contractors will be listed on NYSERDA's website and may be denoted as such. Listing may designate Installer(s) employed or sub-contracted with the contractor.
- B. Full Contractors must consistently deliver projects which fully pass QA field inspections.
- C. Full Contractors must meet Program standards in terms of timely responses to NYSERDA communications and QA field inspection corrective action requests.
- D. Full Contractors must take effective corrective actions to performance deficiencies as identified by NYSERDA.
- E. Full Contractors are required to maintain on staff or through a subcontract at least one "Eligible Installer" that meets one of the credentialing standards referenced in the ST Program Manual. Failure to satisfy this ST Program requirement and present appropriate documentation will result in an automatic change to **Probationary** status.

Probationary Status: Probationary Status is reserved for Installers and Contractors that have failed to meet the requirements of the ST Program. Probation is prescriptive in nature with both a specific list of results to be achieved and a time frame for achieving those results.

Installers and Contractors may be placed in probationary status for any of the following reasons:

- A. Violation of program rules or ethical standards; or
- B. Failure to consistently deliver completed projects which pass the QA Field Inspection standard; or
- C. Failure to take effective corrective actions on a critical or major deficiency or a repeated incidental of minor deficiency in work quality or performance; or
- D. Three (3) or more Corrective Action Notices that have not been responded to or remain unresolved for more than 30 days; or
- E. A lapse in required credentials.

The probationary period will not be less than 30 days. Projects completed by Installers and Contractors on Probationary status will receive enhanced QA oversight. During the probationary period, the Installer or Contractor:

- A. Will remain on the NYSERDA website
- B. May continue to submit new Project Applications, subject to restrictions based upon the reason for the Probationary status.
- C. Will be subject to higher QA inspection levels as outlined in the ST Program Manual.
- D. Must remediate all issues related to probation, as directed by NYSERDA.
- E. Must submit to the Program, in writing, an agreed-upon action plan designed to ensure future violations are avoided.
- F. Must demonstrate successful results through a specified number of completed projects.

Upon satisfactory completion of the action plan and all remediation, and upon review of probationary period QA results, NYSERDA will determine

whether to return the Partner to Full Status, continue the Probationary period or to suspend and/or terminate the Partner.

Suspended Status: Installers and Contractors that have failed to respond to prescriptive probation or have committed more serious violations of the ST Program rules will be placed in Suspended Status.

Installers and Contractors may be suspended from the Program if the Installer or Contractor:

- A. Fails to adequately fulfill the terms of the probationary period; or
- B. Is placed on probation for a second time within twelve (12) months; or
- C. Is under investigation for, or has been determined to have engaged in practices that have put the public or Program at risk; or
- D. Has one or more projects not completed within 120 days from the date of project approval, and where no Project Extension has been granted; or

- E. Has outstanding and unresolved request(s) for return of incentive to NYSERDA due to failure to meet Program requirements; or
- F. Has submitted any application documentation where there is falsification of any required items, including, but not limited to, permits and approvals, and customer signatures.
- G. Has a lapse in required credentials while on Probationary status; or
- H. Fails to consistently deliver completed projects which pass the QA Field Inspection standard.

During a suspension the Installer and/or Contractor:

- A. Will be removed from the NYSERDA website.
- B. Will not be allowed to submit new Project Applications to the ST Program.
- C. Must complete any work that was in progress at the time of suspension.
- D. Is prohibited from representing him/herself as a participating Installer or Contractor except in the execution of remedial action.
- E. May, depending on the reasons for suspension, be directed by NYSERDA to remediate issues related to the suspension, and may be required to submit to the Program, in writing, an agreed-upon action plan that is designed to ensure future violations are avoided.

Suspended Installers and Contractors will either progress to probationary status upon satisfactory completion of the specified remedial activities or resolution of issues related to the suspension or they will be terminated from program participation. Nothing in this Program status relieves the Contractor of the responsibility to fulfill any outstanding obligations to the Program, or Program customers as directed by NYSERDA.

Terminated Status: Terminated status is reserved for Installers and Contractors that have failed to respond to prescriptive and disciplinary measures or have committed serious violations of the program rules.

Installers and Contractors may be terminated from the Program if the Installer or Contractor:

- A. Has been on suspended status for more than 30 days and has been unresponsive to or failed to adequately fulfill the terms of their suspension; or
- B. Has had their credentials lapse while suspended; or
- C. Submits falsified documents or unauthorized signatures to the Program; or
- D. Commits illegal actions while participating in the ST Program; or
- E. Is convicted or has a principal who is convicted of a criminal charge that casts the Program in negative light or calls the integrity or workmanship of the Contractor into question; or
- F. Is in gross violation of program standards; or
- G. Repeatedly bills for uninstalled measures; or
- H. Fails to meet the terms of the Provisional period.

Installers and Contractors with this designation are prohibited from participation in the ST Program. Customers with incomplete projects will be notified of the Installers and/or Contractors termination and may be offered such remedies as NYSERDA deems appropriate. If appropriate, NYSERDA may notify the New York State Attorney General, the New York State Department of Labor, the Better Business Bureau, or others of NYSERDA's findings and decision to terminate the Installer and/or Contractor.

Further, the officers and owners of the terminated Installer and/or Contractor are prohibited from being or becoming officers or owners of any other Program Partner. Nothing in this process relieves the Partner of the responsibility to fulfill any remaining obligation to the Program, or their customers.

Status Review Process: The Status Review Process for administering Probationary, Suspended, or Terminated status is as follows:

- A. NYSERDA will provide written notice of at least ten (10) business days of its intention to take action. This notice will outline the specific for disciplinary action along with supporting documentation for the proposed action.
- B. During this period, the Installer or Contractor will be provided with an opportunity to respond to the notice.
- C. If the Installer and/or Contractor fails to respond to NYSERDA prior to the end of the notice period, the stated disciplinary action will go into effect without further notice.
- D. NYSERDA will promptly review any request for an appeal of the decision received before the end of the notice period.
- E. NYSERDA will confirm, reverse or place its action on hold based upon a review of all information received within ten (10) business days of receipt.
- F. Intended and final action letters will be sent via email and US mail. The ten day notice period commences on the date of the e-mail from NYSERDA.
- G. NYSERDA reserves the right to shorten these time periods, or to take immediate action, in the event of an emergency, as determined by NYSERDA.

2.0 GENERAL PROGRAM RULES

2.1 Program Incentives. Incentives are available on a first-come, first-served basis. Incentives are applied to the total project cost based on displaced kWh of electrically heated domestic hot water (DHW). Combination systems (systems that provide DHW and space heating) are allowed in the Program; however, incentives are only provided on the portion of the solar thermal system output that offsets DHW production in kWh.

The current Incentive rates and per project incentive caps are provided below.

Incentive Rate details - effective for project applications 'Submitted via Internet'			
Sector	Fuel Types	Per displaced kWh incentive rate	Maximum per Project Incentive Cap
Residential	Electric	\$ 1.00	\$ 5,000.00
Commercial	Electric	\$ 0.30	\$ 75,000.00
Agricultural, Non-for-Profit, Government	Electric	\$ 0.40	\$ 75,000.00

The incentive caps are applied per utility meter. If multiple meters are present, multiple systems may be eligible for incentives; the incentive cap will apply to Solar Thermal Program Manual -March 2016, v1 (PON 3221)

each meter. For example, in a shopping mall consisting of four separately metered businesses, each business (site) would be eligible for Program incentives, provided all Program requirements could be met.

Any contractor/installer who moves forward with the installation of a project that has not been funded (i.e., has not obtained a status of “approved” in the program database), does so at their own financial risk as there is no guarantee of incentives until the project is approved.” Also, projects *completed* prior to being *submitted* to NYSERDA (prior to obtaining a status of “submitted via Internet”) are **not** eligible to receive Program incentives.

Incentives are reserved for ST systems designed and installed by Eligible Installers/Participating Contractors. Incentives are available only for new equipment. **Incentives will be provided directly to the Participating Contractor of record for the project, not to the customer.** The Participating Contractor must apply the full value of the NYSERDA incentives to the original cost of the PV System. Contractors are prohibited from engaging in the practice of collecting the NYSERDA incentive portion of the contract from customers and crediting those funds to the customer upon completion of the project, either directly or as a reduction in the final payment.

Once a project has achieved “Approved” status, the Participating Contractor and Eligible Installer will receive an approval notification through PowerClerk, which will include the project incentive amount. Eligible Installer/Contractor is responsible for sending a copy of the approval notification to the customer. The incentive amount in the approval notification will not change assuming the ST system is installed, as approved, and within the Terms and Conditions of the Program. In instances where a Project Application has missing or inaccurate documents, NYSERDA will not receive/accept the application and will contact the Eligible Installer or Contractor requesting the missing information be provided and/or inaccurate information be corrected. If the information is not provided or corrected after three requests by NYSERDA, the Project Application will be denied. The project can be re-submitted at a later date.

Customers whose systems qualify for the incentive through this PON are prohibited from receiving incentives through another funding source or NYSERDA program for the same system.

NYSERDA reserves the right to limit the number of incentives per customer, site, or meter.

The incentive is based on displaced energy usage based upon Solar Rating and Certification Corporation (SRCC) OG-300 estimates of system production. For systems that do not have a SRCC OG-300 rating, an estimate based on calculations from RET screen, Solar Pathfinder Thermal, Polysun or other approved method may be provided. NYSERDA will review the energy production data to determine the accuracy of the estimated production. In addition to system output, the Installer/Contractor must identify and quantify the DHW thermal load to be offset. Estimates of system production and or thermal load that are determined to be highly inaccurate may result in the manufacturer or installer being disqualified from participation in the Program.

NYSERDA reserves the right to make changes in the incentive rate and per project incentive cap. These changes will be posted on the NYSERDA website and can be found at the following web page:

<http://www.nyserdera.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-3221-Solar-Thermal-Incentive-Program.aspx>

Participating Contractors and Eligible Installers/Contractors will also be informed of any changes via email. Any project application submitted to the Program after an incentive change will be processed at the new incentive level. Installers/Contractors and customers are prohibited from cancelling submitted applications and re-applying if the new incentive structure would result in a higher project incentive.

2.2 Incentive Calculations

Incentives are calculated based upon modeled displaced electrical usage. As a typical Solar Thermal systems displaces between 50-80% of the DHW load, the Program does not incentivize systems that are designed to offset more than 80% of the DHW load

Example:

A RET Screen analysis indicates that a residence uses 3,309kWh of electric annually to heat domestic hot water. Therefore, to be eligible for incentives through the Program, the ST system design cannot offset the DHW usage more than 2,674kWh (3,309kWh x 0.8).

2.3 Total Capacity Limit

NYSERDA reserves the right to establish and enforce a per month capacity limit on Installers and Contractors. Applications received after this limit is reached will not be accepted.

2.4 Cancellation Requests

A request to cancel a project must be submitted to NYSERDA using the NYSERDA Change Request Form. The form must be sent to STForms@nyserdera.ny.gov and use the subject line naming convention provided below.

Cancellation Request, ST (4 digit installer # + Application #) - Name of Customer

Should a project wish to move forward after cancellation, the Installer/ Contractor must submit a new project application. In this case, the incentive level and all rules in effect at the time the new project application is received will apply.

2.5 90-Day Project Extensions

A project extension may be granted, upon written request, on a case-by-case basis if there are ***legitimate and verifiable reasons***. Project extensions may be granted in 90-day increments. To request an extension, Installer/Contractor must submit and have approved by NYSERDA a Change Request Form. The form must be sent to STForms@nyserdera.ny.gov and use the subject line naming convention provided below.

90 Day Project Extension, ST (4 digit installer # + Application #) - Name of Customer

2.6 Change Orders

Any system modifications or equipment changes **must be approved** by NYSERDA in writing with a change request form before a system is installed. Failure to get NYSERDA approval may result in revocation of the incentive reservation or nonpayment of the incentive.

Submittal of a Change Request Form is required for all system modifications. The form must be sent to STForms@nyserda.ny.gov and use the subject line naming convention provided below.

Change Order Form, ST (4 digit installer # + Application #) - Name of Customer

For projects accessing Green Jobs Green New York (GJGNY) financing, a new Pro Forma tool must be submitted along with Change Order Form, and the subject line must also include the following information in the format provided below.

Proforma Tool, ST (4 digit installer # + Application #) - Name of Customer

Change order requests must state the reason for the change, the original equipment quantity and catalog numbers, the proposed equipment quantity and catalog numbers, changes in cost, changes in incentive (if applicable) amount and any changes in the collector configuration. All proposed change requests must include the owner's signed acknowledgement of the proposed changes.

For change orders that result in an increase in the incentive amount, the Participating Contractor and Eligible Installer will receive e-mail that provides the revised incentive amount. All other change orders (reduced incentive, change of equipment) will be approved in PowerClerk. Please check PowerClerk before contacting NYSERDA regarding change order approvals.

Change orders resulting in an increase to system size will not result in an additional incentive in excess of the incentive cap in effect at the time the change order is received.

2.7 Expansion of Completed Systems

Installers may request additional incentives for the expansion of a Completed System. Incentives will not be paid for additional production beyond the caps described in Section 2.1 based on the combined aggregate capacity including the existing system. Each Project Application must be completed in its entirety and indicate that it is an expansion system, and all required documents need to be entered into Power Clerk. PowerClerk may require information about the existing solar thermal system such as system size, project number, and associated PON.

2.8 Incentive Payments

A single incentive will be paid to the Contractor upon completion of the installation and acceptance by the Authority Having Jurisdiction (AHJ). The NYSERDA incentive payment will not be paid until all documentation for applicable utility, state, city or town permits and other inspections and approvals, as appropriate, are obtained and submitted to NYSERDA together with a completed *Incentive Request Form*. Installers/Contractors have 120 days from the date of approval by NYSERDA to complete the installation.

All incentive payment requests must be e-mailed to STinvoices@nyserdera.ny.gov and use the following subject line naming convention.

100%, ST (4 digit installer # + Application #) - Name of Customer

Each scanned incentive request should be named **using the same naming convention as outlined above and all documents must be scanned together as a single pdf**. Please do NOT include packing lists.

2.9 Incentive Structure

Where necessary, NYSERDA reserves the right to structure incentive payments differently to accommodate unique situations.

2.10 System Losses

Project applications shall include details on all potential ST system output losses (actual thermal energy generated and equivalent kilowatt hours (kWh) displaced after all equipment losses are applied) associated with shading, system orientation, tilt angle, etc. A system that is shaded by trees, that faces east or west, or that is installed on a flat roof, will have outputs that will be less than ideal. All impacts on system output must be quantified and will be considered during the review of the project application submitted by the Installer/Contractor.

2.11 Coordination with other NYSERDA Programs

ST projects receiving, or selected to receive awards under any other NYSERDA Program, PON, RFP are not eligible to receive incentives through the Solar Thermal Incentive Program. Projects receiving, or selected to receive, awards through another NYSERDA PON or RFP may not be canceled and then re-submitted to NYSERDA through Solar Thermal Incentive Program.

2.12 Financing

Solar Thermal customers may be eligible to finance the purchase of their Solar Thermal system through NYSERDA's Green Jobs/Green New York (GJGNY) financing Program using either a Smart Energy Loan or On-Bill Recovery. GJGNY financing is also 'fuel neutral' and, therefore, is available for projects that displace either electrically, or non-electrically, heated domestic hot water.

- Residential Customers in existing homes of four units or less may be eligible to finance the purchase of their PV system through NYSERDA's Green Jobs/Green New York (GJGNY) loan program using either a Smart Energy Loan or On-Bill Recovery.

Customers may apply online or download an application at www.energyfinancesolutions.com

To submit projects accessing financing, Participating Contractors must apply for approval. To register, Participating Contractors must complete and submit an *EFS Contractor Application Packet*, which is available at:

energyfinancesolutions.com/forcontractors-contractor-qualifications

The Contractor Packet consists of the following documentation:

- EFS Contractor Application
- EFS Participation Agreement
- ACH Authorization Form (allows for electronic transfer of loan proceeds – optional)
- IRS form W-9
- Certificate of Insurance

EFS will notify the Participating Contractors of the status of their application within 5 business days of submittal. **Only Participating Contractors who have been approved by Energy Finance Solutions are eligible to submit project applications that use GJGNY financing.**

- *Commercial, Agricultural and Not-for-Profit Customers* may be eligible to finance the purchase of their PV system through NYSERDA's low-interest small commercial financing made available by GJGNY. A customer who wishes to finance the purchase of their ST system will rely on the Installer/ Contractor to submit a Request for Financing to NYSERDA on their behalf. NYSERDA will review the Request for Financing and will provide the Customer with a letter approving or denying the eligibility of the ST system for GJGNY financing. If the ST system is approved by NYSERDA, the Customer must submit the approval letter as part of their loan application to a Lender participating in NYSERDA's *Small Commercial Energy Efficiency Program*. If approved for financing by the Lender, the Customer will receive the loan proceeds directly from the Lender. More information on NYSERDA's low-interest energy efficiency financing options for small business and not-for-profit customers can be found at:

www.nyserda.ny.gov/small-commercial-financing.

To apply for approval, Participating Contractors must complete and submit an *EFS Contractor Application Packet*. The Contractor Packet consists of the following documentation:

- EFS Contractor Application
- EFS Participation Agreement
- ACH Authorization Form (allows for electronic transfer of loan proceeds – optional)
- IRS form W-9
- Certificate of Insurance

EFS will notify the Participating Contractors of the status of their application within 5 business days of submittal. **Only Participating Contractors who have been approved by Energy Finance Solutions are eligible to submit project applications that use GJGNY financing.**

There are also a number of private lenders that provide financing for Solar Thermal

2.13 Tax Credits

Customers who install a solar thermal system may be eligible for state and federal tax credits. In addition, customers may qualify for Real Property Tax Exemptions and Tax Abatement Programs, along with accelerated depreciation allowances. Always consult with an accountant or tax professional to determine eligibility.

New York City Residents may be eligible for the Real Property Tax Abatement Program. Contractors installing systems in New York City should consult with The New York City Department of Buildings for specific information.

Real Property Tax information can be found at New York State Department of Taxation & Finance Office of Real Property Tax Services website

The Real Property Tax Exemption FORM RP487 may be found at the following:

http://www.tax.ny.gov/pdf/current_forms/orpts/rp487_fill_in.pdf

For a listing of jurisdictions that have opted out of the Real Property Tax Abatement Program be found at the following:

<http://www.tax.ny.gov/research/property/legal/localop/487opt.htm>

3.0 SPECIFIC PROGRAM RULES

3.1 New Components

All components installed as part of an approved ST System must be new. The use of used or refurbished equipment is not permitted under the Program.

3.2 Qualified Solar Collectors

All solar thermal collectors must be certified as meeting all applicable standards of the Solar Rating and Certification Corporation and be included in the eligible list found on PowerClerk. It is the manufacturer's responsibility to ensure that the most recent information is available in PowerClerk. Manufacturers can do so by contracting stforms@nyserda.ny.gov

3.3 System Monitoring

PPA or Lease systems must include a revenue-grade monitoring system that is suitable for billing, accessible to the customer, and installed per manufacturer's specifications.

4.0 SYSTEM REQUIREMENTS

4.1 Displaced Energy Usage

Projects applications must identify the method used for establishing the existing thermal load, and displaced energy usage calculated in kWh. ST system offset cannot exceed 80% of the existing DHW load. Installers must calculate all potential system output losses (kWh, or equivalent BTU for fossil fuel based systems, generated after all losses associated with shading, system orientation, tilt angle, etc. are applied.

4.2 Approved System Design

ST systems must be installed in accordance with the design and ST system components submitted in the application and approved by NYSERDA. Any change in ST system design from the approved design must be approved in writing by NYSERDA prior to installation of the ST system. ST systems that are not installed according to the design submitted to and approved by NYSERDA are **not** eligible to receive Program incentives. When significant changes are made a new 1-line diagram must be included with the change order. See section 2.6 for details on submitting a Change Request.

4.3 Code Compliant Interconnection

The Installer/Contractor is required to ensure that all ST systems designed to be connected to a space heating or domestic hot water systems comply with all applicable national, New York State, and local codes and standards.

4.4 Other Plumbing and Electrical Components

All other Plumbing and electrical components of each ST system including, but not limited to, piping, fittings, insulations, tanks, vessels, valves, controls, safety devices, and associated wiring must be certified as meeting the requirements of all relevant national and New York State codes and standards.

4.5 Compliance with Laws and Codes

All approved ST systems, system components, and installations must comply with any and all manufacturers' installation requirements, applicable laws, regulations, codes, licensing and permit requirements including, but not limited to, the New York State Environmental Quality Review (SEQR), the New York State Building Code, New York State Plumbing Code, the National Electric Code, Fire Codes and all applicable State, city, town, or local ordinances or permit requirements.

4.6 ST System Warranty

The Participating Contractor must provide the purchaser of the ST system with a full five year transferable warranty. The warranty must cover all components of the system against breakdown. The five year warranty shall cover the full costs, including labor, of repair or replacement of defective components or systems. The Participating Contractor is responsible for providing warranty coverage in a timely manner regardless of the level of support from the equipment manufacturer. Requests for warranty services must be responded to within 72 hours and repairs completed within 30 days. The Participating Contractor must provide the customer with information on any additional or extended warranties that may also be applicable.

4.7 Structural Requirements

The Participating Contractor and Eligible Installer are responsible for determining that a building structure is able to support the additional weight of an ST system and that the installation of that ST system does not over stress the structure and/or increase the dead load beyond acceptable limits as described in all relevant National and New York State codes and standards. NYSERDA encourages consulting with a Licensed Professional Engineer or Registered Architect.

4.8 Maintenance Manual

Upon final completion of the installation, the Installer or Contractor shall provide the customer with a maintenance manual containing manufacturer's information on all the major components along with a schedule on any required system maintenance.

4.9 Mechanical Execution of Work

All solar thermal equipment and accessories shall be installed in a neat and professional manner.

5.0 APPLICATION PROCESS

Each Project Application must include a complete and accurate copy of each of the following:

5.1 Project Application Form

The Eligible Installer or their Participating Contractor must submit all applications electronically, using the PowerClerk database.

The process for projects planning to use GJGNY financing (either the Smart Energy loan, Participation Loan or On-Bill Recovery (OBR)), are as follows:

Residential projects: A Proforma tool must be provided to NYSERDA once the project achieves 'received' status. The Installer/Contractor will receive an email on behalf of PowerClerk that will ask you to email the excel version of the ProForma tool and the applicant's pre-approval loan letter from Energy Finance Solutions (EFS) to stforms@nyserda.ny.gov, using the subject line naming convention provided below.

ProForma Tool, ST (4 digit installer # + Application #) - Name of Customer
(Example) ProForma Tool,ST – 4000-29000, John Smith)

The Proforma tool is used to calculate the cost effectiveness of the GJGNY financing options at different loan terms. In order to qualify for GJGNY financing a project must meet the cost-effectiveness test in the Proforma tool. Once the Proforma is received, your application will be in line for design review. After the Proforma has been reviewed and approved, it will be converted to a pdf and uploaded directly into PowerClerk as part of the project application submission.

Small business and not-for-profit customers

A Proforma tool must be provided to NYSERDA once the project achieves 'received' status. The Installer/Contractor will receive an e-mail on behalf of PowerClerk that will ask you to email the excel version to stforms@nyserda.ny.gov, using the subject line naming convention provided below.

ProForma Tool, ST (4 digit installer # + Application #) - Name of Customer
(Example) ProForma Tool,ST – 4000-29000, John Smith)

The Proforma tool is used to calculate the cost effectiveness of the GJGNY financing options at different loan terms. In order to qualify for GJGNY financing a project must meet the cost-effectiveness test in the Proforma

tool. Once the Proforma is received, your application will be in line for design review. After the Proforma has been reviewed and approved, it will be converted to a pdf and uploaded directly into PowerClerk as part of the project application submission.

5.2 Site Map

The site map must include the location of all ST System components including collectors and water tanks, roof type, system orientation and tilt angle, point of connection with existing plumbing system, customer name and address, and Participating Contractor and Eligible Installer name, and Installer number.

5.3 Photos of Major System Components

The installer must submit photos of the major system components, including the collectors, tank, and circulator pump. A manufacturer's equipment datasheet may satisfy this requirement. Installers are also encouraged to submit photos of the site, including the location where collectors and tanks will be installed, as well as photos of the existing water heater.

5.4 Schematics Drawing

All applications require a legible one-line diagram using unique line characteristics and standard symbols to clearly describe the solar thermal system as installed. The one line diagram shall include, but not be limited to: the collectors, water tanks, heat exchanger(s), pumps, meters, piping lengths and sizes, controls, insulation requirements, and associated wiring. Manufacturers' catalog numbers for the key components and other relevant equipment as applicable shall be provided. For SRCC OG-300 rated systems, the diagram on the SRCC certification document may be used to satisfy this requirement.

5.5 Estimating DHW Usage

Residential: The following formulas must be used to calculate the estimated DHW usage:

Existing homes: $20 + [15 * (\# \text{ of residents} - 1)]$

New Homes: $20 + [15 * (\# \text{ of bedrooms} + 1)]$

Existing home example: For a four person household, the gallons per day (gpd) usage would be calculated as follows:

$$20 + [15(4-1)] = X$$

$$20 + [15(3)] = X$$

$$20 + 45 = 65 \text{gpd hot water usage}$$

Commercial (including Not-for-Profit, Government, and Agricultural) systems may require more detailed calculations. Installers/Contractors may need to account for water temperature and seasonal use patterns in their calculations. A calculation or explanation of the site's hot water use must be included as part of the project application.

Commercial Example: A commercial carwash washes, on average, 50 cars per day, and each car wash uses about 10 gallons of hot water.

$$50 \text{ cars} \times 10 \text{ gallons per car} = 500 \text{ gallons per day.}$$

5.6 Existing DHW Thermal Load and System Production

Calculation or data detailing the existing thermal load for DHW usage must accompany an estimate of annual system production (displaced kWh) and be submitted as part of the application process.

For residential systems installed on one to four family homes, the SRCC OG-300 system rating may be used to size and estimate the annual system production in kWh if the properly sized system falls within Program guidelines for maximum displaced DHW load of 80%.

For all calculations, installers shall assume a storage tank water temperature of 120 degrees in the design. Should the installer use a higher temperature, they must provide justification of the higher value with the application.

For larger non-residential systems using non OG-300 components, or residential systems using OG-100 components, a more detailed estimate of system production, and existing thermal load calculations will need to be provided in conjunction with a more detailed system design including a one-line drawing as noted above. Calculations and methods used to determine the system production in non-residential systems must be included in the application.

5.7 System Loss Analysis

Installers must calculate all potential system output losses (kilowatt hours or kWh, or equivalent BTU for fossil fuel based systems), generated after all losses associated with shading, system orientation, tilt angle, etc are applied. Such losses must be detailed using industry accepted shading and orientation tools, verifiable assumptions, and calculations. Incentives will not be approved where losses due to system shading and orientation exceed 25% of what the ideal system for that location would be without any site losses. In cases where trees or any other obstruction must be removed or moved in order to meet the program rules, incentive payment will not be made until a new system loss analysis and photos have been submitted and reviewed by NYSERDA.

5.8 Utility Bill for Commercial, Agricultural and Not-for-Profit Applications Only

The site address on the utility bill must match the installation site address on the Project Application Form and submittal of the customer's historic usage for the past twelve (12) months will be required. For new construction, the Installer or Contractor must submit detailed calculations on anticipated electric usage. For existing construction where 12 months of past billing is not available, the installer or contractor will use the usage info for those months that are available, along with supplemental calculations to estimate the anticipated yearly usage.

NOTE: submittal of utility bill for Residential project applications is not required.

5.9 Permits

Copies of all necessary permits, approvals, certificates, etc. can be submitted either with the project application or with the incentive request. All permits must clearly reference installation of the approved ST System at the customer site. If permit(s) are not needed for installation, a signed letter from the Town Code Officer or Authority Having Jurisdiction (AHJ) must be submitted stating that no building permit

is required. However, AHJs may require plumbing and electrical permits. Submittal of an AHJ inspection certificate is required prior to an incentive payment being processed.

5.10 Addendum to Customer Purchase/Lease Agreement

Submittal of the Addendum to Customer Purchase/Lease Agreement (Addendum) is not required as part of the project application submittal package, but must be made available to NYSERDA upon request.

The Addendum can be found at:

<http://www.nysERDA.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-3221-Solar-Thermal-Incentive-Program>

5.11 Customer Purchase or Lease Agreement,

The Customer Purchase, or Lease Agreement is very important document as it is the Contract between the customer and the participating contractor. The Contract defines the responsibilities of both the customer and participating contractor associated with the installation and payment of a Solar Thermal system. **The Participating Contractor must provide the customer with a copy of the Contract that has been signed by both parties.**

For Solar Thermal systems that are being purchased, the Contract must include, at a minimum, the following:

- Installation location, including town, street, and lot or building number;
- Installation schedule (a realistic installation schedule needs to take into account NYSERDA and local permitting and inspection requirements);
- System description, including a description of the ST system being purchased and an outline of system specifications, the make and model of major system components, identification and location of easy-to-read meter, references to SRCC listing, etc.
- Estimate of annual energy displacement in kWh that summarizes the results of the System Loss Analysis;
- Total system and itemized costs broken down as follows: cost of panels, balance of system costs (solar storage tanks, pumps, piping, insulation, etc.), and labor and overhead (labor, permitting, etc.);
- Applicable incentives. The Customer Purchase Agreement must reflect the entire amount of the anticipated NYSERDA Incentive;
- An explanation and estimate of any additional costs that the customer will incur associated with the development, installation, and commissioning of ST systems;
- Payment schedule;
- Party (customer or contractor) responsible for scheduling, obtaining and paying for permits, inspections or other regulatory requirements;
- Warranty: A full warranty to the purchaser of the ST system installed under the Agreement for a period of five years after installation. The warranty should cover all components of the ST system against breakdown. The warranty must cover the full costs, including labor and repair or replacement of defective components or systems.
- Contract must be completed and signed by both the customer and the Eligible Installer/Contractor.

For Solar Thermal systems that are a Lease or a Power Purchase Agreement (PPA), the Contract must include, at a minimum, the following:

- Installation location; including town, street, and lot or building number;
- Installation schedule (a realistic installation schedule needs to take into account NYSEERDA and local permitting and inspection requirements);
- System description, including a description of the ST system being purchased and an outline of system specifications, the make and model of major system components, identification and location of revenue-grade production meter, references to SRCC listing, etc.
- Estimate of annual energy displacement in kWh that summarizes the results of the System Loss Analysis;
- Total Agreement cost and applicable incentives. The Lease or PPA must reflect the entire amount of the approved NYSEERDA Incentive;
- An explanation and estimate of any and all additional costs that the customer will incur associated with the development, installation, and commissioning of the ST system;
- Payment schedule;
- Party (customer or contractor) responsible for scheduling, obtaining and paying for permits, inspections or other regulatory requirements;
- Warranty: At a minimum, the Contractor shall offer a production guarantee to the Customer for the initial term of this Agreement. This production guarantee will provide the customer with compensation if the system produces less than the guaranteed output as specified in the PPA or lease agreement. Guaranteed output may not allow cumulative degradation in output of more than one percent per year from the original rated output for the initial term of this agreement. Under no circumstance will Customers be responsible for any labor and repair or replacement costs of defective components or systems over the initial term of this Agreement. Should the customer sell the residence at which this solar facility is located, the production guarantee is fully transferrable to a new lessee.
- Other terms such as the party (customer or Contractor) responsible for costs related to movement and re-installation of the system or parts of the system if needed due to necessary roof repairs or other issues and the terms under which those actions will be taken; and any insurance coverage related to the system;
- Contract must be completed and signed by both the customer and the Eligible Installer/Contractor.

5.12 Not-for-Profit or Agricultural Documentation

To qualify for the Not-for-Profit/Agricultural incentive, project applications submitted to the program must include the following:

- Not-for Profit: IRS determination letter
- Agricultural: Documentation verifying that the operation meets the Agriculture and Markets Law 301 definition of “farm operation.”

Other documentation will be considered on a case-by-case basis by NYSEERDA.

6.0 QUALITY ASSURANCE AND COMPLIANCE

NYSERDA maintains the integrity of its ST Program through an independent Quality, Standards and Compliance (QSC) team which manages the quality assurance system for the ST Program. The quality assurance system has several components including review of qualifications and credentials, establishment of program standards and a comprehensive field inspection. QA Field inspection includes verification of contracted scope of work, accuracy of site analysis, comparison of installation to submitted design drawings and the delivered quality of the ST installation. NYSERDA QSC or its representatives may make a reasonable number of visits to the customer site before, during and/or after installation of a ST System.

Field QA inspections are typically conducted by a qualified independent third party chosen by NYSERDA.

Such visit(s) will be at a time convenient to the customer. The customer is given the option of having the Installer or contractor attend the field inspection. If the customer declines to have the installer or contractor present at the time of the field inspection, no notice of scheduled field inspections is sent out. If the customer accepts the attendance of the installer and contractor, a notice of the scheduled field inspections will be sent to both a week in advance. We will make an effort to accommodate the schedule of the installer and contractor, but the customer's schedule and efficient scheduling of inspections take precedence.

6.1 Field Inspection of Completed Projects

NYSERDA selects specific "completed" projects for QA field inspection following a sampling protocol. The sampling protocol utilizes random sampling of completed units with sampling rates primarily based upon the current ST program status of the Eligible Installer and "Contractor."

NYSERDA intends to conduct field inspections on 15% of units installed by full status installers and contractors. Probationary and Suspended status installers and contractors will be subjected to 30% inspection overall and up to 100% inspection on specific units for cause.

Provisional installers and contractors will initially be subjected to up to 100% inspection and after demonstrated competency their inspection rate will be lowered to 30%.

The purpose of the site visit(s) is to provide NYSERDA with an opportunity to evaluate the accuracy of the site analysis, design paperwork, and the installed ST System in order to determine the actual kWh displaced for program evaluation purposes and to verify that the ST System was installed according to all ST Program requirements including applicable code.

Following the QA Field Inspection NYSERDA will produce a detailed report and determine whether the project fully complies with all program requirements and meets acceptable standards of workmanship. The report will be made available to the installer and contractor approximately 15 days after the inspection following an internal review and scoring by NYSERDA. The report will be made available to the owner upon submission of a request directly to NYSERDA.

NYSERDA may select any completed project at any point in the future for Field Inspection based upon customer complaints, warranty related issues or a review of the work done by an Installer or Contractor under status review or program disciplinary action.

6. 2 Handling Non-Conformance and Corrective Action

The QA report generated from the field inspection will provide details of all evaluated elements of the project and list any non-conformances that were identified. The report will identify the overall score of the project and whether this result passes or fails program requirements.

Projects that have non-conformances related to critical (Health & Safety) or major (System Performance) attributes will automatically fail. Projects that have only non-conformances to minor or incidental attributes may pass or fail based upon their overall merits.

All non-conformances are expected to be addressed and corrected with regard to future work conducted in the ST program. Acknowledgement and plans for preventing future problems may be requested with the report.

While some non-conformances cannot be corrected post installation, others can be remedied through corrective action to the documentation, incentive applied to the project or remediation of the installation or its components.

When NYSERDA seeks specific corrective action, a Corrective Action notice will be provided with the QA report. The Corrective Action notice must be either disputed within 15 days by contacting NYSERDA or remedied within 30 days. Sufficient evidence of the remediation must be provided to NYSERDA to document the completion of the required corrective action. NYSERDA may at its option conduct a field verification of the remediated installation.

NYSERDA retains the right to provide a copy of the QA report or specific information from the QA Field Inspection directly to the owner, all authorities having local jurisdiction or the interconnecting utility based upon health, safety and compliance concerns. In an emergency NYSERDA or its representatives may shut down the system. NYSERDA will notify the installer or contractor whenever it takes such action as soon as is practicable.

NYSERDA may, at NYSERDA's discretion, communicate by voice and/or written format with any ST System customer with respect to any matter relevant to a proposed or installed ST System. Such communications may be in reply to an inquiry from a customer or at NYSERDA's initiation.

6. 3 Probation and Disciplinary Action

When an installer or contractor either fails to consistently complete projects which pass NYSERDA's QA evaluation or fails to respond to or remedy Corrective Action notices, NYSERDA will review the contractor or installer status in the ST Program.

An installer or contractor may be moved to either a probation status in which specific results and a timeline for demonstrating those results will be prescribed and monitored or to a disciplinary status such as suspension or termination from the ST Program.

The complete details of the Participation Status and Review Process are stated in Article 6 of the SOLAR ST PROGRAM PARTICIPATION AGREEMENT.

7.0 NYSERDA LOGO USE

7.1 Use of Logo

NYSERDA has very strict policies with regard to our logo. There are very few companies that are eligible to use a version of NYSERDA's logo on their marketing materials. For these purposes, we have established three distinctive attribution marks: Sponsored by NYSERDA, Supported by NYSERDA, and an Independent Contractor to NYSERDA. These attribution marks are distributed by NYSERDA and are evaluated on an individual basis for their appropriateness.

The Sponsored by NYSERDA logo is specifically for Events that NYSERDA has provided funding to sponsor. The Supported by NYSERDA is intended specifically for companies that have received a contract award from NYSERDA, or in instances where NYSERDA is funding specific research, development, or deployment of an energy efficient technology, or service. The Independent contractor logo is reserved for those contractors who have been tasked specifically with customer outreach on NYSERDA's behalf.

In the case of Solar Installers, ESCOs, participating builders, building contractors, and other organizations that have been qualified by NYSERDA, but not contracted, or funded by NYSERDA, it is not appropriate for them to use NYSERDA's logo on their organizations' website, or any marketing materials including business cards. In the future, should you have a need for NYSERDA's logo, you may request one at the following website: <http://www.nyserda.ny.gov/About/Resources/Logo-Requests.aspx>

SOLAR THERMAL (ST) INCENTIVE PROGRAM

PARTICIPATION AGREEMENT

FOR ELIGIBLE INSTALLER “INSTALLER” AND “CONTRACTOR”

This Solar Thermal (ST) Program Participation Agreement (“Agreement”), including Exhibits C and D hereto (attached), and incorporating herein by reference the Solar Thermal Program Manual, as it may be revised, from time to time, is entered into by and between the New York State Energy Research and Development Authority (“NYSERDA”), having its principal place of business at 17 Columbia Circle, Albany, New York 12203-6399; the “Eligible Installer” (hereinafter “Installer”); and the “Contractor”, as identified on the Signature Form as executed and attached hereto, to govern the rights and responsibilities of NYSERDA, the Installer and the Contractor with respect to the procurement, construction and installation of Solar Thermal energy systems (“ST Systems”) approved under and through NYSERDA’s Solar Thermal (ST) Program Opportunity Notice (PON) 3221 (“ST Program”), and to otherwise effectuate the purposes of the ST Program. The terms, conditions and provisions of the ST Program are incorporated herein and made part hereof by reference.

WHEREAS, NYSERDA has been designated by the New York State Public Service Commission as the administrator of the New York State Clean Energy Fund program, which program was established to increase the percentage of energy consumed in the State that is derived from renewable generation sources; and

WHEREAS, NYSERDA has issued the ST Program for the purpose of furthering the objectives of the Clean Energy Fund by supporting the development of the ST industry in New York State and by providing financial incentives (“Incentives”) for the installation of ST Systems that meet the requirements of the ST Program, NYSERDA and the Parties agree to be bound, for purposes of the ST Program, by the following terms and conditions; and

WHEREAS, NYSERDA may expand its Solar Thermal Program using funds from public sources separate from the Clean Energy Fund program; and.

WHEREAS, the success and future of this publicly-funded program depends on the performance and integrity of the Parties in their dealings with the public and their installation of ST Systems; and

WHEREAS, this Agreement has been designed to foster and protect the integrity of the ST Program, and will be enforced; and

WHEREAS, in its role as administrator of the ST Program NYSERDA reserves the right to deny Installer or Contractor status to any applicant and to revoke such status where in its judgment such action is in the best interests of the ST Program.

Article 1: Participation in the ST Program

Section 1: The Installer and/or Contractor agree that by the act of submitting a Project Application(s) to the Solar Thermal Program, Installer and/or Contractor confirms and agrees: (1) that Installer and/or Contractor have read and understand this Solar Thermal Program Participation Agreement and accept and agree to abide by the terms and conditions contained herein; (2) that all of the information provided in Solar Thermal Program Participation Application, including any attachments, is true and accurate, to the best of their knowledge; (3) that any project for which a Project Application is submitted under Solar Thermal Program shall comply with the requirements of the Solar Thermal Program, the applicable Solar Thermal Program Manual, with the terms and conditions of this Agreement, and with all applicable codes, accepted industry standards and best practices. This Agreement does not obligate NYSERDA to make any payment to the Installer and/or Contractor.

Section 2: The Installer and the Contractor acknowledge that failure to adhere to the terms and conditions of participation in the Solar Thermal Program or to otherwise fail to follow Solar Thermal Program requirements and procedures may result in termination of this Participation Agreement. The obligation of the Installer and Contractor with respect to approved applications shall survive any expiration or termination of this Agreement.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

Section 3: The Installer or Contractor is authorized to submit Project Application(s) to the Solar Thermal Program, either on their own behalf or on behalf of the Contractor and their customer(s) based on Installer/Contractor's approval status; Installers/Contractors may be approved to submit applications for incentives under either the Residential/Small Commercial Program, the Commercial/Industrial Program, or both

Programs, based on credentials submitted with application package. The Installer and/or Contractor will be responsible for all Solar Thermal System installations for which a Project Application is submitted under this Agreement, regardless of whether the Installation was performed partially or completely by others.

Section 4: The Installer and Contractor, their employees and subcontractors shall treat customers fairly and in good faith, and shall deliver promised services in a timely, responsible, professional, and competent manner. The Installer and Contractor shall fairly represent the ST Program and the relationship of Installer and Contractor with NYSERDA to customers and the public. If it is determined that the Installer and Contractor are not fairly or accurately representing the ST Program and/or their relationship with NYSERDA, both the Installer and the Contractor will be subject to administrative review and their status within the ST Program may be affected. All installations completed through this program are subject to random field inspections. The selection of installations for inspection will be determined by NYSERDA according to standard NYSERDA protocol and the status of the Installer and Contractor. Written complaints received by NYSERDA from customers will be documented and investigated by NYSERDA or its representatives. Complaints from customers will be shared with the Installer and the Contractor unless determined by NYSERDA to be frivolous and/or have no merit

Section 5: The Installer and Contractor shall not, without prior written permission from NYSERDA, knowingly subcontract with employ or hire any individual or company to perform work related to a Project Application if said individual or company is currently in a probation or suspended status or whose past participation in PON 716, PON1050, PON 2112, PON 2149, or PON 3221 the (ST Program), or any other NYSERDA program has been suspended or terminated. A list of eligible Installers and Contractors is accessible on NYSERDA's website at: <http://www.nyserdera.ny.gov/Contractors/Find-a-Contractor/Solar-Thermal-Installers.aspx>

Article 2: ST Program Incentives and Payments

Section 1: The amounts, limitations, and availability of incentives are as defined in the Program Manual in effect at the time that NYSERDA accepts the Project Application.

Section 2: NYSERDA reserves the right to make changes to the ST Program and the incentive levels at any time. Notice of all such changes will be provided to the Parties via their Designated E-Mail Address as identified on the signature page of this Agreement. Notice of all such changes will also be posted on NYSERDA's website.

Section 3: Incentive payments which result from this Agreement will be paid to the Contractor listed on the corresponding Project Application. Acceptance by the Contractor of final payment shall release NYSERDA from all claims and liability of the Installer, the Contractor, representatives, and assigns to this Agreement. The Contractor is required to pass the entire approved Incentive to the Customer in a timely manner. The Incentive payment must be netted out of the customer balance due in the contract and may not be subject to prepayment by the customer.

Section 4: NYSERDA reserves the right to withhold approval of Project Applications at any time, for any reason. NYSERDA will not process a Project Application submitted by an Installer whose status designation is "Suspended", or if their Agreement has been terminated, or where the Contractor is a party on customer contract(s) that are the subject of unresolved application, installation, or performance issues.

Section 5: NYSERDA may charge the Installer and Contractor for any costs incurred by NYSERDA for additional design review or field inspections that are required due to the failure by the Installer and Contractor to submit a complete application, repetitive errors in design or installation or to make corrections or modifications as requested by NYSERDA.

Section 6: Notwithstanding any other provision of this Agreement, NYSERDA reserves the right to deny or alter payment of an Incentive, to exercise its Set-Off rights, or to seek reimbursement of incentives paid if, at any time, it learns that the approved ST system was not actually

SOLAR THERMAL (ST) INCENTIVE PROGRAM

installed, was not installed by or under the supervision of the Installer, was not installed as required under the ST Program or this Agreement, was not installed according to the approved system design, or if a system was partially or completely installed prior to NYSERDA approval of the Project Application. NYSERDA may: (a) elect to not pay the incentive; (b) require changes before making any payments; (c) require reimbursement of incentives already paid unless the requested changes are made; or (d) withhold approval of Project Applications for other ST Systems.

Section 7: Incentive payments payable under this Agreement will be made pursuant to NYSERDA's Prompt Payment Policy as outlined in Exhibit D of this Agreement.

Article 3: Obligations between Installer and Contractor and Eligible Customers

Section 1: Contractor shall execute a written agreement with the customer for each ST System. Each such agreement shall meet the requirements identified in either Section 1.2 of the ST Manual, inclusive of the warranty provisions. Each agreement must incorporate the "Addendum to Agreement" executed by the Installer, Contractor and the Customer. An executed copy the Addendum must be attached to the associated the Project Application when submitted. NYSERDA may reject any Project Application received by NYSERDA more than thirty (30) days from the Customer's execution of the Addendum.

Section 2: The Parties agree that NYSERDA may, at NYSERDA's discretion, communicate by voice and/or written format with any ST System customer with respect to any matter relevant to a proposed or installed ST System. Such communications may be in reply to an inquiry from a customer or at NYSERDA's initiation.

Article 4: Renewable Attributes

When assessing and reporting on the progress of the ST Program, NYSERDA and the NYS Department of Public Service may include the environmental attributes associated with any ST-funded project as a part of any report, evaluation, or review of the ST Program, whenever any such report, evaluation, or review may be conducted or issued.

Article 5: Insurance Requirements

Section 1: The Contractor, at no additional cost to NYSERDA, shall maintain or cause to be maintained throughout the term of this Agreement, insurance of the types and in the amounts of this Agreement. All such insurance shall be evidenced by insurance policies, each of which shall: (1) reference this Agreement number and name or be endorsed to cover the Contractor and the Installer as the insured, and NYSERDA and the State of New York as additional insured, and reference all work to be performed under the ST Program; (2) provide that such policy may not be cancelled or modified until at least 30 days after receipt by NYSERDA of written notice thereof; and (3) be reasonably satisfactory to NYSERDA in all other respects. NYSERDA reserves the right to request insurance documentation and copies of subcontractor agreements for any subcontractor, and to request the identity of all individuals participating in the ST System installation.

Section 2: The types and amounts of insurance required to be maintained under this Section are as follows: (1) commercial general liability insurance for bodily injury liability, including death, and property damage liability, incurred in connection with the performance of this Agreement, with minimum limits of \$1,000,000 in respect of claims arising out of personal injury or sickness or death of any one person, \$1,000,000 in respect of claims arising out of personal injury, sickness or death in any one accident or disaster, and \$1,000,000 in respect of claims arising out of property damage in any one accident or disaster.

Section 3: Not less than 15 days prior to the date any policy furnished or carried pursuant to this Agreement will expire, the Contractor shall deliver to NYSERDA a certificate(s) of insurance evidencing the renewal of such policy(s), and the Contractor shall promptly pay all premiums thereon due. No work shall be performed under this Agreement without current insurance. NYSERDA will not accept Project Applications or make payments under this Agreement without current insurance certificates.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

Section 4: In the event of threatened legal action, claims, encumbrances, or liabilities that may affect NYSERDA hereunder, or if deemed necessary by NYSERDA due to events rendering a review necessary, the Installer or the Contractor shall deliver to NYSERDA a certified copy of each policy upon request.

Section 5: Within five working days, or contemporaneously with the requirements of each insurance policy, the Installer or the Contractor shall notify NYSERDA in writing of the occurrence of any accident, event or incident involving personal injury or property damage that might reasonably result in any complaint or claim, in law or in equity, against the Installer, the Contractor, any non-Customer party to the applicable Customer Purchase Agreement or NYSERDA.

Article 6: Indemnification

The Installer and the Contractor shall protect, indemnify, and hold harmless NYSERDA and the State of New York from, and against, all liabilities, losses, claims, damages, judgments, penalties, causes of action, costs and expenses (including, without limitation, experts' and/or attorney's fees and expenses) imposed upon, or incurred by, or asserted against, NYSERDA or the State of New York resulting from, arising out of or relating to the Installer's or the Contractor's performance of this Agreement. The obligations of the Installer and the Contractor under this section shall survive any expiration or termination of this Agreement, and shall not be limited by any enumeration herein of required insurance coverage.

Article 7: Miscellaneous

Section 1: NYSERDA does not endorse, guarantee, or warrant any particular manufacturer, product, the Installer, or the Contractor, and NYSERDA disavows and provides no warranties, expressed or implied, for any product or services that may be rendered hereunder. The Installer's and the Contractor's reliance on warranties is limited to any warranties that may arise from, or be provided by contractors, vendors, manufacturers, etc.

Section 2: The Parties acknowledge that neither NYSERDA nor any of its representatives are responsible for assuring that the design, engineering, construction and/or Installation of the ST System is proper or in compliance with any particular laws (including patent laws), regulations, codes, or industry standards. NYSERDA does not make any representations of any kind regarding the results to be achieved by any ST System, or the adequacy or safety of such measures. The scope of review by NYSERDA of the Installation of the ST Systems is limited solely to determining whether such ST Systems conform to ST Program terms, conditions, and requirements.

Section 3: This Agreement is the entire Agreement between NYSERDA, the Installer, and the Contractor and supersedes all other communications and representations. If either NYSERDA or the Parties desire to modify this Agreement, the modification must be in writing and signed by an authorized representative of the party against which enforcement of the modification is sought.

Section 4. The status of the Installer and the Contractor under this Agreement shall be that of an independent contractor and not that of an agent, and in accordance with such status, the Installer, the Contractor's subcontractors, the Contractor and their respective officers, agents, employees, representatives and servants shall at all times during the term of this Agreement conduct themselves in a manner consistent with such status and by reason of this Agreement shall neither hold themselves out as, nor claim to be acting in the capacity of, officers, employees, agents, representatives or servants of NYSERDA nor make any claim, demand or application for any right or privilege applicable to NYSERDA, including, without limitation, rights or privileges derived from workers' compensation coverage, unemployment insurance benefits, social security coverage and retirement membership or credit. Nothing in this Agreement shall be construed as creating a partnership, joint venture, employment, agency, legal representation or other relationship between NYSERDA and Contractor or Installer for any reason, including but not limited to unemployment, workers' compensation, employee benefits, vicarious liability, professional liability coverage or indemnification. No party shall have the right, power or authority to obligate or bind the other in any manner not specified in this Agreement. Contractor and Installer expressly acknowledge NYSERDA's need to be advised, on an immediate basis, of the existence of any claim or event that might result in a claim or claims against NYSERDA, Installers and Contractor and/or Contractor's personnel by virtue of any act or omission on the part of NYSERDA or its employees.

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Section 5: The Parties shall collaborate with NYSERDA's Director of Communications to prepare any press release and to plan for any news conference concerning ST Systems installed under the ST Program. In addition, the Installer or Contractor shall notify NYSERDA's Director of Communications regarding any media interview involving ST Systems installed under the ST Program.

Section 6: Commercial promotional materials, advertisements, informational brochures, and web site content produced by the Installer, the Contractor, or customer shall credit NYSERDA and shall be submitted to NYSERDA for review and recommendations to improve their effectiveness prior to use. Such content may be approved in advance by NYSERDA, and, after initial approval, such content may be used in subsequent promotional materials or advertisements without additional approvals. In the event that NYSERDA determines that the Installer or Contractor is presenting or publishing incorrect or misleading information regarding the ST Program or Installer's status in the ST Program the Installer or Contractor agrees to make appropriate modifications promptly upon notification by NYSERDA. If a website maintained by or for the Installer or Contractor includes references to NYSERDA and/or the ST Program, the website must include the following link: <http://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities.aspx>

Section 7: This Agreement does not commit NYSERDA to approve any Project Application, pay any costs incurred in preparing a Project Application, or to procure or contract for services or supplies. NYSERDA reserves the right to accept or reject any or all Project Applications received, to negotiate with all qualified sources, or to cancel in part or in its entirety PON 3221 when it is in NYSERDA's best interest.

Section 8: This Agreement may be terminated by NYSERDA at any time upon notice to the Installer. If the Installer wishes to cancel or terminate this Agreement, NYSERDA may seek reimbursement of any incentives provided by NYSERDA regarding ST Systems that have not been completely installed, interconnected, and commissioned or that have not submitted three full years of ST System data readings as required in this Agreement.

Section 9: Installer agrees and consents to receive notices at the Designated E-Mail Addresses provided on the Signature Form of this Agreement.

Section 10: The Installer shall disclose any indictment for any alleged felony, or any conviction for a felony within the past five years, under the laws of the United States or any state or territory of the United States, and shall describe circumstances for each. This disclosure requirement extends to the Contractor and its officers, partners, and directors or members of any similarly governing body. If an indictment or conviction should come to the attention of NYSERDA after the execution of this Agreement, NYSERDA may exercise its stop-work right pending further investigation, or terminate the Agreement; the Installer and/or Contractor may be subject to penalties for violation of any law which may apply in the particular circumstances. The Installer and/or Contractor must also disclose if they have ever been debarred or suspended by any agency of the U.S. Government or the New York State Department of Labor.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

EXHIBIT A

REVISED 5/12

STANDARD TERMS AND CONDITIONS

FOR ALL NYSERDA AGREEMENTS

(Based on Standard Clauses for New York State Contracts and Tax Law Section 5-a)

The parties to the Agreement agree to be bound by the following clauses which are hereby made a part of the Agreement:

1. NON-DISCRIMINATION REQUIREMENTS. To the extent required by Article 15 of the Executive Law (also known as the Human Rights Law) and all other State and Federal statutory and constitutional non-discrimination provisions, the Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, national origin, sexual orientation, age, disability, genetic predisposition or carrier status, or marital status. Furthermore, in accordance with Section 220-e of the Labor Law, if this is an Agreement for the construction, alteration or repair of any public building or public work or for the manufacture, sale or distribution of materials, equipment or supplies, and to the extent that this Agreement shall be performed within the State of New York, Contractor agrees that neither it nor its subcontractors shall, by reason of race, creed, color, disability, sex or national origin: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this Agreement. If this is a building service Agreement as defined in Section 230 of the Labor Law, then, in accordance with Section 239 thereof, Contractor agrees that neither it nor its subcontractors shall, by reason of race, creed, color, national origin, age, sex or disability: (a) discriminate in hiring against any New York State citizen who is qualified and available to perform the work; or (b) discriminate against or intimidate any employee hired for the performance of work under this contract. Contractor is subject to fines of \$50.00 per person per day for any violation of Section 220-e or Section 239 as well as possible termination of this Agreement and forfeiture of all moneys due hereunder for a second subsequent violation.

2. WAGE AND HOURS PROVISIONS. If this is a public work Agreement covered by Article 8 of the Labor Law or a building service Agreement covered by Article 9 thereof, neither Contractor's employees nor the employees of its subcontractors may be required or permitted to work more than the number of hours or days stated in said statutes, except as otherwise provided in the Labor Law and as set forth in prevailing wage and supplement schedules issued by the State Labor Department. Furthermore, Contractor and its subcontractors must pay at least the prevailing wage rate and pay or provide the prevailing supplements, including the premium rates for overtime pay, as determined by the State Labor Department in accordance with the Labor Law. Additionally, effective April 28, 2008, if this is a public work contract covered by Article 8 of the Labor Law, the Contractor understands and agrees that the filing of payrolls in a manner consistent with Subdivision 3-a of Section 220 of the Labor Law shall be a condition precedent to payment by NYSERDA of any NYSERDA-approved sums due and owing for work done upon the project.

3. NON-COLLUSIVE BIDDING REQUIREMENT. In accordance with Section 2878 of the Public Authorities Law, if this Agreement was awarded based upon the submission of bids, Contractor warrants, under penalty of perjury, that its bid was arrived at independently and without collusion aimed at restricting competition. Contractor further warrants that, at the time Contractor submitted its bid, an authorized and responsible person executed and delivered to NYSERDA a non-collusive bidding certification on Contractor's behalf.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

4. INTERNATIONAL BOYCOTT PROHIBITION. If this Agreement exceeds \$5,000, the Contractor agrees, as a material condition of the Agreement, that neither the Contractor nor any substantially owned or affiliated person, firm, partnership or corporation has participated, is participating, or shall participate in an international boycott in violation of the Federal Export Administration Act of 1979 (50 USC App. Sections 2401 et seq.) or regulations thereunder. If such Contractor, or any of the aforesaid affiliates of Contractor, is convicted or is otherwise found to have violated said laws or regulations upon the final determination of the United States Commerce Department or any other appropriate agency of the United States subsequent to the Agreement's execution, such Agreement, amendment or modification thereto shall be rendered forfeit and void. The Contractor shall so notify NYSERDA within five (5) business days of such conviction, determination or disposition of appeal. (See and compare Section 220-f of the Labor Law, Section 139-h of the State Finance Law, and 2 NYCRR 105.4).

5. SET-OFF RIGHTS. NYSERDA shall have all of its common law and statutory rights of set-off. These rights shall include, but not be limited to, NYSERDA's option to withhold for the purposes of set-off any moneys due to the Contractor under this Agreement up to any amounts due and owing to NYSERDA with regard to this Agreement, any other Agreement, including any Agreement for a term commencing prior to the term of this Agreement, plus any amounts due and owing to NYSERDA for any other reason including, without limitation, tax delinquencies, fee delinquencies or monetary penalties relative thereto.

6. PROPRIETARY INFORMATION. Notwithstanding any provisions to the contrary in the Agreement, Contractor and NYSERDA acknowledge and agree that all information, in any format, submitted to NYSERDA shall be subject to and treated in accordance with the NYS Freedom of Information Law ("FOIL," Public Officers Law, Article 6). Pursuant to FOIL, NYSERDA is required to make available to the public, upon request, records or portions thereof which it possesses, unless that information is statutorily exempt from disclosure. Therefore, unless the Agreement specifically requires otherwise, Contractor should submit information to NYSERDA in a non-confidential, non-proprietary format. FOIL does provide that NYSERDA may deny access to records or portions thereof that "are trade secrets or are submitted to an agency by a commercial enterprise or derived from information obtained from a commercial enterprise and which if disclosed would cause substantial injury to the competitive position of the subject enterprise." [See Public Officers Law, § 87(2)(d)]. Accordingly, if the Agreement specifically requires submission of information in a format Contractor considers a proprietary and/or confidential trade secret, Contractor shall fully identify and plainly label the information "confidential" or "proprietary" at the time of disclosure. By so marking such information, Contractor represents that the information has actual or potential specific commercial or competitive value to the competitors of Contractor. Without limitation, information will not be considered confidential or proprietary if it is or has been (i) generally known or available from other sources without obligation concerning its confidentiality; (ii) made available by the owner to others without obligation concerning its confidentiality; or (iii) already available to NYSERDA without obligation concerning its confidentiality. In the event of a FOIL request, it is NYSERDA's policy to consider records as marked above pursuant to the trade secret exemption procedure set forth in 21 New York Codes Rules & Regulations § 501.6 and any other applicable law or regulation. However, NYSERDA cannot guarantee the confidentiality of any information submitted. More information on FOIL, and the relevant statutory law and regulations, can be found at the website for the Committee on Open Government (<http://www.dos.state.ny.us/coog/foil2.html>) and NYSERDA's Regulations, Part 501 (<http://www.nyserda.ny.gov/About/New-York-State-Regulations.aspx>)

7. IDENTIFYING INFORMATION AND PRIVACY NOTIFICATION. (a) FEDERAL EMPLOYER IDENTIFICATION NUMBER and/or FEDERAL SOCIAL SECURITY NUMBER. As a condition to NYSERDA's obligation to pay any invoices submitted by Contractor pursuant to this Agreement, Contractor shall provide to NYSERDA its Federal employer identification number or Federal social security number, or both such numbers when the Contractor has both such numbers. Where the Contractor does not have such number or numbers, the Contractor must give the reason or reasons why the payee does not have such number or numbers.

(b) PRIVACY NOTIFICATION. The authority to request the above personal information from a seller of goods or services or a lessor of real or personal property, and the authority to maintain such information, is found in Section 5 of the State Tax Law. Disclosure of this information by Contractor to the State is mandatory. The principal purpose for which the information is collected is to enable the State to identify individuals, businesses and others who have been delinquent in filing tax returns or may have understated their tax liabilities and to generally identify persons affected by the taxes administered by the Commissioner of Taxation and Finance. The information will be used for tax administration purposes and for any other purpose authorized by law.

8. CONFLICTING TERMS. In the event of a conflict between the terms of the Agreement (including any and all attachments thereto and amendments thereof) and the terms of this Exhibit C, the terms of this Exhibit C shall control.

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9. GOVERNING LAW. This Agreement shall be governed by the laws of the State of New York except where the Federal supremacy clause requires otherwise.

10. NO ARBITRATION. Disputes involving this Agreement, including the breach or alleged breach thereof, may not be submitted to binding arbitration (except where statutorily required) without the NYSERDA's written consent, but must, instead, be heard in a court of competent jurisdiction of the State of New York.

11. SERVICE OF PROCESS. In addition to the methods of service allowed by the State Civil Practice Law and Rules ("CPLR"), Contractor hereby consents to service of process upon it by registered or certified mail, return receipt requested. Service hereunder shall be complete upon Contractor's actual receipt of process or upon NYSERDA's receipt of the return thereof by the United States Postal Service as refused or undeliverable. Contractor must promptly notify NYSERDA, in writing, of each and every change of address to which service of process can be made. Service by NYSERDA to the last known address shall be sufficient. Contractor will have thirty (30) calendar days after service hereunder is complete in which to respond.

12. CRIMINAL ACTIVITY. If subsequent to the effectiveness of this Agreement, NYSERDA comes to know of any allegation previously unknown to it that the Contractor or any of its principals is under indictment for a felony, or has been, within five (5) years prior to submission of the Contractor's proposal to NYSERDA, convicted of a felony, under the laws of the United States or Territory of the United States, then NYSERDA may exercise its stop work right under this Agreement. If subsequent to the effectiveness of this Agreement, NYSERDA comes to know of the fact, previously unknown to it, that Contractor or any of its principals is under such indictment or has been so convicted, then NYSERDA may exercise its right to terminate this Agreement. If the Contractor knowingly withheld information about such an indictment or conviction, NYSERDA may declare the Agreement null and void and may seek legal remedies against the Contractor and its principals. The Contractor or its principals may also be subject to penalties for any violation of law which may apply in the particular circumstances. For a Contractor which is an association, partnership, corporation, or other organization, the provisions of this paragraph apply to any such indictment or conviction of the organization itself or any of its officers, partners, or directors or members of any similar governing body, as applicable.

13. PERMITS. It is the responsibility of the Contractor to acquire and maintain, at its own cost, any and all permits, licenses, easements, waivers and permissions of every nature necessary to perform the work.

14. PROHIBITION ON PURCHASE OF TROPICAL HARDWOODS. The Contractor certifies and warrants that all wood products to be used under this Agreement will be in accordance with, but not limited to, the specifications and provisions of State Finance Law Section 165 (Use of Tropical Hardwoods), which prohibits purchase and use of tropical hardwoods, unless specifically exempted by NYSERDA.

15. OMNIBUS PROCUREMENT ACT OF 1992. It is the policy of New York State to maximize opportunities for the participation of New York State business enterprises, including minority and women-owned business enterprises as bidders, subcontractors and suppliers on its procurement contracts.

Information on the availability of New York State subcontractors and suppliers is available from:

NYS Department of Economic Development
Division for Small Business
625 Broadway
Albany, New York 12207
Telephone: 518-292-5200
Fax: 518-292-5884

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<http://www.esd.ny.gov>

A directory of certified minority and women-owned business enterprises is available from:

NYS Department of Economic Development
Division of Minority and Women's Business Development
625 Broadway
Albany, New York 12207
Telephone: 518-292-5200
Fax: 518-292-5803

<http://www.empire.state.ny.us>

The Omnibus Procurement Act of 1992 requires that by signing this Agreement, Contractors certify that whenever the total amount is greater than \$1 million:

(a) The Contractor has made reasonable efforts to encourage the participation of New York State Business Enterprises as suppliers and subcontractors, including certified minority and women-owned business enterprises, on this project, and has retained the documentation of these efforts to be provided upon request to the State;

(b) The Contractor has complied with the Federal Equal Opportunity Act of 1972 (P.L. 92-261), as amended;

(c) The Contractor agrees to make reasonable efforts to provide notification to New York State residents of employment opportunities on this project through listing any such positions with the Job Service Division of the New York State Department of Labor, or providing such notification in such manner as is consistent with existing collective bargaining contracts or agreements. The Contractor agrees to document these efforts and to provide said documentation to the State upon request; and

(d) The Contractor acknowledges notice that the State may seek to obtain offset credits from foreign countries as a result of this contract and agrees to cooperate with the State in these efforts.

16. **RECIPROCITY AND SANCTIONS PROVISIONS.** Bidders are hereby notified that if their principal place of business is located in a country, nation, province, state or political subdivision that penalizes New York State vendors, and if the goods or services they offer will be substantially produced or performed outside New York State, the Omnibus Procurement Act 1994 and 2000 amendments (Chapter 684 and Chapter 383, respectively) require that they be denied contracts which they would otherwise obtain. NOTE: As of May 15, 2002, the list of discriminatory jurisdictions subject to this provision includes the states of South Carolina, Alaska, West Virginia, Wyoming, Louisiana and Hawaii. Contact NYS Department of Economic Development for a current list of jurisdictions subject to this provision.

17. **COMPLIANCE WITH NEW YORK STATE INFORMATION SECURITY BREACH AND NOTIFICATION ACT.** Contractor shall comply with the provisions of the New York State Information Security Breach and Notification Act (General Business Law Section 899-aa; State Technology Law Section 208).

18. **PROCUREMENT LOBBYING.** To the extent this Agreement is a "procurement contract" as defined by State Finance Law Sections 139-j and 139-k, by signing this Agreement the Contractor certifies and affirms that all disclosures made in accordance with State Finance Law Sections 139-j and 139-k are complete, true and accurate. In the event such certification is found to be intentionally false or intentionally incomplete, NYSERDA may terminate the agreement by providing written notification to the Contractor in accordance with the terms of the agreement.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

19. COMPLIANCE WITH TAX LAW SECTION 5-a. The following provisions apply to Contractors that have entered into agreements in an amount exceeding \$100,000 for the purchase of goods and services:

- a) Before such agreement can take effect, the Contractor must have on file with the New York State Department of Taxation and Finance a Contractor Certification form (ST-220-TD).
- b) Prior to entering into such an agreement, the Contractor is required to provide NYSERDA with a completed Contractor Certification to Covered Agency form (Form ST-220-CA).
- c) Prior to any renewal period (if applicable) under the agreement, the Contractor is required to provide NYSERDA with a completed Form ST-220-CA.

Certifications referenced in paragraphs (b) and (c) above will be maintained by NYSERDA and made a part hereof and incorporated herein by reference.

NYSERDA reserves the right to terminate this agreement in the event it is found that the certification filed by the Contractor in accordance with Tax Law Section 5-a was false when made.

20. IRANIAN ENERGY SECTOR DIVESTMENT. In accordance with Section 2879-c of the Public Authorities Law, by signing this contract, each person and each person signing on behalf of any other party certifies, and in the case of a joint bid or partnership each party thereto certifies as to its own organization, under penalty of perjury, that to the best of its knowledge and belief that each person is not on the list created pursuant to paragraph (b) of subdivision 3 of [section 165-a of the State Finance Law](#) (See www.ogs.ny.gov/about/regs/ida.asp).

SOLAR THERMAL (ST) INCENTIVE PROGRAM

EXHIBIT B

NYSERDA PROMPT PAYMENT POLICY STATEMENT

504.1. Purpose and Applicability. (a) The purpose of this Exhibit is to provide a description of Part 504 of NYSERDA's regulations, which consists of NYSERDA's policy for making payment promptly on amounts properly due and owing by NYSERDA under this Agreement. The section numbers used in this document correspond to the section numbers appearing in Part 504 of the regulations.¹

(b) This Exhibit applies generally to payments due and owing by the NYSERDA to the Contractor pursuant to this Agreement. However, this Exhibit does not apply to Payments due and owing when NYSERDA is exercising a Set-Off against all or part of the Payment, or if a State or Federal law, rule or regulation specifically requires otherwise.

504.2. Definitions. Capitalized terms not otherwise defined in this Exhibit shall have the same meaning as set forth earlier in this Agreement. In addition to said terms, the following terms shall have the following meanings, unless the context shall indicate another or different meaning or intent:

(a) "Date of Payment" means the date on which NYSERDA requisitions a check from its statutory fiscal agent, the Department of Taxation and Finance, to make a Payment.

(b) "Designated Payment Office" means the Office of NYSERDA's Controller, located at 17 Columbia Circle, Albany, New York 12203.

(c) "Payment" means payment properly due and owing to Contractor pursuant to Article IV, Exhibit B of this Agreement.

(d) "Prompt Payment" means a Payment within the time periods applicable pursuant to Sections 504.3 through 504.5 of this Exhibit in order for NYSERDA not to be liable for interest pursuant to Section 504.6.

(e) "Payment Due Date" means the date by which the Date of Payment must occur, in accordance with the provisions of Sections 504.3 through 504.5 of this Exhibit, in order for NYSERDA not to be liable for interest pursuant to Section 504.6.

¹ This is only a summary; the full text of Part 504 can be accessed at: <http://www.nyserdera.ny.gov/About/New-York-State-Regulations.aspx>

SOLAR THERMAL (ST) INCENTIVE PROGRAM

(f) “Proper Invoice” means a written request for Payment that is submitted by a Contractor setting forth the description, price or cost, and quantity of goods, property or services delivered or rendered, in such form, and supported by such other substantiating documentation, as NYSERDA may reasonably require, including but not limited to any requirements set forth in Exhibits A or B to this Agreement; and addressed to NYSERDA’s Controller, marked “Attention: Accounts Payable,” at the Designated Payment Office.

(g)(1) “Receipt of an Invoice” means:

(i) if the Payment is one for which an invoice is required, the later of:

(a) the date on which a Proper Invoice is actually received in the Designated Payment Office during normal business hours; or

(b) the date by which, during normal business hours, NYSERDA has actually received all the purchased goods, property or services covered by a Proper Invoice previously received in the Designated Payment Office.

(ii) if the Agreement provides that a Payment will be made on a specific date or at a predetermined interval, without having to submit a written invoice the 30th calendar day, excluding legal holidays, before the date so specified or predetermined.

(2) For purposes of this subdivision, if the Agreement requires a multifaceted, completed or working system, or delivery of no less than a specified quantity of goods, property or services and only a portion of such systems or less than the required goods, property or services are working, completed or delivered, even though the Contractor has invoiced NYSERDA for the portion working, completed or delivered, NYSERDA will not be in Receipt of an Invoice until the specified minimum amount of the systems, goods, property or services are working, completed or delivered.

(h) “Set-off” means the reduction by NYSERDA of a payment due a Contractor by an amount equal to the amount of an unpaid legally enforceable debt owed by the Contractor to NYSERDA.

504.3. Prompt Payment Schedule. Except as otherwise provided by law or regulation or in Sections 504.4 and 504.5 of this Exhibit, the Date of Payment by NYSERDA of an amount properly due and owing under this Agreement shall be no later than thirty (30) calendar days, excluding legal holidays, after Receipt of a Proper Invoice.

504.4. Payment Procedures.

(a) Unless otherwise specified in this Agreement, a Proper Invoice submitted by the Contractor to the Designated Payment Office shall be required to initiate payment for goods, property or services. As soon as any invoice is received in the Designated Payment Office during normal business hours, such invoice shall be date-stamped. The invoice shall then promptly be reviewed by NYSERDA.

(b) NYSERDA shall notify the Contractor within fifteen (15) calendar days after Receipt of an Invoice of:

(1) any defects in the delivered goods, property or services;

(2) any defects in the invoice; or

(3) suspected improprieties of any kind.

SOLAR THERMAL (ST) INCENTIVE PROGRAM

(c) The existence of any defects or suspected improprieties shall prevent the commencement of the time period specified in Section 504.3 until any such defects or improprieties are corrected or otherwise resolved.

(d) If NYSERDA fails to notify a Contractor of a defect or impropriety within the fifteen (15) calendar day period specified in subdivision (b) of this section, the sole effect shall be that the number of days allowed for Payment shall be reduced by the number of days between the 15th day and the day that notification was transmitted to the Contractor. If NYSERDA fails to provide reasonable grounds for its contention that a defect or impropriety exists, the sole effect shall be that the Payment Due Date shall be calculated using the original date of Receipt of an Invoice.

(e) In the absence of any defect or suspected impropriety, or upon satisfactory correction or resolution of a defect or suspected impropriety, NYSERDA shall make Payment, consistent with any such correction or resolution and the provisions of this Exhibit.

504.5. Exceptions and Extension of Payment Due Date. NYSERDA has determined that, notwithstanding the provisions of Sections 504.3 and 504.4 of this Exhibit, any of the following facts or circumstances, which may occur concurrently or consecutively, reasonably justify extension of the Payment Due Date:

(a) If this Agreement provides Payment will be made on a specific date or at a predetermined interval, without having to submit a written invoice, if any documentation, supporting data, performance verification, or notice specifically required by this Agreement or other State or Federal mandate has not been submitted to NYSERDA on a timely basis, then the Payment Due Date shall be extended by the number of calendar days from the date by which all such matter was to be submitted to NYSERDA and the date when NYSERDA has actually received such matter.

(b) If an inspection or testing period, performance verification, audit or other review or documentation independent of the Contractor is specifically required by this Agreement or by other State or Federal mandate, whether to be performed by or on behalf of NYSERDA or another entity, or is specifically permitted by this Agreement or by other State or Federal provision and NYSERDA or other entity with the right to do so elects to have such activity or documentation undertaken, then the Payment Due Date shall be extended by the number of calendar days from the date of Receipt of an Invoice to the date when any such activity or documentation has been completed, NYSERDA has actually received the results of such activity or documentation conducted by another entity, and any deficiencies identified or issues raised as a result of such activity or documentation have been corrected or otherwise resolved.

(c) If an invoice must be examined by a State or Federal agency, or by another party contributing to the funding of the Contract, prior to Payment, then the Payment Due Date shall be extended by the number of calendar days from the date of Receipt of an Invoice to the date when the State or Federal agency, or other contributing party to the Contract, has completed the inspection, advised NYSERDA of the results of the inspection, and any deficiencies identified or issues raised as a result of such inspection have been corrected or otherwise resolved.

(d) If appropriated funds from which Payment is to be made have not yet been appropriated or, if appropriated, not yet been made

SOLAR THERMAL (ST) INCENTIVE PROGRAM

available to NYSERDA, then the Payment Due Date shall be extended by the number of calendar days from the date of Receipt of an Invoice to the date when such funds are made available to NYSERDA.

504.6. Interest Eligibility and Computation. If NYSERDA fails to make Prompt Payment, NYSERDA shall pay interest to the Contractor on the Payment when such interest computed as provided herein is equal to or more than ten dollars (\$10.00). Interest shall be computed and accrue at the daily rate in effect on the Date of Payment, as set by the New York State Tax Commission for corporate taxes pursuant to Section 1096(e)(1) of the Tax Law. Interest on such a Payment shall be computed for the period beginning on the day after the Payment Due Date and ending on the Date of Payment.

504.7. Sources of Funds to Pay Interest. Any interest payable by NYSERDA pursuant to Exhibit shall be paid only from the same accounts, funds, or appropriations that are lawfully available to make the related Payment.

504.8. Incorporation of Prompt Payment Policy Statement into Contracts. The provisions of this Exhibit shall apply to all Payments as they become due and owing pursuant to the terms and conditions of this Agreement, notwithstanding that NYSERDA may subsequently amend its Prompt Payment Policy by further rulemaking.

504.9. Notice of Objection. Contractor may object to any action taken by NYSERDA pursuant to this Exhibit that prevents the commencement of the time in which interest will be paid by submitting a written notice of objection to NYSERDA. Such notice shall be signed and dated and concisely and clearly set forth the basis for the objection and be addressed to the Vice President, New York State Energy Research and Development Authority, at the notice address set forth in Exhibit B to this Agreement. The Vice President of NYSERDA, or his or her designee, shall review the objection for purposes of affirming or modifying NYSERDA's action. Within fifteen (15) working days of the receipt of the objection, the Vice President, or his or her designee, shall notify the Contractor either that NYSERDA's action is affirmed or that it is modified or that, due to the complexity of the issue, additional time is needed to conduct the review; provided, however, in no event shall the extended review period exceed thirty (30) working days.

504.10. Judicial Review. Any determination made by NYSERDA pursuant to this Exhibit that prevents the commencement of the time in which interest will be paid is subject to judicial review in a proceeding pursuant to Article 78 of the Civil Practice Law and Rules. Such proceedings shall only be commenced upon completion of the review procedure specified in Section 504.9 of this Exhibit or any other review procedure that may be specified in this Agreement or by other law, rule, or regulation.

504.11. Court Action or Other Legal Processes.

(a) Notwithstanding any other law to the contrary, the liability of NYSERDA to make an interest payment to a Contractor pursuant to this Exhibit shall not extend beyond the date of a notice of intention to file a claim, the date of a notice of a claim, or the date commencing a legal action for the payment of such interest, whichever occurs first.

(b) With respect to the court action or other legal processes referred to in subdivision (a) of this section, any interest obligation incurred by NYSERDA after the date specified therein pursuant to any provision of law other than Public Authorities Law Section 2880 shall be determined as prescribed by such separate provision of law, shall be paid as directed by the court, and shall be paid from any source of funds available for that purpose.



SOLAR THERMAL INCENTIVE PROGRAM

Customer Step by Step Guide

HERE ARE SOME STEPS TO HELP YOU GET STARTED

Are you tired of paying to heat your hot water? Do you have a sunny, south-facing roof? Are you interested in renewable technologies? If you answered yes to any of these questions, you may be a candidate for participation in the NYSERDA Solar Thermal Incentive Program (Program). Solar thermal is a technology that uses the sun to heat water. It's not the same as photovoltaics (PV) which uses the sun to create electricity.

Find a Solar Thermal (ST) Eligible Installer to learn about installation options and requirements. Only Eligible Installers can apply for incentives from the Program. A list of Eligible Installers is available on NYSERDA's [website](#). In order to be a Solar Thermal Eligible Installer with NYSERDA, installers must demonstrate that they have the technical expertise and training required to install a solar thermal system that maximizes thermal output and efficiency. NYSERDA recommends that you contact at least three Eligible Installers to receive cost proposals for your system. Installers should conduct a site visit to assess the solar resource and your site before providing a cost proposal. Additional information about the Program's rules and procedures is available in the Solar Thermal Program Manual; which can be found at:

<http://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-3221-Solar-Thermal-Incentive-Program.aspx>

Ask the Eligible Installer questions such as:

- Are they a NABCEP-certified Solar Thermal Installer? Or do they have at least 18 hours of Manufacturer Certified Solar Thermal training? Or are they Journeymen that have completed an approved NYS DOL Apprenticeship Program through the United Association of Plumbers, Fitters, Welders, and HVAC Service Techs?
- How many solar thermal hot water systems they have installed?
- What are their typical prices based on system size, etc?
- Will you need a building permit?
- Does your system need to be approved by the local code official?
- What other approvals are required in your jurisdiction?

Call your town, city, or local government and the utility to learn more about their requirements for your Solar Thermal System. Be sure you know who is responsible for obtaining and paying for any and all permits, inspections, and approvals. These responsibilities should be addressed in your written agreement with an Eligible Installer.



SOLAR THERMAL INCENTIVE PROGRAM

Customer Step by Step Guide

Completing and submitting an Incentive Application. Once you have decided to install a Solar Thermal hot water heating system and you have chosen an Eligible Installer, the following forms need to be completed, signed, and submitted to NYSERDA by your Eligible Installer:

- A completed application that is legible and accurate
- Customer Purchase/Lease Agreement. This is the contract between you and the Eligible Installer for the installation of a qualified Solar Thermal hot water system. This agreement should outline everything the Eligible Installer will be doing for you with respect to the installation, and should include details such as system costs, installation and payment schedule, responsibilities related to all permitting, etc. The Agreement must clearly apply the full amount of the NYSERDA incentive towards the price of the system. You may wish to consult an attorney before signing.
- The Addendum to the Customer Purchase/Lease Agreement must be signed and attached to the written Customer Purchase Agreement. The Addendum includes provisions designed to protect you. The eligibility of your system for the payment of incentives will depend on the Eligible Installer's adherence to its terms.

Your incentive application is submitted by your Eligible Installer. Once you have signed all of the paperwork, your Eligible Installer will submit your application package to NYSERDA for review. You may want to ask the Eligible Installer for a copy of the package for your records.

Note that systems partially installed or completed prior to the Installer receiving written notification of approval may jeopardize the incentive payment. **Do not let an Eligible Installer begin installing the Solar Thermal system until you have confirmation that NYSERDA has approved the system and that the incentive funds have been reserved for your project. Funding will only be reserved for a customer once the application for incentives has been received by NYSERDA.** The installer is responsible for notifying the customer of NYSERDA's approval of a project application.

It is important that you, the customer, keep track of any deadlines. The eligibility of your Solar Thermal system for incentive payments depends on meeting the deadlines as outlined in the Solar Thermal Program Manual.

Project Extensions may be granted, upon written request, on a case-by-case basis if there are legitimate and verifiable issues related to new construction or equipment availability. Project extension requests must provide a detailed description of the issues and provide any back up documentation. The request must be signed by the customer and the installer. If the installation of your Solar Thermal system is not progressing according to schedule, contact your Eligible Installer!

The Installer submits a request for payment of the incentive amount. Once the Solar Thermal system has been installed and you receive written approvals from all appropriate jurisdictions that the system has met their requirements, the Eligible Installer can then request payment of the incentive by NYSERDA

If you have any questions regarding the program or an application, you can e-mail NYSERDA at stforms@nyserda.ny.gov. In the subject line please reference the Solar Thermal Incentive Program.

**Solar Thermal (ST) Incentive Program
ADDENDUM to the AGREEMENT**



Please check appropriate box below.

This is an Addendum to a Customer Purchase Agreement

All Customer Purchase Agreements submitted in connection with an Application for Incentives under PON 3221 must include a fully executed copy of this Addendum to the Customer Purchase Agreement to be eligible to apply for Solar ST Program incentives. The Eligible Installer is identified below as “Installer”, the Customer/Owner is identified below as “Customer,” and the Eligible Installer’s Contractor is identified as the “Contractor.” Once executed by Contractor and Customer, this Addendum shall be incorporated into and shall become part of the Customer Purchase Agreement. _____(initial)(Customer)

This is an Addendum to a Lease Agreement

All Leases and Power Purchase Agreements (Agreements) submitted in connection with an Application for Incentives under PON 3221 must include a fully executed copy of this Addendum to the Lease or Power Purchase Agreement (“Addendum”). The Contractor or Lessor under the principal Agreement to which this Addendum is attached is identified below as Contractor; the Customer/Lessee is identified below as “Customer.” Once executed by Contractor and Customer this Addendum shall be incorporated into and shall become part of the Customer Agreement. _____(initial)(Customer)

Attorney Consultation: This Agreement is a legally binding document; you may wish to consult with an attorney before signing.

Conflicting Terms: In the event of a conflict between the terms of the Agreement (including any and all attachments thereto and amendments thereof) and the terms of this Addendum, the terms of this Addendum shall control.

Assumption of Responsibilities: Should the Contractor or owner of the Solar Thermal System sell or transfer ownership of the System during the term of the Agreement, the Contractor/owner agrees that it will alert Customer in advance of such transfer or sale, and that, during the duration of the term of the Agreement, either: (1) the Contractor will remain responsible to the Customer for all obligations and responsibilities stated herein, or (2) under the agreement of sale the buyer will assume all responsibilities to Customer stated herein, if applicable.

Incentives are only available for the installation of new equipment and ST Systems that have not been installed (partially or completely) prior to the *Project Application* achieving a status of ‘Submitted via Internet’. Incentives will not be provided directly to Customers but are paid to the Contractor, who must apply the entire approved amount to the Customer’s cost via a corresponding reduction in Customer’s Total System Cost. The Incentive Request Form must be completed and signed by the Installer/Contractor and Customer. The Contractor is required to disclose the full amount of the NYSERDA incentive to the end-use customer. The Contractor cannot collect the value of the incentive upfront and reimburse the customer upon completion of the project, or upon receipt of the NYSERDA incentive.

Review of System Design: NYSERDA will review the design of the Solar Thermal System considering issues including, but not limited to, existing thermal demand, system layout, orientation, shading, expected output, etc. NYSERDA approval of the Incentive Application is contingent on adherence to the proposed system design. Installers/Contractors must receive approval from NYSERDA for any material modification of the proposed system or its components, or the incentive may be revoked.

All potential system output losses (after all equipment losses are applied) associated with shading, system orientation, tilt angle, must be included. Such losses must be detailed in each application package using industry accepted shading and orientation tools, verifiable assumptions and calculations. In cases where trees or any other obstruction must be removed or moved in order to meet the program rules, incentive payments will not be

Solar Thermal (ST) Incentive Program ADDENDUM to the AGREEMENT



made until the obstructions are removed and a new shading analysis and/or photos have been submitted and reviewed by NYSERDA. Any trees or obstructions must be clearly labeled in the site map.

Warranty for Purchase Agreements: Both the Eligible Installer and the Contractor shall offer a full/transferable warranty to the purchaser of the ST System installed under this Customer Purchase Agreement for a period of five (5) years from the date the system is marked 'Completed' by NYSERDA. This warranty covers all components of the system against breakdown or degradation in thermal output of more than ten percent from their original rated thermal output. This warranty covers the full costs, including labor and repair or replacement of defective components or systems.

Warranty for Leases and Power Purchase Agreements: At a minimum, the Contractor shall offer a production guarantee to the Customer for the initial term of this Agreement. This production guarantee will provide the customer with compensation if the system produces less than the guaranteed output as specified in the PPA or lease agreement. Guaranteed output may not allow cumulative degradation in output of more than one percent per year from the original rated output for the initial term of this agreement. Under no circumstance will Customers be responsible for any labor and repair or replacement costs of defective components or systems over the initial term of this Agreement. Should the customer sell the residence at which this solar facility is located, the production guarantee is fully transferrable to a new lessee.

No party, including but not limited to owners, lessees/lessors, operators, and/or associated contractors shall agree to or enter any transaction that would or may be intended to result in the exportation or transmittal of any electrical energy created by any project receiving funds through the NYSERDA Clean Energy Fund to any party or system outside of New York State. The treatment of attributes detailed above apply to any project that receives funding from NYSERDA including, but not limited to funding from the Regional Green House Gas Initiative (RGGI).

Inspection/Reporting/Commissioning: For quality control purposes, all parties including the Customer must provide NYSERDA or its representative with reasonable access to the Solar Thermal System for inspection purposes. Final incentive payment may be contingent on NYSERDA inspection of the installed Solar Thermal System.

Publicity and Site Events: Customers and Installers are required to collaborate with NYSERDA's Director of Communications should they prepare any press release or plan any news conference related to the Solar Thermal System. NYSERDA is authorized to use Solar Thermal system photographs in brochures, on its website, and in other print materials.

Tax Incentives: Customers are encouraged to consult the Internal Revenue Service (See www.irs.gov), the NYS Department of Taxation and Finance (See www.tax.ny.gov) and with an accountant/tax adviser for details on eligibility for the tax credit provided in the law, regardless of whether the Installer/Contractor has provided information regarding the expected tax benefits (real property, federal or state tax incentives, or sales and use tax exemptions).

Cost Estimate/Total System Price: The Customer has relied upon the Installer/ Contractor to include any and all costs associated with the complete installation of the proposed Solar Thermal system in the Customer Agreement. If additional costs are sought from the Customer, the Customer Agreement may be cancelled without penalty and the customer may seek a full refund of any deposit paid to Contractor or costs the Customer incurred under this Agreement, less any reasonable site visit fees charged by the Contractor.

Incentive Estimate: If the Installer/ Contractor does not submit a completed Project Application to NYSERDA, or if the Project Application (a) is not approved by NYSERDA or (b) if NYSERDA approves a lower incentive, the Customer may terminate this Customer Agreement without penalty and seek a full refund of any deposit paid to Installer or costs he or she incurred under this Customer Agreement, less any reasonable site visit fees charged by the Contractor.

**Solar Thermal (ST) Incentive Program
ADDENDUM to the AGREEMENT**



Green Jobs Green New York (GJGNY) Financing: Should an eligible residential customer who chooses to access GJGNY financing to pay for the purchase of the ST system be unable to proceed with the installation of the ST system, due to either the system not meeting the Program’s eligibility requirements, or the customer being denied GJGNY financing, the customer may terminate the Agreement without penalty and seek a full refund of any deposit paid to Installer/Contractor or costs he or she incurred under the Agreement, less any reasonable site visit fees charged by the Installer/Contractor.

Solar Thermal system completion/commissioning: The Contractor/Installer agrees to complete the installation of the ST system, and request all necessary inspections, within 120 days of NYSERDA’s approval of the Project Application. Unless written approval of an extension has been issued by NYSERDA, the Contractor will be required to return any and all incentive payments to NYSERDA if this milestone has not been met.

General Business Law: If this Agreement is deemed to be a Home Improvement Contract under the NYS General Business Law §770, et seq., Customer is entitled to various notices. A description and explanation of this law can be accessed at <http://www.dec.ny.gov/lands/5341.html> This Agreement may also be subject to the federal Consumer Leasing Act (15 USC 1667 et. seq). <http://www.federalreserve.gov/boarddocs/supmanual/cch/leasing.pdf>

Consumer Information: New York consumers and customers are encouraged to consult the New York State Office of the Attorney General web site for consumer information:

<http://www.ag.ny.gov/consumer-frauds/home-improvements>

The NYS Consumer Protection Board offers additional information with the following publications:

<https://www.dos.ny.gov/consumerprotection/publications.html>

Communication with Customer: Installer, Company and Customer agree that NYSERDA may, at NYSERDA’s discretion, communicate by voice and/or written format with any Solar Thermal System Customer with respect to any matter relevant to a proposed or installed Solar Thermal System. Such communications may be in reply to an inquiry from a Customer or at NYSERDA’s initiation.

Disclaimer: The Customer understands that neither NYSERDA nor the State of New York: (1) endorse any Eligible Installer/Contractor; or (2) guarantee, warranty, or in any way represent or assume liability for any work proposed or carried out by an Eligible Installer/Contractor. Additionally, NYSERDA is not responsible for assuring that the design, engineering and construction of the project or installation of any solar electric generation system is proper or complies with any particular laws, regulations, codes, licensing, certification and permit requirements, or industry standards. NYSERDA does not make any representations of any kind regarding the results to be achieved by the solar generation systems or the adequacy or safety of such measures.

Statement of Acknowledgement: By signing, all parties acknowledge that they have read and understand the above information and requirements and agree to abide by them.

Customer Signature _____

Print Name _____ Date _____

Contractor: By signing below, the Installer and/or Contractor confirm that there is a fully-executed Agreement to install the Solar Thermal project that has been signed by both Installer/Contractor and Customer and that the costs and incentives stated on the NYSERDA approved application for incentive funding are complete and accurate. The Installer and/or Contractor is responsible for keeping this document on file. NYSERDA may request, at any time, that a signed copy of this addendum be provided.

Contractor Signature* _____

Print Name _____ Date _____

**Solar Thermal (ST) Incentive Program
ADDENDUM to the AGREEMENT**



*If executed by Installer, Installer and Contractor certify that Installer is authorized by Contractor to do so.



Email this form to STforms@nyserda.ny.gov

Solar Thermal Incentive Program Change Request Form

Date _____ 4 Digit Installer # _____ 5 Digit Application # _____

Indicate Reason for Request: Change Order _____ Cancellation _____ Extension Request _____

Will project use GJGNY financing? _____ No _____ Yes (If yes, submit a new ProForma Tool)

Reason for Change/Cancel/Extension _____

COMPLETE THE SECTION BELOW ONLY IF THIS IS A CHANGE ORDER

NEW SYSTEM

Domestic Hot Water Displaced by ST	kWh		
Total Price	\$	*Is this an OG-300 System?	<input type="checkbox"/> yes <input type="checkbox"/> no
NYSDERDA Incentive	\$	*Is an additional incentive requested?	<input type="checkbox"/> yes <input type="checkbox"/> no
Equipment:	Quantity	Cost	Manufacturer & Model Number
Solar Water Tanks		\$	Gallons
Solar Water Collector		\$	
Other		\$	

To accept, sign below and return.

Contractor Signature _____ Date _____
 If executed by Installer, Contractor certifies that Installer is authorized by Contractor to do so.

Customer Name _____

Customer Signature _____ Date _____

<p>For NYSDERDA use only.</p> <p>Approved in PC by _____</p> <p>Date _____</p>	<p>PO # _____</p> <p>Original PO Amount: _____</p> <p>Amount of Increase: _____</p> <p>New PO Amount: _____</p>
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E-mail this form to STinvoices@nyserda.ny.gov



SOLAR Thermal Incentive Program Incentive Request Form

Please refer to Program Manual, Section 2.8 for naming protocol of incentive requests. All documents must be scanned as a single pdf.

Contractor Name _____ Installer Name _____

NYSERDA Project No. _____ -- _____ Customer Name _____

Installation Address _____

Total Approved Incentive Amount \$ _____

If insurance will expire soon, email current Certificate of Insurance to ela@nyserda.ny.gov.

NYSERDA PO# (click on link in PC "show contract details" to find PO#) _____ Amount Requested \$ _____

Date of Installation _____

ITEMS TO BE INCLUDED WITH THIS REQUEST (This request will be denied if the following are not included)

_____ Acceptance of system by the Authority having Jurisdiction (AHJ)

_____ Any and all required permits including applicable utility, state, city and town permits.

CERTIFICATION STATEMENT: I certify that all information provided in this form, including all attachments, are true and correct to the best of my knowledge. _____ (installer/contractor initials)

Must be initialed

All installation and interconnection responsibilities have been completed by the Installer/Contractor as outlined in the Solar Thermal Program Manual. _____ (Installer/Contractor initial).

I attest that the ST system is operational, and further agree to notify NYSERDA should the ST system be non-operational for any 4 week period of time going forward. _____ (Customer initial)

Customer Signature _____ Date _____

Print Customer Name: _____

Contractor Signature _____ Date _____

Print Contractor Name _____

If executed by Installer, Installer and Contractor certify that Installer is authorized by Contractor to do so.

KEY

Yellow Cells are Required Input

Project Information	
Total Cost of Project	
NYSERDA ST Incentive	
Customer Out of Pocket Contribution (In Addition to Loan)	
Total Loan Amount Requested*	\$0
Energy Type Displaced by System	
Annual Energy Displaced by System	
Energy Rate	
Annual Value of Energy Displaced (Estimated)	\$0
Customer Utility (Energy Type Being Displaced)	Other
Annual Energy Use of Facility (Energy Type Being Displaced)	

*NYSERDA's portion of the loan may be 50% of the total loan amount up to \$50,000.

Owner Eligibility Criteria	<p>Organization Eligibility Eligible organizations include:</p> <ol style="list-style-type: none"> 1. Small Businesses with 100 employees or less 2. Not-for-profit organizations 	
	<p>Applicant Authority Small business and not-for-profit organizations that own their building have the authority to apply for financing.</p> <p>Lessees and Building Managers must obtain (see Partner Portal) a release from the building owner to apply for financing through the Program.</p>	

Cust	<p>Building Owner Release Signed Small Business and Not-for-Profit applicants who lease or manage a building or space within a building must obtain a release from the building owner in order to apply for financing through the Program.</p>	
-------------	--	--

Loan Eligibility Criteria	Cost-Effectiveness	
	Projects must have a simple payback of 15 year or less to be eligible for either On-Bill Recovery	
	For On-Bill Recovery projects must be cash positive within 10 years.	
	Parameter	Participation Loan
	Average Monthly Energy Use	
	Estimated Monthly Energy Displaced by ST System	
	Estimated Percentage of Monthly Energy Use Offset by ST System	
	Simple Payback, Years	#DIV/0!
Cash Flow Positive Within 10 Years	NA	
Eligibility	#DIV/0!	

ST Installer/Contractor Notes

NYSERDA Notes

NYSERDA Project Number

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Customer Information	
Name:	<input type="text"/>
Address:	<input type="text"/>
City, State, Zip:	<input type="text"/>
County	<input type="text"/>
Phone:	<input type="text"/>
Email:	<input type="text"/>

ST Installer/Contractor Informa	
Name:	<input type="text"/>

select option

select option

select option

or Participation Loans
On-Bill Recovery Loan
#DIV/0!
No
#DIV/0!



_____ Reviewed by _____



SERDA

ation



KEY
Yellow Cells are Required Input



Project Information	
\$150 Processing Fee Financed?	Yes
Total Cost of Project	\$10,000.00
NYSERDA ST Incentive	\$3,000.00
Customer DHW fuel Type-Region	Electric-NGRID Upstate
Annual kWh Displaced by System	2,400
Customer Contribution	\$3,000.00
Annual Value of Energy Displaced	\$261.60
Average Measure Life (Years)	20.00

Customer Information	
Name:	_____
Address:	_____
City, State, Zip:	_____

ST Installer/Contractor Information	
Name:	_____

Loan Eligibility Criteria	On-Bill Recovery Loan at 3.49% APR			Smart Energy Loan at 3.49% APR			Smart Energy Loan at 3.99% APR		
	5 Year	10 Year	15 Year	5 Year	10 Year	15 Year	5 Year	10 Year	15 Year
SIR Required Customer Contribution -or- Required FY Savings	1.25	1.15	1.06	1.25	1.15	1.06	1.23	1.12	1.02
Cash Flow Eligibility Loans >\$13,000 Payback Must be <=15 Years	NO	NO	NO	YES	YES	YES	YES	YES	YES
OBR- 1/12th Rule Smart Energy- loan term <= average measure life									
Required Customer Contribution -or- Required FY Savings	\$5,933 \$892	\$4,864 \$475	\$3,922 \$337	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A

*Note: The monthly payment is an estimate and may be adjusted in the Loan Agreement. The annual value of energy displaced will vary based upon your system operation and the cost per kWh which is subject to change.

		Loan Calculator		
		On-Bill Recovery Loan	Smart Energy Loan	Personal Loan
Loan Information	Loan Amount (Above)		\$4,150.00	
	Term in Years		15	
	Interest	3.49%	3.49%	12.00%
Payment Information	Monthly Payment	\$29.65	\$29.65	\$49.81
	Total Invested	\$5,336.50	\$5,336.50	\$8,965.26
	Interest Accrued	\$1,186.50	\$1,186.50	\$4,815.26
Savings After Improvement	Monthly			
	Dollar Savings		\$23.06	
	Loan Payment Amount	\$29.65	\$29.65	\$49.81
	Net	-\$6.58	-\$6.58	-\$26.74
	Project Lifetime Energy Savings	\$5,649.38	\$5,649.38	\$5,649.38
Simple Payback Period (Years)	15.86	15.86	15.86	

Notes	
ST Installer/Contractor Notes	

NYSERDA Notes	NYSERDA Project Number	Reviewed by

SOLAR HEATING SYSTEMS

Field Inspection Guidelines

**FIELD INSPECTION GUIDELINES FOR SOLAR HEATING SYSTEMS
STATE OF NEW YORK**

INTRODUCTION

The field of solar water heating (SWH) has a long history in the United States. During times when nonrenewable fuel sources have been scarce and/or expensive, the SWH industry has gone through periods of significant growth. These periods have been marked by development in the various technologies involved in the trade – collectors, controls, heat exchangers, etc. - and the need for quality assurance to ensure that systems are designed and installed properly.

This manual serves as an educational tool for Code Enforcement Officials (CEOs) and solar heating installers in New York. Though SWH has been used in the United States for over a century, it hasn't yet achieved enough of a market share to be considered as a "conventional" heating source. It is our hope that this guide will help with the development of uniform standards for residential SWH systems in New York.

It is easy to wistfully promote "uniform standards," but such a concept is difficult in practice. While there are State Codes in New York, local jurisdictions (such as New York City) may have their own codes, and codes are only consistent across jurisdictions if there is consistency in enforcement. This situation is not unique to New York. There are two dominant codes relating to SWH in the United States – the International Codes and the Uniform Codes. Figure 1 illustrates the state-by-state adoption of plumbing codes across the U.S.

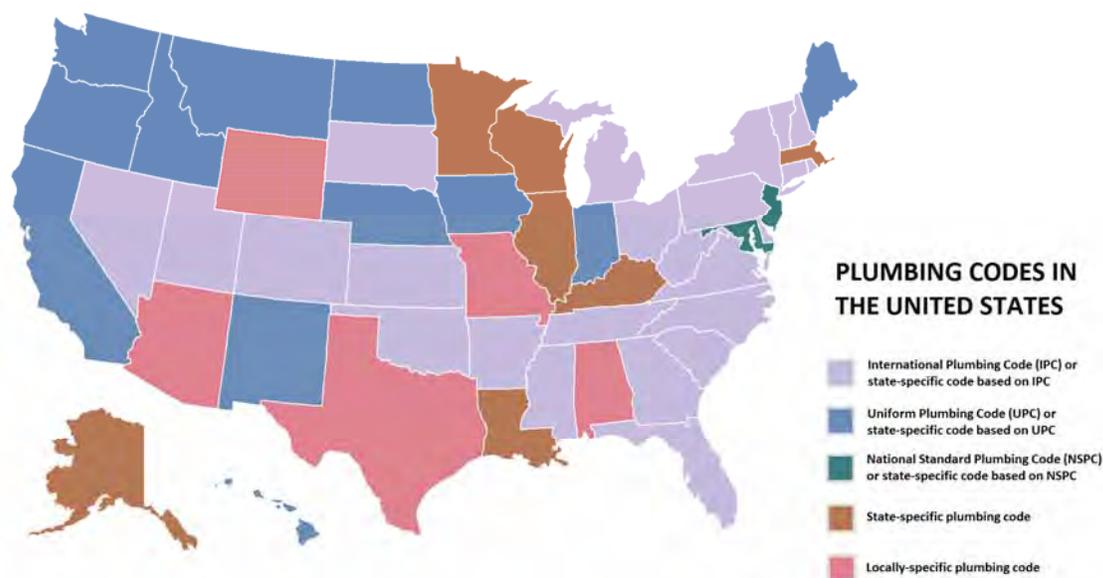


Figure 1 - Map illustrating state plumbing codes (based on Reed's Construction Data and author's research)

Because there is a lack of widespread access to comprehensive details on code compliance of SWH systems in the United States, this guide may eventually be read by individuals outside of New York State. It is critical for readers to recognize how codes differ by jurisdiction. For example, a contractor from California that installs a SWH system in compliance with the information in this manual might not satisfy codes in California, where the Uniform Plumbing Code has been adopted.

Whether in New York or elsewhere in the U.S., it is critical to compare the contents of this guide with the rules adopted by the Authority Having Jurisdiction (AHJ) to ensure code-compliance of an installation.

This manual is built upon the *Inspection Checklist for Solar Heating Systems* (pages iv-vii). This checklist includes requirements from the following sources:

- 2010 Plumbing Code of New York State (NYSPC)
- 2010 Mechanical Code of New York State (NYSMC)
- 2010 Building Code of New York State (NYSBC)
- 2010 Energy Conservation Construction Code of New York State (NYSECC)

These codes are all based on the 2009 International Codes. The *Inspection Checklist* cites the section of code that relates to each installation requirement. These items are discussed in further detail in the manual.

It is possible for a system to be code-compliant without functioning properly or adhering to industry “best practices.” The Solar Rating and Certification Corporation (SRCC) Operating Guidelines 300 (OG-300) have been included in this manual to address these deficiencies. OG-300 details the minimum standards for systems that are certified by the SRCC. While OG-300 *Certification* is not necessary to qualify for local incentives in New York, it is necessary for installers to comply with OG-300 *practices*.

For ease of navigation and to assist the Inspector with his/her assessment, the manual has been organized as illustrated in Figure 2 and described below:

Section 1: Collector Array focuses on the collector array and other major equipment that is installed outdoors. On many systems this portion of the inspection will take place upon the roof, though some systems may be wall-mounted or ground-mounted. Much of this section is regulated by the NYSMC, NYSBC, and OG-300 Guidelines.

Section 2: Solar Loop includes all of the piping and components between the collector array and the heat exchanger. This portion of the installation is primarily regulated by the NYSMC and OG-300 Guidelines.

Section 3: Solar Storage & Potable Tie-In focuses on storage tanks and domestic water supply. This section is guided primarily by the NYSPC with some inclusion of the OG-300 Guidelines.

Section 4: Controls covers the electrical requirements of a properly-installed system. The National Electrical Code (NEC) provides guidance for this section.

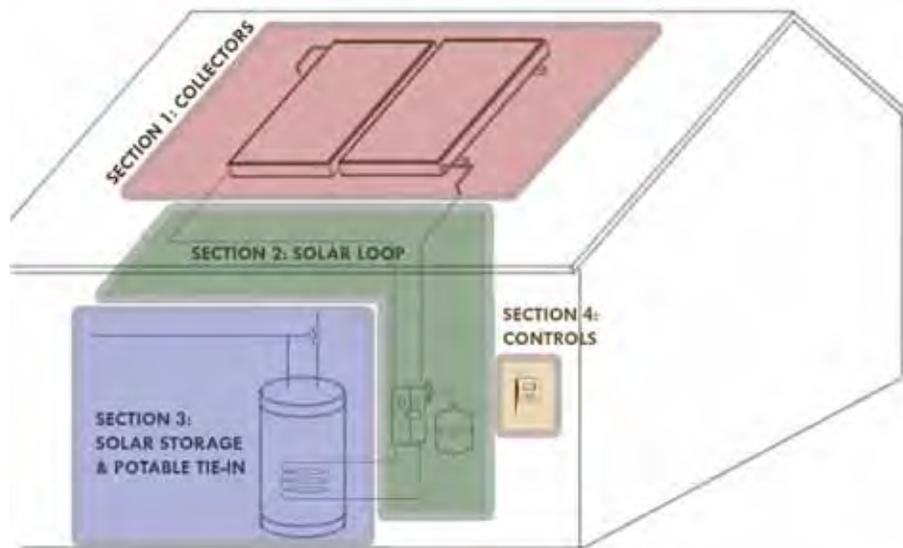


Figure 2 - Organizational structure of the Inspection Manual

As SWH becomes a conventional energy source, the understanding of proper code-compliance and best practices will continue to develop. Consequently, we understand that this will be a dynamic document – one that responds to the needs of inspectors and the market. If you believe that an error has been made in this document, please contact Vicki Colello at: vac@nysesda.ny.gov.

This document was authored by Vaughan Woodruff, Solar Thermal Instructor at Kennebec Valley Community College (KVCC). KVCC is part of the U.S. Department of Energy’s Solar Instructor Training Network. KVCC’s Northeast Solar Heating and Cooling Instructor Training Project is a “train the trainers” project to increase access to instructor training and create pathways for the highly-skilled, technical workforce. Vaughan would like to thank Mark Thornbloom of Kelelo Engineering, Darren Vaux of Camosun College, Mark Sevier of Cadmus Group, and Todd Hoitsma of Liquid Solar Systems for reviewing and adding their expertise to this document. He would also like to express his appreciation to Kennebec Valley Community College and the Interstate Renewable Energy Council for their support.

Production of this document was funded by the New York State Energy Research and Development Authority (NYSERDA) under contract agreement 9991 with the Interstate Renewable Energy Council (IREC). The purpose of this manual is to provide a detailed resource manual to support growth and development of the Solar Thermal industry in the State of New York. The guide might also be used by local code enforcement officials as a reference. Those interested in participating in the RPS funded Solar Thermal incentive programs should refer to PON 2149 for the specific details of that program and its processes.

SOLAR HEATING INSPECTION CHECKLIST

Customer Name _____ Customer Phone No. _____

Installation Address _____ City _____ State _____ Zip _____

Eligible Installer _____ Eligible Installer E-mail _____

Company _____ Installer No. _____ Phone No. _____

(A) COLLECTORS						
SECTION 1: COLLECTOR ARRAY	Yes	No	N/A	Requirement	Source of Requirement	Page #
				(i) Shading analysis accurate	Program requirement	1
				(ii) Tilt and azimuth consistent with application	Program requirement	3
				(iii) Collector manufacturer, model, and quantity matches program application	Program requirement	5
				(iv) Collector certified by SRCC OG-100	NYSMC 1404.1, OG-300 6.1.2.1, Federal Tax Credit	5
				(v) Inlet and outlet piping plumbed correctly	NYSMC 1401.4, OG-300 6.1.2.4	5
				(vi) Multiple-collector banks plumbed and balanced properly	NYSMC 1401.4, OG-300 6.1.2.4	6
				(vii) Multiple banks plumbed and balanced properly	NYSMC 1401.4, OG-300 6.1.2.4	8
				(viii) Collector sensor(s) securely attached in appropriate location	OG-300 6.5.18	9
				(ix) Sensor wire properly protected from UV degradation and excessive heat	OG-300 6.1.2.2	10
				(x) Collectors sloped ¼" per foot (min.) towards the collector inlet <i>for drainback systems</i>	OG-300 6.2.5	11
				(xi) Manual or automatic air vent installed at high point of system –or- alternate OG-300 design for air elimination <i>for pressurized glycol systems</i>	OG-300 6.3.9	11
(B) COLLECTOR RACKING						
				(i)(a) Collector racking installed per manufacturer's specifications	NYSMC 1401.4	12
				–OR–		
				(i)(b) Custom rack engineered and installed per design specifications	NYSMC 301.12	12
				(ii) Attachment between collector(s) and rack fastened properly	NYSMC 1401.4	13
				(iii) Dissimilar metals galvanically isolated between collector rack and metal roofing	OG-300 6.2.4	13
				(iv)(a) Collector rack connected to structure in accordance with building permit	NYSMC 302.1	13
				–OR–		
				(iv)(b) Collector rack connected to structure in accordance with collector manufacturer specifications	NYSMC 1401.4	13
				–OR–		
				(iv)(c) Collector rack connected to structure in accordance with engineered design	NYSMC 302.1	13
				(v) Attachment points sealed properly	NYSBC 1503.2, NYSMC 1402.6, OG-300 6.5.5	15

SECTION 1: COLLECTOR ARRAY	Yes	No	N/A	Requirement	Source of Requirement	Page #	
				(vi) Foundation installed per specifications detailed in building permit <i>for ground-mounted systems</i>	NYSBC Ch. 18	16	
	(C) EXTERIOR PIPING						
				(i) Exterior piping supported properly	NYSMC 305.2, 305.4	16	
				(ii) Exterior piping insulated properly	NYSECC 403.3, 503.2.8	17	
				(iii) Pipe insulation protected from UV degradation	OG-300 6.1.2.2	18	
				(iv) Pipe penetrations flashed and sealed properly	NYSPC 305.7, NYSMC 1402.6, OG-300 6.5.5	19	
				(v) Piping sloped ¼" per foot, minimum, <i>for drainback systems</i>	OG-300 6.2.5	20	
				(vi) Dissimilar materials isolated properly, if required	NYSMC 1203.1.1; OG-300 6.2.4	20	
				(vii) Polymer materials are not used in the collector loop unless approved by the SRCC in a specific OG-300 certified system	Design requirement	20	

SECTION 2: SOLAR LOOP	(A) PIPING CONSIDERATIONS						
				(i) Piping supported by appropriately-spaced hangers	NYSMC 305.4	21	
				(ii)(a) Hanger material compatible with piping material -OR- (ii)(b) Hangers isolated properly from piping	NYSMC 305.2	22	
					OG-300 6.2.4	22	
				(iii) Piping insulated properly	NYSECC 403.3, 503.2.8	22	
				(iv) Dissimilar materials isolated properly, if required	NYSMC 1203.1.1; OG-300 6.2.4	23	
				(v) Penetrations through structural members consistent with code	NYSMC 302.3, 302.4, 302.5	23	
				(vi) Piping backfilled properly <i>for ground-mounted systems</i>	NYSPC 306.1, 306.3	24	
				(vii) Piping installed to allow system draining	NYSMC 1206.2, OG-300 6.5.15	24	
	(B) HEAT TRANSFER FLUID						
				(i)(a) System utilizes water as heat transfer fluid -OR- (i)(b) System utilizes propylene glycol solution as its heat transfer fluid	NYSPC 608.16.3	25	
					NYSPC 608.16.3; OG-300 6.3.12	25	
				(ii) Heat transfer fluid is rated for solar applications	NYSMC 1403.1, OG-300 6.2.1, 6.2.8, 6.3.14	25	
				(iii) Propylene glycol concentration is appropriate for application	OG-300 6.2.5	25	
	(C) PRESSURE CONSIDERATIONS						
				(i) Pressure relief valve and relief drain installed properly	NYSMC 1402.5.1; OG-300 6.1.1.1, 6.2.3, 6.3.5	26	
				(ii) Pressure relief valve cannot be isolated from collector array	NYSMC 1402.5.1, OG-300 6.3.16	26	

SECTION 2 : SOLAR LOOP	Yes	No	N/A	Requirement	Source of Requirement	Page #	
				(iii) All system components rated higher than pressure relief rating	NYSMC 1202.3, 1402.5.1; OG-300 6.2.3	27	
				(iv) Expansion tank sized and installed properly for <i>pressurized glycol systems</i>	NYSMC 1009.2, 1402.5.4; OG-300 6.1.3.4	27	
				(v) System tested to 100psi for at least 15 minutes, for <i>pressurized glycol systems</i>	NYSMC 1208.1	28	
				(vi) System pressure is within standard limits	Design requirement	29	
	(D) OTHER CONSIDERATIONS						
				(i) Penetrations between conditioned and unconditioned space airsealed	NYSECC 402.4.1, OG-300 6.5.5	29	
				(ii) Check valve installed to prevent passive cooling for <i>pressurized glycol systems</i>	OG-300 6.1.1.5	30	
				(iii) Expansion tank located between check valve and collector array for <i>pressurized glycol systems</i>	Best practice	31	
				(iv) System drains correctly for <i>drainback systems</i>	OG-300 6.2.5	31	
			(v) Piping labels show type of fluid and direction of flow	NYSMC 608.8.1	32		
			(vi) Drain and fill valves labeled	OG-300 6.3.7	33		

SECTION 3: SOLAR STORAGE AND POTABLE TIE-IN	(A) STORAGE TANK					
				(i) Tank manufacturer, model, and capacity matches application	NYSERDA	34
				(ii) Tank labeled with pressure rating for <i>pressurized storage</i>	NYSMC 501.7, OG-300 6.4.3	34
				(iii) Temperature and pressure relief valve installed properly for <i>pressurized storage</i>	NYSMC 504.4, 504.5; NYSECC 1006.3	34
				(iv) Relief drain plumbed properly for <i>pressurized storage</i>	NYSMC 504.6, NYSECC 1006.3	34
				(v) Tank drain installed for <i>pressurized storage</i>	NYSMC 501.3	35
				(vi) Tank vented to atmosphere for <i>atmospheric tank</i>	Design requirement	35
				(vii) Tank water adjusted to proper pH level for <i>atmospheric tank</i>	Design requirement	35
				(vii) Galvanized steel pan and installed below tank and drained, as appropriate	NYSMC 504.7	35
				(ix) Tank installed on level surface	NYSMC 304.9	36
				(x) Tank supported for seismic loads, if applicable	NYSMC 502.6, NYSECC 301.15	36
				(xi) Tank meets requirements for installation in attic or garage, if applicable	NYSMC 502.2, 502.5; NYSECC 304.7	36
				(xii) Storage tank sensor(s) installed properly	OG-300 6.5.18	36
(B) POTABLE PIPING						
			(i) Mixing valve installed properly	OG-300 6.1.5.6	38	
			(ii) Mixing valve set to appropriate temperature	NYSMC 501.2, NYSECC 504.3, OG-300 6.1.5.6	38	
			(iii) Isolation valve installed on cold water feed to water heater	NYSMC 503.1; OG-300 6.1.1.2, OG-300 6.1.6.5	39	

SECTION 3: SOLAR STORAGE	Yes	No	N/A	Requirement	Source of Requirement	Page #
				(iv) Isolation valves installed to allow bypass of solar storage tank	OG-300 6.1.1.2, OG-300 6.1.6.11	39
				(v) Heat traps properly installed	NYSECC 504.4	40
				(vi) Antisiphon device installed properly	NYSPC 504.1	40
				(vii) Dissimilar materials isolated properly, if required	NYSPC 605.25	40
				(viii) Thermal expansion tank installed and sized properly for cold water supply with check valve or backflow prevention	NYSPC 607.3.2	41
				(ix) Interconnecting piping insulated properly	OG-300 6.1.6.3	41
				(x) All valves and fittings are rated for potable systems	NYSPC 605.2	42
				(xi) Isolation valves labeled with normal operating position	OG-300 6.1.1.2	42

CONTROLS						
SECTION 4: CONTROLS				(i) Wiring between controller and outputs (pumps, motorized valves, etc.) installed properly	NEC 430.21(G), 110.14(B)	43
				(ii)(a) Controller relay(s) rated higher than each output -OR- (ii)(b) Appropriately rated intermediate relay(s) installed between controller and output(s)	Design requirement	43
					Design requirement	43
				(iii) Wiring between controller and power source (line voltage) installed properly	NEC 110.14(B), 310.104, Ch. 9	44
				(iv) wiring to PV module installed and sized appropriately for PV-controlled systems	NEC 310.10(D), Article 690(IV)	44
				(v) PV module sized appropriately for DC pump for PV-controlled systems	Design requirement	44

SECTION 1: COLLECTOR ARRAY

The collector array is the major energy source for any SWH system and represents some unique challenges for the Installer. Because it is located outdoors, the array is subject to unique live loads (wind and snow). Additionally, materials used in and around the array must be resistant to degradation from ultraviolet (UV) light.

Inspection of the collector array provides its own difficulties. Because many arrays are located on the roof, access may be difficult and provide significant risk for the Inspector. OSHA does not *require* fall protection for inspections, but it is recommended due to the inherent risk. The Inspector should bring adequate safety equipment to access the roof to ensure proper protection during the Inspection.

The **Inspection Checklist** for this section is organized into the following categories:

- **Collectors:** The collectors must be inspected to ensure they are sited, oriented, and inclined correctly. Multiple-collector arrays must be installed to balance flow through individual collectors.
- **Collector racking:** This category refers to the mechanical attachments between the collector and the roof attachment. For tilt racks, this includes the tilt rack and the collector attachments. For a flush-mounted collector, this includes the collector attachment.
- **Attachment to structure:** The attachment of the collectors to the structure must be able to withstand the various forces on the collectors and ensure the integrity of the building or ground-mount to which it is attached.
- **Exterior piping:** This category refers to the piping that connects the collectors to the balance-of-system, the pipe covering, and the penetration of the piping into the structure.

(A) COLLECTORS

(i) Shading analysis is accurate

Incentive programs may require a shading analysis to be submitted with the program application. This shading analysis details the accessible solar energy at the installation site. The Inspector may be responsible for conducting an independent shading analysis to verify that the site will receive sufficient sunlight throughout the year. If there is a major discrepancy between the independent shading analysis and the one submitted with the program analysis, this issue will likely need to be resolved by the Installer to comply with the incentive program.

A shading analysis can be performed using several different instruments. The two most common tools for this purpose are the Solar Pathfinder and Solmetric SunEye.

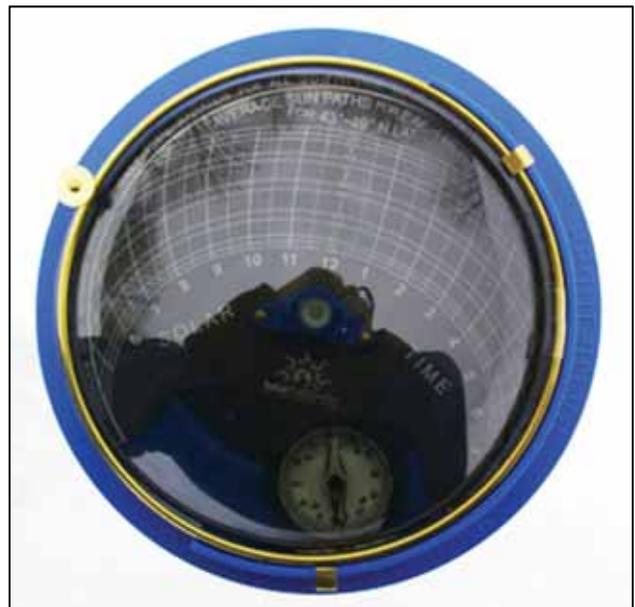


Figure 1-1 – View of Solar Pathfinder plastic dome from above (photo courtesy of Kennebec Valley Community College)

Solar Pathfinder

The Solar Pathfinder is a tool that reflects the horizon on a plastic dome (See Figure 1-1). By superimposing the reflection atop a stereographic diagram that illustrates the paths the sun takes throughout the year, a derating can be determined to account for shading.

The *Solar Pathfinder Assistant software with Thermal Plug-In* allows the Installer to import a digital photo of the Solar Pathfinder dome into a program that can provide precise shading estimates and approximate system performance based upon the specific components used and the tilt and orientation of the collector array.

In order to work properly, the Solar Pathfinder should be placed on a level surface in the site where the collectors are (or will be) situated. After orienting the Solar Pathfinder's compass towards true south, the shading obstructions can be traced on the stereographic chart to estimate their impact on the amount of solar energy available at the site. Alternately, the device can be leveled and oriented towards magnetic south, a digital photo can be taken, and the photo can be imported into the Solar Pathfinder Assistant Software. For more detailed information, including an instructional manual, visit www.solarpathfinder.com.

In the state of New York, magnetic declination varies from roughly 10°W in Ripley to 14°W in Montauk. It is important to consider the site's magnetic declination when preparing an accurate site assessment. Site-specific magnetic declination is available at the National Oceanic and Atmospheric Administration's National Geophysical Data Center website: <http://www.ngdc.noaa.gov/geomagmodels/struts/calcDeclination>.

Important note: If manually tracing the stereographic diagram, the results will only account for derating due to shading. A report generated by the Pathfinder Assistant software will also account for derating *due the tilt and orientation of the array*. See Section 1, (A)(ii) below for details regarding the effects of tilt and azimuth (the orientation of the collectors in relation to true south) on a system's performance.

SunEye

The Solmetric SunEye is a handheld digital device (see Figure 1-2) that can provide instantaneous analysis of a site based on its shading profile, tilt, and azimuth. When performing a site assessment, information about the project is imported into the SunEye and a digital fish eye lens displays an image similar to the one that appears when looking down upon the Solar Pathfinder. Once the SunEye is leveled and oriented towards true south, the image is captured by the device and the derating due to shading and orientation is determined immediately. More information on the SunEye is available at www.solmetric.com



Figure 1-2 – The SunEye 210 (photo courtesy of Solmetric)

Evaluating

The Inspector should verify that the site meets relevant program requirements by performing an independent shading analysis. If the solar energy at the site is marginal but acceptable (75-80%) and future tree growth is likely to limit the system's performance, this should be noted.

(ii) Tilt and azimuth consistent with application

The tilt and azimuth of the collector array is required on the application for some incentive programs. The as-built tilt and azimuth must be obtained during the inspection and compared to the values submitted on the application.

Tilt

The tilt of the collector array is determined by using an inclinometer (see Figure 1-3).



Figure 1-3 – An inclinometer is used to determine the tilt angle of a collector.

Azimuth

The azimuth of the array can be determined several ways:

- For collectors mounted in-line with the structure, an aerial photograph of the site (see Figure 1-4) can be accessed prior to or during the Inspection. These maps are oriented to true south, so the measure of the azimuth can be derived by using a protractor to measure the angle between the building orientation and a vertical line on the map. If using this method, the azimuth must be determined prior to leaving the site. Some sites do not have adequate aerial maps due to cloud cover or other issues (see Figure 1-5).
- When orienting the Solar Pathfinder or SunEye for the shading analysis in Section 1, (A)(i), the angle between solar south and the collector array can be approximated. This is best done from behind the collector array. Be aware that metal objects may affect the accuracy of a magnetic compass.



Figure 1-4 – Aerial photograph of a prospective installation site (©2011 Google, TerraMetrics)



Figure 1-5 – The limitations of aerial photographs (photo from Google Maps)

Important notes:

- Consideration should be taken when flush-mounting evacuated tube collectors. Due to their low thermal losses, evacuated tubes tend to shed snow poorly (see Figure 1-6). When snow is shed, it can collect between the tubes of the array. On roofs that are less than 10:12 in slope, it is *recommended* that



Figure 1-6 - Evacuated tube collectors flush-mounted on a roof with an 8:12 slope (photo courtesy of Kennebec Valley Community College)

- evacuated tubes are installed on tilt racks to increase the slope, allow wind to get behind the collectors for removing snow, and to allow space between the collector and roof where snow can shed.
- Flat plate collectors may benefit from being flush-mounted rather than installed on a tilt rack. If the roof slope is steep enough to maintain adequate available solar insolation (see the discussion of “Surface Orientation Factors” below), a flush-mounted system may provide aesthetic benefits and reduce concerns associated with wind loading.
- Evacuated tube collectors may require a minimum collector slope for proper functionality. Consult the manufacturer’s specifications to ensure proper installation.

In addition to the use of shading tools, the effect of tilt and azimuth on available *annual* solar insolation can be quantified through the use of Surface Orientation Factor charts. These charts illustrate the amount of energy available at specific sites for various orientations (see Figure 1-7).

These figures illustrate the acceptable margin of error for sites with an orientation that is different than the one profiled on program application form. For example, a system in Syracuse was initially planned to be installed at a tilt angle of 40 degrees and an azimuth of 165 degrees. This system could be installed at the same azimuth and a tilt angle of 50 degrees without a significant drop in *annual production*. Annual production is not always the greatest concern in solar heating systems; the most important consideration is to match the amount of energy generated to the hot water demand.

See <http://www.solmetric.com/annualinsolation-us.html> for site-specific Surface Orientation Factors.

Evaluating

As mentioned in the discussion of shading analyses (Section 1(A)(i)), effects of tilt and azimuth must be considered when assessing the performance of the system. To facilitate this, Inspectors should use a SunEye tool for verification. If a Solar Pathfinder is used, a digital photo must be taken for use with the Pathfinder Assistant software.

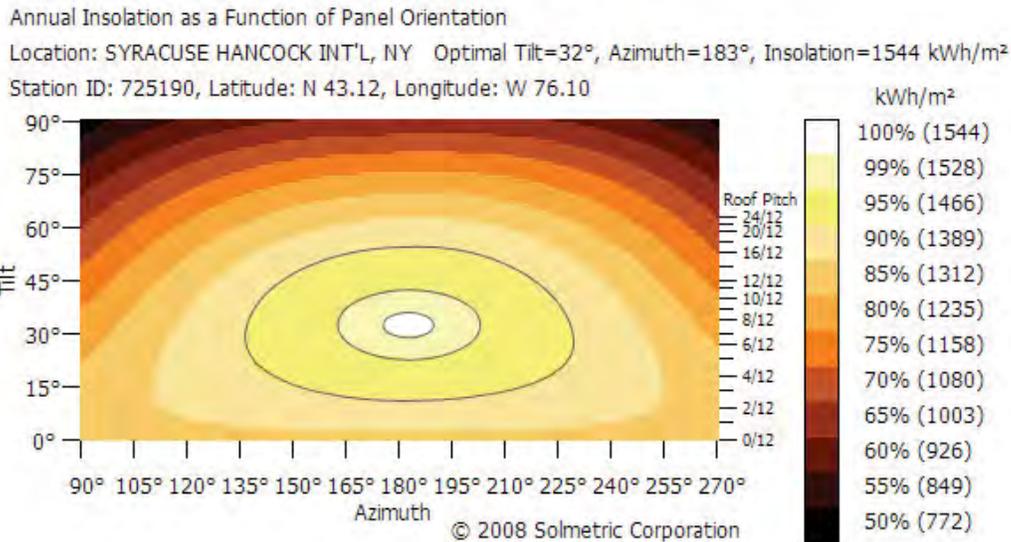


Figure 1-7 – Surface Orientation Factor diagram for Syracuse, NY

- (iii) Collector manufacturer, model, and quantity matches application
- (iv) Collector certified by SRCC OG-100

All qualified SWH collectors must be certified by the Solar Rating and Certification Corporation (SRCC). Collector certifications are found on the frame of flat plate collectors and on the manifold for evacuated tube collectors (see Figure 1-8). These labels indicate the manufacturer and model. Collectors must be certified under SRCC Operating Guidelines (OG-100) to qualify for the federal tax credit and many local incentives.



Figure 1-8 - SRCC OG-100 Certification plate for an Apricus AP-20 Collector

Evaluating

The Inspector should verify that the collectors are OG-100 certified.

- (v) Inlet and outlet piping plumbed correctly

The heat transfer fluid in the system must travel from the coolest part of the collector to the hottest part in order to absorb the sun's heat efficiently. In evacuated tube collectors, the inlet and outlet ports of the collector are often interchangeable (see Figure 1-9). In harp-style flat plate collectors, the inlet and outlet ports are distinct (see Figure 1-10). Serpentine/meander-style flat plate collectors may or may not have distinct inlet and outlet ports (see Figure 1-11 and Figure 1-12).

Note: Some serpentine/meander-style flat plate collectors are manufactured in models specifically designed for landscape mounting (the long side oriented to horizontal). It is critical to verify that serpentine/meander-style flat plate collectors mounted landscape (sometimes referred to as “horizontal”) are designed for this purpose. Otherwise, the collectors could create steam traps during stagnation that increase system pressures and temperatures. Likewise, serpentine/meander-style collectors designed as horizontal collectors should not be mounted in portrait orientation.

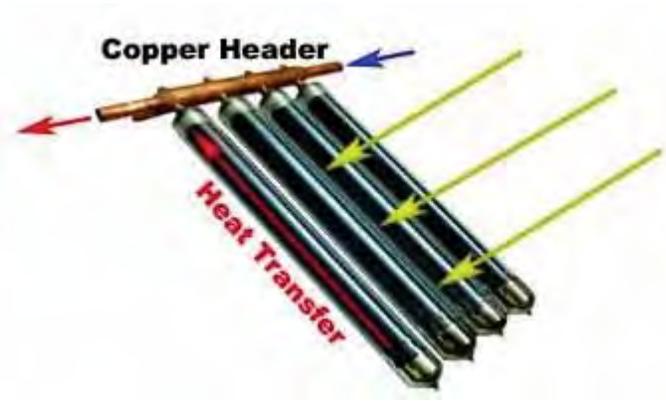


Figure 1-9 – Sample evacuated tube schematic. Flow of the heat transfer fluid is shown from right to left, but could also go from left to right (image courtesy of Solar Panels Plus)



Figure 1-10 – Grid-style flat plate collector. The inlet is on the bottom and the outlet is on top. This collector could also be plumbed with the inlet on the bottom right and the outlet on the top left, but not with flow from top to bottom (image courtesy of Heliodyne).

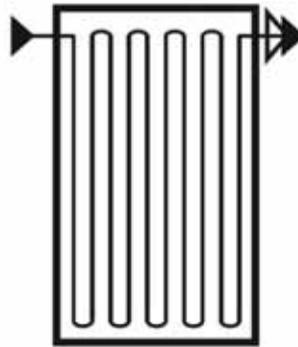


Figure 1-11 – Serpentine/meander-style flat plate collector with interchangeable inlet and outlet. This collector could also be plumbed right to left (image courtesy of Schuco).

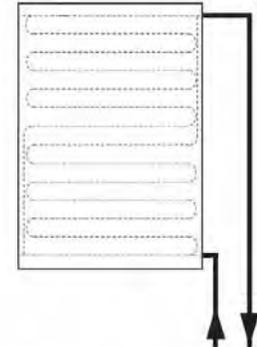


Figure 1-12 – Serpentine/meander-style flat plate collector with distinct inlet and outlet. This collector can be plumbed with the inlet on either side of the bottom header and the outlet at either side of the top header, but not from top to bottom (image courtesy of Buderus).

Evaluating

The Inspector should verify that the collectors are plumbed properly. If unfamiliar with the style of collector used in the system, the Inspector should refer to the collector manufacturer’s documentation.

(vi) Multiple-collector banks plumbed and balanced properly

Many systems in New York utilize more than one collector. It is critical that these systems are properly installed to ensure proper utilization of each collector in the array.

Flat plate collectors – Harp-style

Harp-style flat plate collectors should always be installed *in parallel*. This is accomplished by connecting the collectors header-to-header as illustrated in Figure 1-13. Most harp-style flat plate collectors can be arranged in arrays of six collectors. Larger arrays may need to be plumbed in separate arrays due to frictional head loss in the collector array, excessive fluid velocities, and/or the inability for large arrays to balance flow through each of the risers (the tubing that connects one header to the other). Consult the collector manufacturer's recommendations for banks with five or more collectors.

Harp-style flat plate collectors should not be plumbed in series (see Figure 1-14). Plumbing collectors in parallel leads to equivalent temperatures across the array. When plumbed in series the last collector will be hotter than the first collector. Because of the thermal losses of typical flat plate collectors, such an arrangement leads to inefficient solar collection. The additional piping required to connect the headers in series creates further inefficiency.

When typical harp-style collectors are oriented horizontally (or "landscape"), extra piping must be installed to plumb the collectors in parallel (see Figure 1-15). Some companies manufacture harp-style collectors with rotated headers that allow them to be plumbed in parallel similar to the style shown in Figure 1-13.

Flat plate collectors – Serpentine/Meander-style

Serpentine/meander-style collectors should always be connected *in parallel* (see Figure 1-16). The method for plumbing serpentine/meander collectors in parallel may vary by manufacturer. The Inspector should refer to the collector manufacturer's documentation if unfamiliar with the model of serpentine/meander-style collector used in the system. It is important to also verify the maximum number of serpentine/meander collectors allowed in each individual bank.



Figure 1-13 – Grid-style flat plate collectors plumbed in parallel (image courtesy of AET).

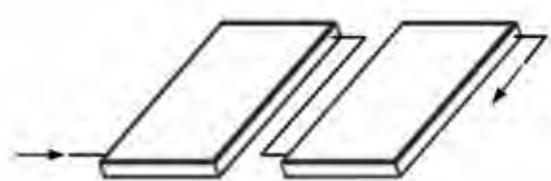


Figure 1-14 - Flat plate collectors plumbed in series



Figure 1-15 – Horizontal flat plate collectors plumbed in parallel

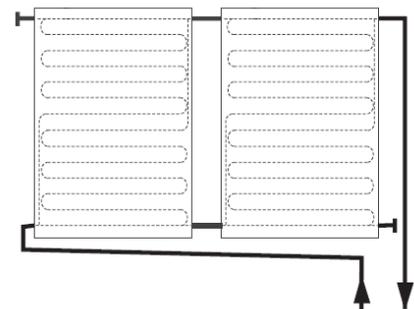


Figure 1-16 – Serpentine/meander-style collectors plumbed in parallel (image courtesy of Buderus)

Evacuated tube collectors

The benefit of evacuated tubes is their lower thermal losses when compared to typical flat plate collectors. Due to this phenomenon and the typical design of evacuated tube manifolds, it is appropriate to connect evacuated tube collectors *in series*. Evacuated tube collectors are connected in series by directly connecting the manifold headers to one another (see Figure 1-17 and Figure 1-18).

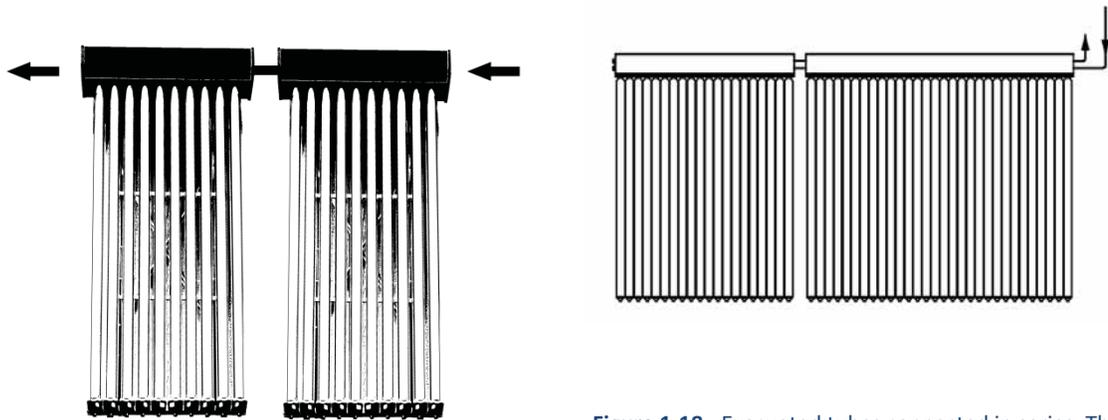


Figure 1-17 – Evacuated tubes connected in series. This collector could also be plumbed with flow from right to left.

Figure 1-18 - Evacuated tubes connected in series. The inlet and outlet in this installation could also be located on the left side of the array. Note that this is an example of an evacuated tube collector with a distinct inlet and outlet, unlike the models in Figure 1-9 and Figure 1-17 (image courtesy of Viessman).

There are limits to connecting evacuated tube collectors in series. Too many collectors in series will increase the thermal losses to an unacceptable level, result in high fluid velocities, and may lead to unacceptable stagnation temperatures. Consult the collector manufacturer’s recommendations for arrays with four or more evacuated tube collectors.

Evaluating

The Inspector should verify that the collectors are plumbed properly. If unfamiliar with the style of collector used in the system, the Inspector should refer to the collector manufacturer’s documentation.

(vii) Multiple banks plumbed and balanced properly

Multiple banks should be connected in parallel with balanced flow. SRCC OG-300 Guidelines stipulate that the variation in flow between multiple collector banks shall not exceed 10%. The flow can be balanced as follows:

Reverse return

Multiple banks can be balanced by plumbing them reverse return (see Figure 1-19). When done correctly, this method ensures that the heat transfer fluid experiences roughly the same flow through both collector banks if the piping is the same diameter and the

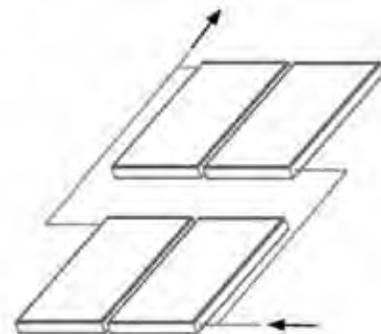


Figure 1-19 – Multiple banks balanced with reverse return piping

difference in pipe length between the banks is 10% or less. Care should be taken when connecting collector banks in parallel with a drainback system, as a minor difference in flow between banks may lead to inadequate filling of portions of the system.

Balancing valves

While it is best to use piping strategies to balance collector flow in small residential systems, when more precise balancing of collector banks is required, balancing valves can be utilized. A ball valve or specialized balancing valve (see Figure 1-20) may be used for this purpose. If ball valves are used, temperature gauges or flow meters must be installed to determine whether the flow is properly balanced.



Figure 1-20 – Balancing valve (image courtesy of Taco, Inc.)

Multiple pumps

Through the use of advanced controls, multiple pumps can be used to circulate heat transfer fluid through separate collector banks to heat a common storage tank (see Figure 1-21). Flow meters should be installed on each collector loop to verify balanced flow through the arrays.

Evaluating

The Inspector should verify that the collectors are plumbed properly. If unfamiliar with the style of collector used in the system, the Inspector should refer to the collector manufacturer’s documentation.

(viii) Collector sensor(s) securely attached in appropriate location

It is critical that collector sensors are installed appropriately to ensure that system operates as designed. Most installation manuals for OG-300 certified systems will specify the appropriate sensor locations.

The sensors must be placed to measure the hottest temperature in the collectors. If sensor locations are not specified by the collector manufacturer, appropriate sensor locations include:

- **Directly on the absorber plate of a flat plate collector.** This can be achieved by feeding the sensor through a collector vent (see Figure 1-22) or by drilling a hole in the collector frame. Holes drilled in the collector frame must be installed in accordance with the collector manufacturer’s recommendation.
- **Inside a dry well.** Some collectors have a pre-installed dry well that is in direct contact with the header (see Figure 1-23). Dry wells – typically with threaded male fittings – are available from certain collector manufacturers and plumbing supply houses and can be installed in a tee at the hot outlet pipe of the collector. The sensor probe should be coated with heat transfer paste (thermal grease) and inserted into the well. The end of the well should then be sealed with silicone caulk to ensure accurate sensor readings.
- **Between the collector header and the header gasket.** Many collectors utilize a rubber gasket or synthetic heat shield to isolate the copper header from the collector frame or manifold (see Figure 1-24). If the entire sensor probe can be inserted between these surfaces, this is an appropriate location.

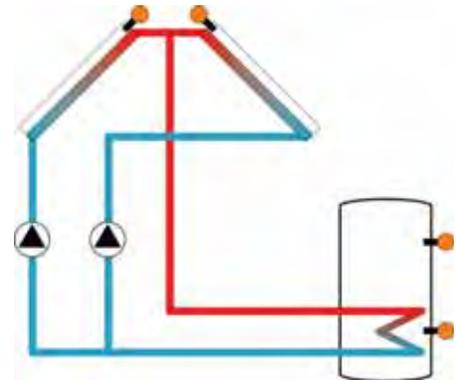


Figure 1-21 – Simple schematic of the use of multiple pumps for balancing flow (image courtesy of Resol)

- **Clamped to outlet piping:** It is common practice to clamp a sensor on the hot outlet piping with a stainless steel hose clamp or with copper wire. This method relies heavily on the integrity of the pipe insulation and gives temperature readings that are significantly lower than the methods listed above in cold weather locations such as New York. If this method is used, the sensor should be clamped as close as possible to the collector outlet and the pipe insulation must be robust and secured properly at the sensor location. There should be no section of uncovered pipe between the sensor and the collector.

In all of the methods listed above, it is critical that the sensor wiring is secured with wire ties to eliminate sensor displacement. The sensor wire should be supported within 12” of the sensor (minimum) and every 24” with wire ties or the pipe covering. Sensor wire that is in contact with the collector piping shall be insulated with material that is rated for 400F.

Important note: In ground-mounted systems, the sensor wire must be installed inside of conduit to protect the wire.

Evaluating
 The Inspector shall verify that:

- the sensor is installed in an appropriate location,
- the sensor is insulated appropriately,
- the sensor wire is proper secured.



Figure 1-22 – Sensor probe installed on absorber plate through collector vent



Figure 1-23 – Sensor installed in collector dry well. The well is partially visible behind the glazing.

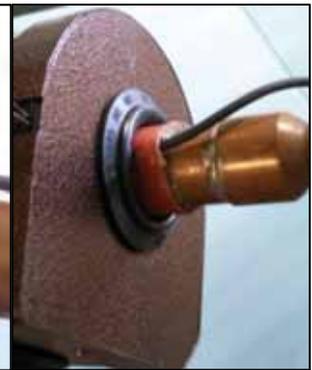


Figure 1-24 – Sensor installed between header and heat shield (sensor wire must be secured to piping and have a high-temperature coating)

(ix) Sensor wire properly protected from UV degradation and excessive heat

Standard wire coatings will degrade over time when exposed to ultraviolet (UV) radiation. All exposed solar sensor wire shall be rated for UV-exposure. Sensor wire that is not UV-rated must be concealed via a UV-rated conduit or by the UV-protected sleeve for the exterior pipe insulation. Sensor wire that is in contact with the collector piping shall be insulated with material that is rated for 400F.

Evaluating
 The Inspector should verify that any exposed sensor wire is UV-rated.

(x) Collectors sloped ¼" per foot (minimum) towards the collector inlet for drainback systems

Drainback systems utilize water or a low-concentration glycol/water solution as a heat transfer fluid. In order to avoid freeze damage, these systems depend upon drainage of the heat transfer fluid when the pump is not in operation. To accomplish this, collectors must be sloped towards the collector inlet.

There is concern about using a low-concentration mixture of glycol in a drainback system that consistently shuts down during full sun due to reaching the tank's high temperature limit. Some systems have shown significant glycol degradation under these conditions.

Important note: The collectors in a drainback system must be able to drain. Most harp-style flat plate collectors are appropriate for drainback systems. Serpentine/meander-style flat plate collectors cannot be used in drainback systems due to their inability to drain properly. For evacuated tube collectors, consult the manufacturer's literature to determine whether the collector is designed to be used with drainback systems. While some evacuated tube collectors can be used in drainback systems, the warranty may be voided if used for this purpose or the warranty may be voided if the collectors are empty for extended periods of time (15 days or more).

Evaluating

The collector slope can be determined with a two-foot level and tape measure.

(xi) Manual or automatic air vent installed at high point of system –or- alternate OG-300 design for air elimination for pressurized glycol systems

An air vent is typically required in pressurized glycol system to allow the release of trapped air at the top of the system and to facilitate system draining for maintenance. There are two industry-accepted methods for doing this:

Manual air vent

A manual air vent, also referred to as a coin vent, can be installed at the top of the system.

Automatic air vent

Another option is an automatic air vent. The air vent must be installed with a shutoff valve that allows the vent to be isolated after the initial commissioning of the system. This is necessary to avoid the entrance of air into the system during low pressure circumstances.

Important note: Because the vent is typically installed near the hottest location in the system – collector temperatures may exceed 400F during stagnation - the vent must be rated for working temperatures of at least 360F and be located several inches from the collector outlet. Typical air vents used in boiler systems are not rated for these temperatures.

Alternately, there are proprietary designs for air elimination that are approved under SRCC OG-300 Certification.

Evaluating

The Inspector shall verify that a manual or automatic high vent is installed for pressurized glycol systems or that the OG-300 Certification for the system does not require a high air vent.

(B) COLLECTOR RACKING

- (i) (a) Collector racking installed per manufacturer's specifications –OR–
(b) Custom rack engineered and installed per design specifications

Manufacturers have proprietary designs for attaching their collectors to a roof, wall, or ground-mount foundation. These designs are typically engineered and are specific to the collector.

Flat plate collectors

Flat plate collectors are typically attached by one of three methods:

- **Clamp system:** with this method, a clamp slides into a groove or flange in the side of the collector frame to clamp the collector to a backing strut (see Figure 1-25).
- **Bracket with set-screw:** some collectors are attached via a groove on the back of the collector frame. This design typically utilizes a set-bolt to clamp a bracket to the collector (see Figure 1-26).
- **Direct attachment to collector frame:** Some manufacturers attach a bracket to the collector frame using stainless steel self-tapping screws (see Figure 1-27).

Evacuated tube collectors

Unlike flat plate collectors, evacuated tubes are not self-supporting, thus they require a metal frame to support the manifold, tubes, and attachment strut that secures the bottoms of the tubes. The manifold and strut are typically attached to the frame via clamps (see Figure 1-28) or bolts.

Tilt racks

Most collector manufacturers offer optional tilt racks that can be used to increase the tilt angle of the collector. These are proprietary and must be installed per the manufacturer's specifications.

Custom racks

Occasionally, an Installer will utilize a custom tilt rack. The rack must be designed to withstand the weight of the collector and heat transfer fluid, seismic loads, snow loads, and – most importantly – wind loads. Custom tilt racks should be engineered.



Figure 1-25 – Clamp style collector attachment



Figure 1-26 – Set-screw style collector attachment



Figure 1-27 – Direct attachment to collector frame

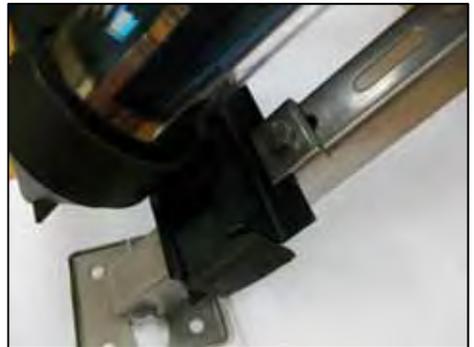


Figure 1-28 – Clamp connecting evacuated tube collector to mounting rack

Evaluating

Plans should be made available to the Inspector for the particular racking system being used. The Inspector should verify that all components are installed as specified by the manufacturer or engineer.

(ii) Attachment between collector(s) and rack fastened properly

The Inspector should verify that the attachment points between the collector and the rack have been tightened properly.

(iii) Dissimilar metals galvanically isolated between collector rack and metal roofing

Most proprietary racks are designed of aluminum or stainless steel with stainless steel fasteners to ensure material compatibility and eliminate the potential for galvanic corrosion. Improper isolation of dissimilar metals can lead to galvanic corrosion, as seen in Figure 1-29. Custom engineered racks must take this into consideration and connections between any rack and a metal roof must use an appropriate gasket. Paint alone is not an adequate means to isolate dissimilar metals due to the deterioration of the finish over time. All methods for ensuring galvanic isolation shall be installed per the roofing manufacturer's specifications.



Figure 1-29 – Galvanic corrosion on a collector array due to direct contact of dissimilar metals between the collectors and racking

Evaluating

The Inspector shall provide details from the roofing manufacturer regarding galvanic isolation of the collector rack and the metal roof. The Inspector should verify that all components are installed as specified by the manufacturer.

(iv) (a) Collector rack connected to structure in accordance with building permit –OR- (b) Collector rack connected to structure in accordance with collector manufacturer specifications -OR- (c) Collector rack connected to structure in accordance with engineered design

The connection between the collector rack and the structure is a critical consideration. The Mechanical Code of New York State stipulates that “the building or structure shall not be weakened by the installation of mechanical systems.” Improper installation of solar collectors can lead to collectors detaching from the roof or failure of the roof structure.

Roof integrity

The Installer must verify that the roof structure is capable of supporting the collector array. For buildings that are constructed to current building codes, a flush-mounted collector will not add significant loads to the roof. The dead load of a filled collector is roughly 2-3psf. Older structures

that are not built to current codes should be evaluated for their structural integrity. A roof that shows significant visual dips in the roof rafters is likely structurally inadequate for installing collectors. Such a roof needs to be reinforced prior to collector installation.

When collectors are mounted on tilt racks, wind loads will increase the required structural strength significantly. Many manufacturers will provide guidelines for determining loads on the tilt rack, which can be used to determine the affect the system will have on the structure. When tilt racks are mounted on a low-sloped roof, wind loading will be amplified and the roof should be evaluated by an engineer to determine whether the wind loads on the array will exceed the structural strength of the roof members.

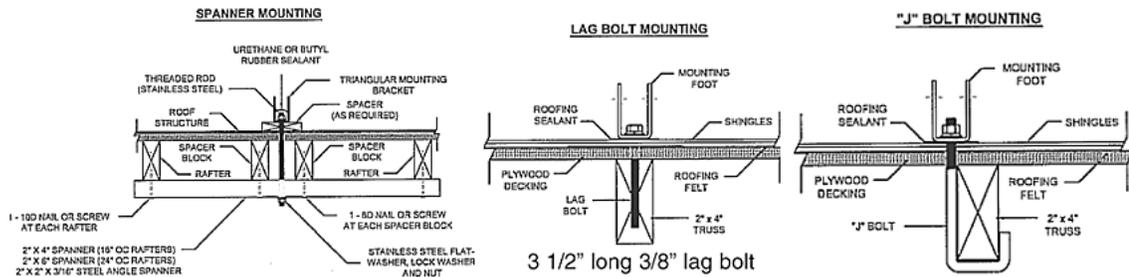


Figure 1-30 – Appropriate attachments to a building’s roof structure (images courtesy of *Solar Hot Water Systems: Lessons Learned 1977 to Today* by Tom Lane).

Connection points

Collector frames must be attached to structural members. Examples include rafters, roof trusses, or wall studs. Sheathing is not an acceptable attachment point. The frame can be attached to the structure by using appropriately sized lag screws, spanners, or J-bolts (see Figure 1-30). On structures with standing-seam metal roofs, collectors can be flush-mounted on proprietary clips that are attached to the metal seams of the roof (see Figure 1-31). Tilt racks should not be attached to these seams. Additionally, proof of attachment of the standing seam metal roofing to the roof structure shall be provided to verify the integrity of the attachment points.



Figure 1-31 – Standing seam clamp attached to collector bracket

Lag screws

Due to the structural integrity of spanners and J-bolts, these two connections are preferred. When installed correctly, lag screws are also acceptable. Concern arises when lag bolts split out the rafter or roof truss (see Figure 1-32). When using lag screws, the Installer must verify that the lag screw is properly embedded. When rafters are exposed in an attic, this can be done by visual inspection. If the underside of the rafter is concealed in a cathedral ceiling, verification must be made while drilling pilot holes and installing the lag screws. Lag screws that spin once torqued indicate improper installation (typically due to missing or blowing out the side of a rafter or roof truss).



Figure 1-32 – Improperly installed lag bolt (image courtesy of Mark Thornbloom)

The depth of the lag screw is critical. Withdrawal – where

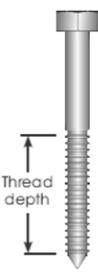
the lag screw is being pulled out of the structural member – is the critical design scenario for common tilt racks. Figure 1-33 shows standard design values per inch of thread depth for a 5/16” lag screw installed in various species of wood.

When installing the feet of a tilt rack, a minimum of two lag screws must be installed per attachment point. Using just one lag screw allows for prying action of the foot (see Figure 1-34).

Evaluating
 Ideally, the Authority Having Jurisdiction will require a building permit and ensure that the design for collector attachment to the structure is compliant. If this is not available, the Installer is responsible for justifying the roof connection through manufacturers’ specifications or an engineered design. Consideration must be made for the roof structure. If the roof system appears marginal for the installation, it should be noted on the **Inspection Checklist**.

Lag pull-out (withdrawal) capacities (lbs) in typical roof truss lumber

	Specific gravity	Lag screw specifications		
		5/16" shaft,* 2 1/2" thread depth	5/16" shaft,* per 1" thread depth	5/8" shaft,* per 1" thread depth
Douglas Fir, Larch	0.50	665	266	304
Douglas Fir, South	0.46	588	235	269
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	0.46	588	235	269
Hem, Fir	0.43	530	212	243
Hem, Fir (North)	0.46	588	235	269
Southern Pine	0.55	768	307	352
Spruce, Pine, Fir	0.42	513	205	235
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	0.50	665	266	304



Sources: Uniform Building Code; American Wood Council.
 Notes: (1) Thread must be embedded in a rafter or other structural roof member.
 (2) Pull-out values incorporate a 1.6 safety factor recommended by the American Wood Council.
 (3) See UBC for required edge distances.
 *Use flat washers with lag screws.

Figure 1-33 – Withdrawal capacities for 5/16” lag screws (image courtesy of EcoFasten Solar)

(v) Attachment points flashed and sealed properly

Any penetration made through the water-tight membrane of the building – typically the roof surface – must be properly sealed. If the roof is warrantied, the installer of the roof should be consulted to ensure that any new attachments will not void the roof warranty. Acceptable methods for sealing structural penetrations may include:

- **Mechanical flashing:** There are numerous products on the market that utilize mechanical means for sealing roof penetrations. These products typically use gaskets and flashing plates and do not require chemical sealants. The Inspector should ensure that these flashings have been installed in accordance with the manufacturer’s specifications.



Figure 1-34 - Example of improper attachment of tilt rack foot. Without a bolt in the front hole, live loads would pry the foot from the roof surface. A neoprene gasket should also be installed between the foot and metal roofing to provide a durable seal for the bolt penetration and to isolate dissimilar metals.

- **Roof boots:** Mounting systems that utilize cylindrical standoffs can utilize standard roof boots to seal around the standoff (see Figure 1-35). Boots should be installed in accordance with the manufacturer’s specifications. This typically requires the use of sealant and a stainless steel hose clamp to seal the rubber boot to the standoff.
- **Gasket sealing:** The use of proprietary or custom neoprene or EPDM gaskets is suitable when used in conjunction with appropriate chemical sealants (see Figure 1-36). The gasket should be cut to fit the bottom of the mounting foot and sealant should be applied to the bottom of the gasket, the threads of the lag bolt, and the head of the lag bolt (once the bolt is installed). The gasket and sealant shall extend sufficiently beyond the mounting foot to allow for inspection.



Figure 1-35 – Roof boot (on right) used to seal cylindrical standoff (copper top hat pipe flashing on left)

Evaluating
The Inspector shall verify that the type of flashing used is appropriate for the application and that it was installed properly.

(vi) Foundation installed per specifications detailed in building permit for ground-mounted systems

When new foundations are installed to support a ground-mounted collector array, a building permit should be obtained. The Inspector should verify that the foundation has been installed in accordance with the construction plans submitted with the permit, including depth of foundation(s), size of foundation(s), and spacing of foundation components. Acceptable means for ground-mounted foundations include, but are not limited to:

- Cast-in-place concrete piers
- Cast-in-place concrete slabs
- Precast concrete piers
- Posts appropriately anchored into bedrock
- Helical piles



Figure 1-36 – Custom EPDM gasket for mounting foot. Sealant should be applied between gasket and roof and gasket and foot before installing the lag screws.

Evaluating
The Inspector shall verify that the ground-mounted foundation is constructed as designed.

(C) EXTERIOR PIPING

(i) Exterior piping supported properly

Copper piping should be used for most exterior piping. Where system specifications allow for other types of piping (stainless steel linesets or, in rare occasions, PEX), the system must adhere to SRCC’s ruling on the acceptable use of PEX in drainback systems (see http://www.solar-rating.org/certification/ogdocuments/PEX_policy_for_drainback_systems.pdf) or written

justification from the piping manufacturer must be presented to the Inspector to ensure the equipment is rated for the appropriate pressure and temperature.

Copper tubing must be supported as follows (per the Mechanical Code of New York State):

Size	Maximum horizontal spacing	Maximum vertical spacing
1¼-inch diameter and smaller	6 feet	10 feet
1½-inch diameter and larger	10 feet	10 feet

Unless it is part of a heat dissipation zone, piping should be supported on the outside of the insulation to avoid thermal bridging between the piping and outside air through the pipe support. This also ensures proper isolation of dissimilar metals.

Exterior piping can be supported as follows:

- **By the collector or collector rack:** Support mechanisms, such as threaded rod or conduit clamps, can be attached to the structure of the collector and/or rack.
- **By the roof:** For long runs along the roof, the piping can be supported by stands that are attached to the roof. All penetrations must be sealed per Section 1(B)(v) of this manual. Piping should not be laid on the roof for support.
- **Immediately under the roof:** Where the distance between the pipe penetration and the collector is less than those stipulated above, the piping can be supported by a roof joist or roof rafter immediately adjacent to the pipe penetration. It is critical that the pipe support is rigid enough to eliminate pipe movement that may displace the pipe flashing while also allowing for thermal expansion.

Ground-mounted systems

Piping between the collector array and heat exchanger in a ground-mounted system should be located underground. The piping between the collectors and the ground shall adhere to these standards. Details about appropriate practices for burying piping are covered in Section 2(A) of this manual.

Evaluating

The Inspector shall verify that the exterior piping is appropriately supported at intervals less than or equal to the minimum support spacing detailed above.

(ii) Exterior piping insulated properly

Types of insulation

Due to the maximum temperatures associated with SWH systems, only particular types of pipe insulation are appropriate. These include fiberglass, mineral wool, and elastomeric rubber. Pipe insulation must be rated for stagnation conditions, which may reach 400F.

Elastomeric (rubber) pipe insulation is the most common type used in residential SWH systems (see Figure 1-35), due to its ability to withstand the temperatures present in the collector loop. Polyethylene pipe insulation, which is typically used to insulate domestic water lines, cannot withstand these temperatures and will melt when used on the collector loop piping. Fiberglass is appropriate for interior applications, but should not be used in exterior applications due to its

ability to saturate with moisture. Mineral wool is less hydroscopic than fiberglass but is not recommended for exterior applications. Only hydrophobic materials, such as elastomeric rubber or foam glass should be used.

Thickness of insulation

The Energy Conservation Construction Code of New York State states that mechanical system piping in residential systems must be insulated to a minimum of R-3 when carrying fluids above 105°F. Due to higher temperature differentials in exterior applications, elastomeric insulation used for exterior applications should be a minimum of ¾" (R-4).

Installation

It is critical that the insulation provides full coverage for external piping – this includes the pipe connections between collectors and header pipes that are capped. Pipe insulation should be sealed at the seams and care should be taken to ensure that all fittings are properly insulated.

Ground-mounted systems

Piping between the collector array and heat exchanger in a ground-mounted system should be located underground. The piping between the collectors and the ground shall adhere to these standards. Details about appropriate practices for insulating buried piping are covered in Section 2(A) of this manual.

Evaluating

The Inspector shall verify that the exterior pipe insulation is high-temperature, hydrophobic pipe insulation with a minimum thickness of ¾".

(iii) Pipe insulation protected from UV degradation

All exterior insulation must be protected from UV degradation. Often, exterior piping is treated as a service item due to the impacts of UV radiation and other exterior conditions. The Installer should exercise due diligence to minimize this need to service the pipe insulation. This can be done in a variety of ways:

- **UV-resistant coating:** Some types of elastomeric insulation have a UV-resistant coating on them. A material that is rated as "UV-resistant" can still degrade under conditions typically seen in solar heating systems. The Installer should determine the length of the warranty for insulation that is exposed to the sun if a coating is the only means of protection used.
- **Sheathing/cladding:** Metal or PVC cladding (see Figure 1-37) can be used to protect exterior insulation.
- **Paint:** Some elastomeric insulation can be painted with latex paint to provide additional UV protection.
- **Wrap:** UV-resistant wraps, such as silicone tape, can be used to protect the pipe insulation.



Figure 1-37 – PVC cladding over exterior insulation

Evaluating

The Inspector shall verify that the exterior pipe insulation has appropriate UV-protection.

(iv) Pipe penetrations flashed and sealed properly

Pipe penetrations present a unique challenge in solar water heating systems. Due to stagnation temperatures in pressurized systems, some pipe flashing systems that are used for standard plumbing vents are not adequate. Typical EPDM roof boots are rated to 180F. Flashing materials should be rated to 400F in pressurized glycol systems if placed in direct contact with the solar piping. Therefore, pipe penetrations should be flashed as follows:

Asphalt shingle roof

The standard detail for asphalt shingled roofs is the “copper top hat” flashing. This flashing is sheet copper with a copper collar soldered on (see Figure 1-38). A cap slides down over the piping and is soldered *to the piping but not the collar*. If the cap is soldered to the collar, it will affect the integrity of the flashing as the piping expands and contracts. The flashing extends under the upper course of shingles. The bottom of the upper course of roofing shingles should be sealed to the flashing with roofing cement. Roofing cement should be used on the bottom of the flashing, as well. The copper top hat flashing is secured in place with roofing nails; these should be driven under the upper course of shingles.

Another option on asphalt-shingled roofs is a silicone vent flashing (aka “roof boot”) that slides under an upper course of shingles. Silicone is rated for 500F intermittent and 437F for continuous and can be used in direct contact with piping in a pressurized glycol system. For drainback systems, EPDM vent flashing is appropriate (rated for 275F intermittent and 212F continuous). Vent flashing should be installed in accordance with the manufacturer’s specifications. This typically requires the use of sealant and a stainless steel hose clamp to seal the boot to the standoff.

Metal roofs

Another type of silicone or EPDM boot is typically used on metal roofs (see Figure 1-39). A malleable flange is attached to the roof with self-tapping stainless steel screws and a bead of silicone caulk is applied between the flange and roofing. Silicone should be used for direct contact with piping in pressurized glycol systems.



Figure 1-38 – Copper top hat flashing with gooseneck for sensor wire. In this example, the flashing sheet was installed entirely under a course of shingles. If the flashing falls on a seam or has inadequate coverage by the upper course, this is necessary.



Figure 1-39 – Silicone pipe flashing on metal roof. Note that the sealant between the flashing and the roof should extend beyond the flange for inspection purposes. Also, care should be taken to avoid squeezing the silicone through the hose clamp, as it is here.

Evaluating

The Inspector shall verify that all piping penetrations are flashed, that the flashing system used is appropriate for the application, and that the flashing is installed properly.

(v) Piping sloped ¼" per foot, minimum, for drainback systems

Drainback systems utilize water or a low-concentration glycol/water solution as a heat transfer fluid. In order to avoid freeze damage, these systems depend upon drainage of the heat transfer fluid when the pump is not in operation. To accomplish this, all piping must be sloped towards the pump.

Evaluating

The slope of piping can be determined with a two-foot level and tape measure.

(vi) Dissimilar metals isolated properly, if required

Black iron or galvanized fittings should not be used in exterior applications. Brass, copper, and stainless steel can be joined together by mechanical and/or soldered joints.

Evaluating

The Inspector shall look for any joints in the piping to ensure proper material compatibility.

(vii) Polymer materials are not used in the collector loop unless approved by the SRCC in a specific OG-300 certified system

There have been numerous attempts to incorporate polymer materials, such as cross-linked polyethylene (PEX), within pressurized solar heating systems to reduce labor and material costs. Unless designed appropriately, these systems will fail due to the temperatures and pressures experienced during stagnation. The SRCC allows the use of polymers only in very specific applications.

Evaluating

If any polymer materials are used in the collector loop, the Inspector must verify that the system is OG-300 Certified and that the materials were installed in accordance with the OG-300 Installation Manual.

SECTION 2: SOLAR LOOP

The solar loop between the collector array and heat exchanger includes the critical components that ensure the proper operation of SWH systems. This section of the system includes piping, valves, gauges, pumps, insulation, and heat transfer fluid.

The ease of inspection of the solar loop will vary by installation. In new construction, some of the components will have been buried in insulation, chases, or the walls of the structure. It is important that the Inspector inquires about these sections and inspects the portions of the loop that are accessible. Care should be taken when accessing attics during the inspection – this includes eye and respiratory protection, as well as maintaining proper footing. If the Inspector accesses the attic, s/he can also verify that the lag bolts did not split out the side of a rafter or truss chord.

Section 2 is organized as follows:

- **Piping considerations:** Piping must be insulated, supported properly, and allow for system draining.
- **Heat transfer fluid:** Because there is risk of contamination between the heat transfer fluid and potable water supply, and because the heat transfer fluid may be subjected to extreme conditions, proper attention must be paid to its selection.
- **Pressure considerations:** While SWH systems typically operate under pressures common to other hydronic systems, during stagnation events they may see pressures above 100psi. This section discusses appropriate techniques for mitigating issues resulting from these pressure spikes.
- **Other considerations:** This category covers other items relating to the solar loop that are necessary for proper system operation.

(A) PIPING CONSIDERATIONS

(i) Piping supported by appropriately-spaced hangers

Copper tubing must be supported as follows (per the Mechanical Code of New York State):

Size	Maximum horizontal spacing	Maximum vertical spacing
1¼-inch diameter and smaller	6 feet	10 feet
1½-inch diameter and larger	10 feet	10 feet

Other piping materials must be installed in accordance with the Mechanical Code of New York 305.4 or the manufacturer's specifications.

Evaluating

The Inspector shall verify that all piping supports are spaced at proper intervals.

(ii) (a) Hanger material compatible with piping material –OR- (b) Hangers isolated properly from piping

To avoid the effects of galvanic corrosion between dissimilar materials, appropriate hangers must be used with system piping. Hangers that directly support copper must be made of copper or be plated with a material that isolates the copper from the hanger material. Examples of appropriate hangers include:



Figure 2-1 – Split ring, threaded rod, and plate



Figure 2-2 – Bell hanger

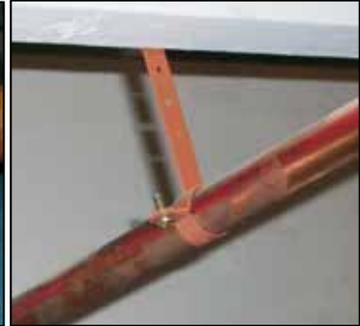


Figure 2-3 – Milford hanger

- **Split ring connectors:** these connectors are made of plated steel and clamp the piping (see Figure 2-1). Threaded rod is used to connect the split ring to a plate that is attached to the structure. Nuts should be used on the threaded rod to properly secure the support.
- **Bell hangers:** these hangers are typically plated metal that clamp around the pipe and connect directly to the structure (see Figure 2-2). The “bell” portion of the hanger holds the pipe approximately 1” from the surface of the structure.
- **Milford hangers:** this style of hanger is used to hang piping below a structural support, such as a floor joist. The device consists of a clamp and strapping (see Figure 2-3). These hangers are typically made of plated steel.

Piping can also be supported on the outside of the insulation. When done this way, either with clevis hangers (see Figure 2-4), conduit straps, or plumber’s strap, consideration must be made to keep the support from compressing the insulation. This can be done using a bearing strip, either custom-made or similar to the one seen in Figure 2-4.

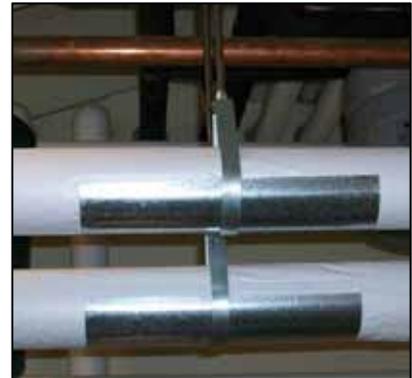


Figure 2-4 – Clevis hanger with bearing strip to protect pipe insulation

Evaluating

The Inspector shall verify that all piping supports are galvanically isolated from the piping.

(iii) Piping insulated properly

Types of insulation

Pipe insulation must be rated for high solar loop temperatures. Appropriate pipe insulation materials include: elastomeric rubber, fiberglass, and mineral wool.

Thickness of insulation

The Energy Conservation Construction Code of New York State states that mechanical system piping in residential systems must be insulated to a minimum of R-3 when carrying fluids above 105°F. The minimum thicknesses for various types of pipe insulation are listed below:

- Elastomeric: ½"
- Mineral wool: 1"
- Fiberglass: 1"

Installation

Pipe insulation must be installed on the entire solar loop to ensure efficient delivery of solar heat from the collectors to the heat exchanger(s). When split-style insulation is used, the seam must be sealed. Care should be taken to fully insulate fittings.

Ground-mounted systems

Elastomeric insulation should be used for underground pipe runs. Underground solar piping is typically insulated utilizing one of the following methods:

- The use of proprietary, pre-insulated linesets that are rated for the temperatures and pressures of a pressurized glycol system;
- Soft copper with elastomeric pipe insulation encased in a sealed PVC conduit;
- Soft copper with elastomeric pipe insulation sprayfoamed in a trench. The elastomeric insulation is used to isolate the copper from the sprayfoam, which can melt when exposed to stagnation temperatures.

Evaluating

The Inspector shall verify that the interior pipe insulation on the collector loop is either high-temperature elastomeric with a minimum thickness of ½", or fiberglass or mineral wool pipe insulation with a minimum thickness of 1".

(iv) Dissimilar materials isolated properly, if required

Galvanized steel should not be used for solar piping in pressurized glycol systems as it will react with the inhibitors in glycol to create a sludge. Black steel should not be used in systems with entrained air, such as drainback systems. Where cast iron components are necessary, a dielectric fitting or brass fitting must be used to transition to copper or stainless steel.

Evaluating

The Inspector shall look for any joints in the piping to ensure proper material compatibility. Particular points of interest include transitions between piping materials, most notably at the storage tank and pump station.

(v) Penetrations through structural members consistent with code

When piping must be run through structural members, such as floor joists or rafters, care must be taken to retain the integrity of the member. Figure 2-5 illustrates the restrictions on notching and boring through wooden joists.

When drilling through wood studs in bearing walls, the hole cannot exceed 40% of the depth of the stud. In non-loadbearing walls, a hole cannot exceed 60% of the depth of the stud. The hole must be at least 5/8" from the edge of the stud.

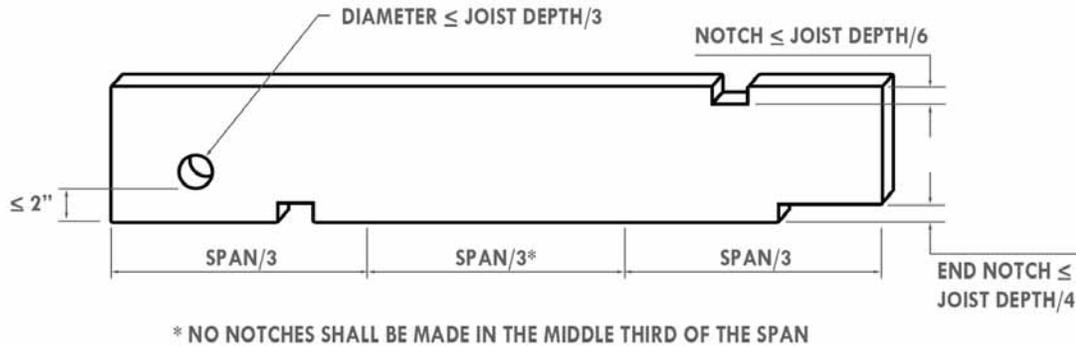


Figure 2-5 – Code requirements when notching or boring through joists

The Installer and Inspector must consult the manufacturer’s recommendations when holes are required in trusses or engineered wood products.

Evaluating

The Inspector shall verify the proper location of penetrations in all exposed structural members.

(vi) Piping backfilled properly for ground-mounted systems

Because the solar piping in a ground-mounted system is already frost protected in a pressurized glycol system, burial below frost depth is not required – it is recommended where possible, though. Displacement of the piping due to frost action is a concern and should be considered since the structure and the ground-mount are designed to be rigid.

The Mechanical Code of New York State requires piping to be covered with a minimum of 12" of backfill. Other requirements for buried pipe include:

- Pipe must be supported for its entire length
- Backfill beneath pipe shall be compacted in 6" layers
- Backfill shall be loose earth free from rocks, broken concrete, construction debris, or frozen chunks
- Backfill must be placed in 6" layers and tamped in place
- At least 3" of backfill must be placed on top of removed rock to provide a proper bed for the buried piping

Evaluating

The Installer shall keep any trenches open until the Inspector has verified the piping and insulation. Backfill material should be present during the inspection.

(vii) Piping installed to allow system draining

Solar piping must be installed to permit draining of the system for servicing. In sections of pressurized glycol systems where a trap is formed because the piping cannot be sloped

appropriately, a drain shall be installed. Buried pipe is exempt from this requirement. Drainback systems must be sloped to allow for system draining during normal operation.

Evaluating
The Inspector should verify the presence of a drain in any sections of the system that cannot drain by gravity or with the use of pressurized air.

(B) HEAT TRANSFER FLUID

- (i) (a) System utilizes water as heat transfer fluid –OR- (b) System utilizes propylene glycol solution as its heat transfer fluid**

While the New York State Codes technically allow for the use of toxic heat transfer fluid when using a double-wall heat exchanger, there is no practical reason to include ethylene glycol or any other toxic fluid in a residential system. Leaks are common in the lifetime of a SWH systems; the use of toxic fluids puts people and pets at serious risk.

Drainback systems use either water or a propylene glycol and water solution as a heat transfer fluid.

Evaluating
The Inspector shall verify the heat transfer fluid used in the system.

- (ii) Heat transfer fluid is rated for solar applications**

The fluid in a SWH system can be subjected to high temperatures, especially in pressurized systems that can stagnate. Propylene glycol is a nontoxic antifreeze that includes inhibitors to protect the fluid’s stability when subjected to high temperatures. It is possible for the inhibitors to degrade under prolonged exposure to high temperatures, which leads to acidification of the glycol. If this occurs, the glycol will destroy components in the solar loop. As a result, glycol should be rated to 325F.

Water is stable as a heat transfer fluid for the temperatures experienced in a SWH system.

Evaluating
The Inspector shall verify the type of heat transfer fluid used in the system.

- (iii) Propylene glycol concentration is appropriate for application**

Figure 2-6 shows the temperature ratings for various concentrations of one brand of propylene glycol rated for solar applications. The freeze point represents the temperature at which ice crystals begin to form. The flow point is the temperature at which the solution will still flow. The burst point is the temperature at which the fluid becomes solid and threatens to burst

NOBURST HD	Freeze Point	Flow Point	Burst Point
100%	-60°F	-70°F	-100°F
75%	-60°F	-60°F	-100°F
50%	-30°F	-40°F	-75°F
40%	-7°F	-15°F	-60°F
35%	0°F	-10°F	-60°F

Figure 2-6 - Temperature ratings for NoBurst HD propylene glycol (image courtesy of the Noble Company)

the piping and components of the solar loop.

For pressurized glycol systems, the glycol concentration should reflect the minimum ambient temperatures for the site. For New York, this translates to a glycol concentration of 40-50%.

Glycol can be used as a heat transfer fluid in drainback systems, as well. The glycol adds a secondary freeze protection, thus a lower concentration of glycol (25-30%) can be used. Glycol is only required in drainback systems where a component failure could lead to catastrophic system failure, such as a system that utilizes pumps in series. The use of glycol in drainback systems may lead to the accumulation of residue in collector piping and the breakdown of glycol inhibitors if the system constantly shuts down due to reaching the storage tank high limit.



Figure 2-7 - Refractometer for measuring concentration of propylene glycol solution (image courtesy of ExTech)

The glycol concentration can be verified by use of a glycol refractometer (see Figure 2-7).

Evaluating

The Inspector shall verify the concentration of the heat transfer fluid in the system documentation.

(C) PRESSURE CONSIDERATIONS

- (i) Pressure relief valve and relief drain installed properly**
- (ii) Pressure relief valve cannot be isolated from collector array**

All systems in New York must have a pressure relief valve to protect system components from pressure due to the expansion of fluids. The rating of pressure relief valves ranges from 30-150psi, depending upon the type of system and design. In pressurized glycol systems, there is an inverse correlation between the rating of the pressure relief valve and the size of expansion tank required – systems with lower rated pressure relief valves require larger expansion tanks.

Some manufacturers require 150psi rated valves in order to prevent steam formation in the collectors during system stagnation. Stagnation occurs in pressurized glycol systems when there is solar insolation on the collectors and the heat transfer fluid is not circulating, either due to a component failure or in order to protect the solar storage tank from excessive temperatures.

The pressure relief valve shall be installed in a location where the valve cannot be isolated from the collectors. The relief drain shall be piped to within 6 inches of the floor, cannot contain any traps, reducers, or valves, and should be directed to an area that is visible and will not cause damage to the structure or its inhabitants. A container is also an acceptable means for collecting discharged fluid.

Evaluating

The Inspector shall verify that there are no means by which to isolate the collectors from the pressure relief valve and that the discharge piping is installed properly.

(iii) All system components rated higher than pressure relief rating

During times of stagnation, the collector array may reach temperatures exceeding 400F. This increases the system pressure and can cause catastrophic failure if the components are not protected adequately by the pressure relief valve.

Collectors, expansion tanks, heat exchangers, flow meters, piping, and all other components must be rated to a pressure exceeding the pressure rating of the relief valve. Component ratings are listed on the component itself or in the manufacturer's documentation. Relief valves exceeding 100psi should only be used in systems that are OG-300 certified.

In drainback systems, the drainback tank is typically the lowest rated component for pressure. The relief valve must be rated at a pressure less than or equal to the maximum design pressure of the drainback tank.

Evaluating

The Inspector shall verify the rating of the pressure relief valve and compare to the pressure ratings of system components.

(iv) Expansion tank sized and installed properly for pressurized glycol systems

Hydronic expansion tanks are used to buffer the pressure variations that exist in pressurized glycol systems. Expansion tanks must be installed in accordance with manufacturer's specifications. These usually specify the orientation of the tank.

The expansion tank should be pre-charged to a pressure 2-3psi less than the initial fill pressure of the solar loop. If the bladder is pre-charged too low, it will limit the acceptance volume of the expansion tank. If it is pre-charged too high, the expansion tank is unable to appropriately buffer the solar loop during times of fluid contraction.

The Mechanical Code of New York State requires sizing expansion tanks for pressurized glycol systems using the same technique as is used for boilers. The formula for sizing is given in Section 1009.2 of the code. This method is only adequate if the system never stagnates. It is impossible to ensure the system does not stagnate. If the expansion tank is sized in accordance with this code and stagnation occurs, the relief valve will release glycol and a service call may be required.

Correct sizing of the expansion tank will alleviate the need for a service call under these conditions. In addition to buffering the expansion caused by the thermal expansion of the heat transfer fluid, a solar expansion tank must also account for steam formation in the collectors. An appropriately-sized expansion tank can absorb the normal expansion of the system fluid and accommodate the fluid in the array during a stagnation event.

Some OG-300 certified systems may use a steam prevention method that involves using a much smaller expansion tank that significantly increases pressures during stagnation, which in turn increases the boiling point of the heat transfer fluid. This is an engineered process and must be approved by the manufacturer.

Evaluating

It is impractical for the Inspector to determine the precise expansion tank sizing for each system. The following guidelines should be used for inspection purposes:

- For OG-300 systems, expansion tank sizing guidelines from the manufacturer should be used (where available).
- For systems without expansion tank sizing guidelines, Figure 2-8 can be used to determine the minimum expansion tank size for the system. The expansion tank size should be within 10% of the value given in the graph.

Important note: The values contained in Figure 2-8 are based on system assumptions and should not be used for design purposes.

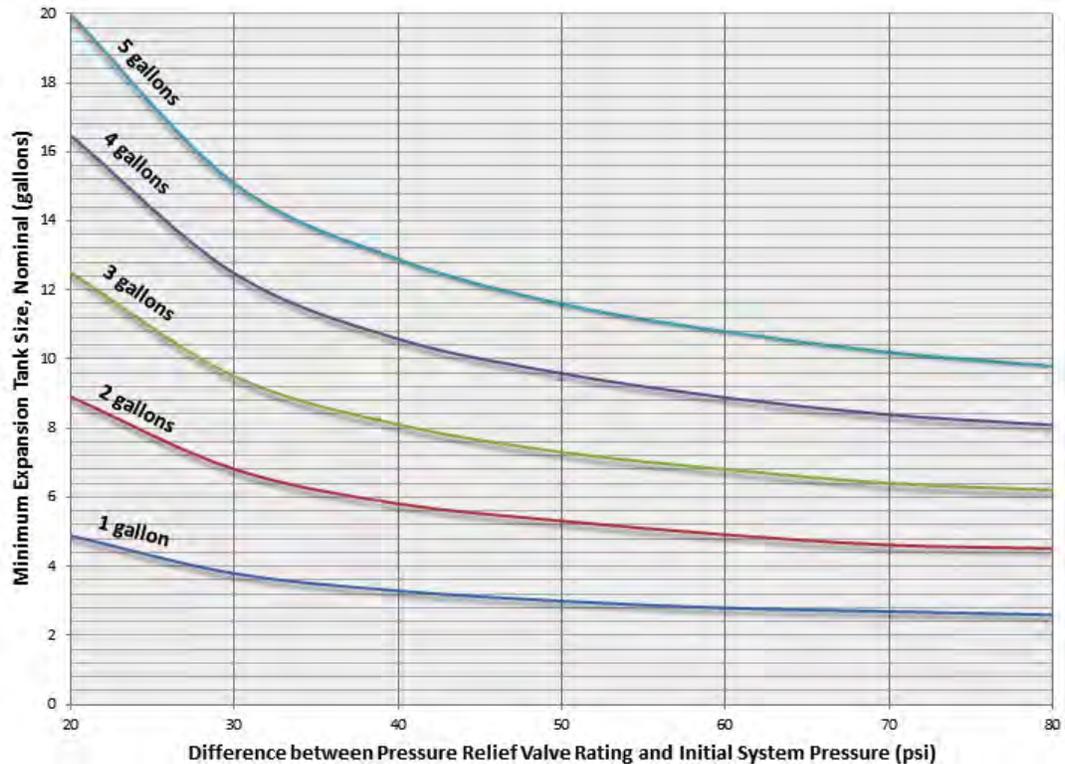


Figure 2-8 – Approximate expansion tank sizes for Inspection purposes. The curves in the figure represent the fluid capacity of the collector(s). Based on this model, a system with a two-gallon collector capacity that is initially charged to 30psi and utilizes a 90psi pressure relief valve would require a 4.9-gallon expansion tank.

(v) System test to 100psi for at least 15 minutes for pressurized glycol systems

For pressurized systems, the Mechanical Code of New York State requires that SWH piping shall be tested “at one and a half times the maximum system design pressure, but not less than 100psi” for at least 15 minutes.

Pressure testing SWH systems provides some challenges in comparison to other hydronic systems due to the presence of solar collectors. Dramatic changes in weather during the pressure test can influence system pressures.

The Installer must isolate any components that are not rated to the test pressure to avoid damage.

Evaluating

The Inspector must ask the Installer the pressure to which the hydronic piping was tested during the Inspection.

(vi) System pressure is within standard limits

The minimum pressure for pressurized glycol system should be 20psi at the pump station pressure gauge. For systems where the collector array elevation is more than 33 feet above the pump station, the minimum initial system pressure should be:

$$P_{\min} = 0.45h + 5$$

where: P_{\min} = minimum system pressure (psi)

h = the height of the collector array above the pressure gauge (in feet)

The initial system pressure should reflect the initial design pressure for the system used for sizing the solar expansion tank.

Though drainback systems are often installed at atmospheric pressure, they may be pressurized to improve performance. In drainback systems with high flow rates or significant gravity head, pressurization alleviates pump cavitation. Cavitation occurs when negative pressure before the pump cause fluid to boil at lower temperatures. This leads to the formation of bubbles that can damage the pump impeller and cause poor performance of the system.

Evaluating

The system pressure during the Inspection may be different from the initial pressure depending upon the outdoor ambient air temperature, available solar insolation, and whether the system is in operation. The Inspector should verify the initial system pressure with the Installer and observe conditions at the site to determine whether the system is pressurized properly.

In pressurized glycol systems, the system pressure may be higher than the initial pressure if the circulator is running or there is significant sun on the collectors. If it is winter and there is minimal solar energy available, the pressure should be below the initial system pressure. If the pressure is at or near zero, the system will need to be repressurized.

(D) OTHER CONSIDERATIONS**(i) Penetrations between conditioned and unconditioned space airsealed**

Whenever the piping in a SWH system passes through the building's envelope – the surface that separates the indoor air that is heated from areas that are unheated (the outdoors, cold attics, crawlspaces, etc.) – the penetration must be sealed to prevent the movement of air through the building envelope.

Caulk and sprayfoam are the standard materials used for this purpose. Insulation itself is not an adequate air barrier. Air moves through certain types of insulation, thus stuffing fiberglass into the gap will not work. The seal should be installed between the piping and the envelope to ensure conditioned air cannot escape around pipe penetrations.

Evaluating

The Inspector shall identify all penetrations in the building envelope and verify proper airsealing.

(ii) **Check valve properly installed to prevent passive cooling for pressurized glycol systems**

Without a check valve, a pressurized glycol system will surrender its heat in the evening by allowing cooler fluid in the collectors to sink down the piping on the feed side and return warmer fluid in the heat exchanger to flow to the collectors through the return line.

A swing check valve (see Figure 2-9) must be installed horizontally to function properly. A spring check valve (see Figure 2-10) can be installed in any direction.

Many pre-manufactured pump stations utilize ball valves with integrated check valves that have three settings: “fully open”, “open with check valve”, and “closed” (see Figure 2-11). The Inspector should assure that these valves have been set in their proper configuration.



Figure 2-9 - Swing check valve with indication for direction of flow



Figure 2-10 - Spring check valve with indication for direction of flow

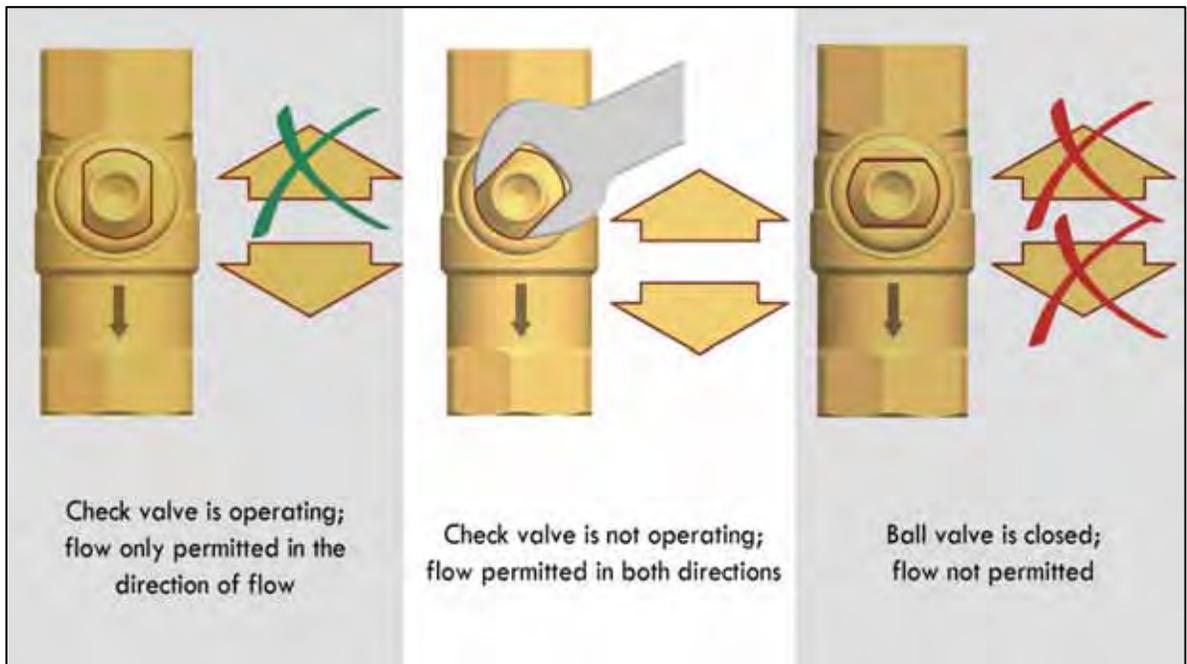


Figure 2-11 - Diagram illustrating the three settings of a specialized ball valve with an integrated check valve (image courtesy of PAW)

Evaluating

The Inspector shall verify that a check valve has been installed properly in pressurized glycol systems.

(iii) Expansion tank located between check valve and collector array for pressurized glycol system

During stagnation, steam should be able to evacuate out the inlet and outlet to the collector array. The steam is only able to push out the inlet piping if the expansion tank is located between the collector array and the check valve (see Figure 2-12).

Evaluating

The Inspector shall verify that the check valve has been located properly in pressurized glycol systems.

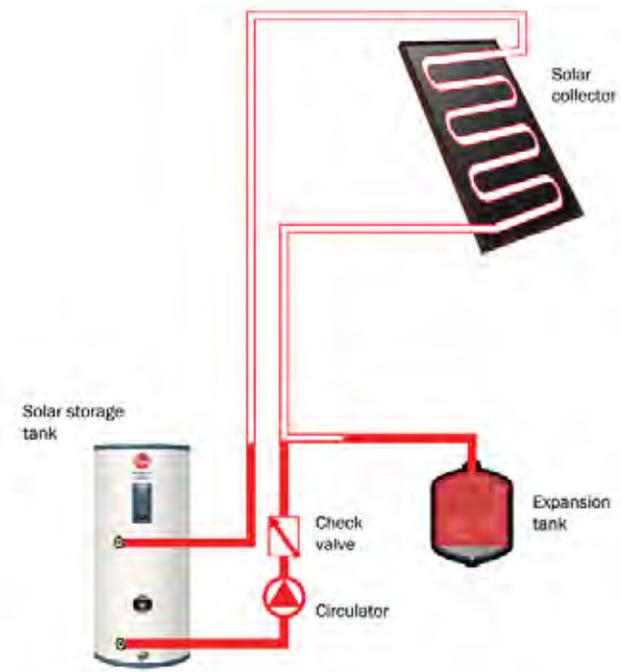


Figure 2-12 - Diagram illustrating the behavior of the heat transfer fluid in a pressurized glycol system during stagnation. The lower portion of the system remains filled with liquid while steam forms in the collector and adjacent piping. With the expansion tank positioned between the check valve and the collector array, the steam is able to push the fluid into the expansion tank from the collector inlet and outlet. If the check valve were installed above the tee to the expansion tank, steam would only be able to leave the collector through its outlet. This would lead to excessive steam development in the system and potential damage to system components (image courtesy of Kennebec Valley Community College).

(iv) System drains correctly for drainback systems

During the Inspection of a drainback system, the pump must be turned on until the system is filled and then turned off to verify the draining of the system. A site glass, or other appropriate method, should be installed to monitor the level of fluid in the system. It may take several minutes for the system to fill and several minutes for it to fully drain. The initial level of the system should be marked on or near the site glass for reference.

Evaluating

The Inspector shall verify that the system drains properly. The test should not be performed during freezing conditions unless the system is already running. The Inspector should then have the Installer turn off the pump manually to verify that the system drains properly.

(v) Piping labels show type of fluid and direction of flow

The solar loop piping must have a moisture-tolerant label that indicates the direction of flow and the type of piping. Labels may be purchased or custom made by laminating paper or card stock and attaching the label to the pipe insulation. Labels must be at least 8" long and lettering must be at least ½" in height.

Evaluating

The Inspector shall verify the proper installation of labels.

(vi) Drain and fill valves labeled

Drain and fill valves must be labeled with a warning that identifies the fluid in the solar loop and includes a warning that the fluid may be discharged at high temperature and pressure. Drain caps should also be installed at all drain and fill valves.

Evaluating

The Inspector shall verify the proper installation of labels.

SECTION 3: SOLAR STORAGE AND POTABLE PIPING

The solar storage tank typically represents the interconnection between the mechanical portion of the system (collectors and solar loop) and the potable portion of the system. For indirect systems, which are the most appropriate for New York, the interface between the systems is the heat exchanger. The plumbing on the solar side of the heat exchanger is governed primarily by the Mechanical Code of New York State (or the mechanical code for the local jurisdiction), while the potable side of the heat exchanger falls under the Plumbing Code of New York State (or the plumbing code for the local jurisdiction).

Section 3 deals with the potable side of the heat exchanger and contains the following sections:

- **Storage tank:** Due to the effects of pressure, temperature, and potability, the codes are very specific about the proper installation of water heaters. This category summarizes those codes requirements.
- **Potable piping:** This category summarizes the valves, temperature settings, and other requirements for connecting to the domestic water supply.

Figure 3-1 illustrates some of the key requirements of this section for a standard one-tank system.

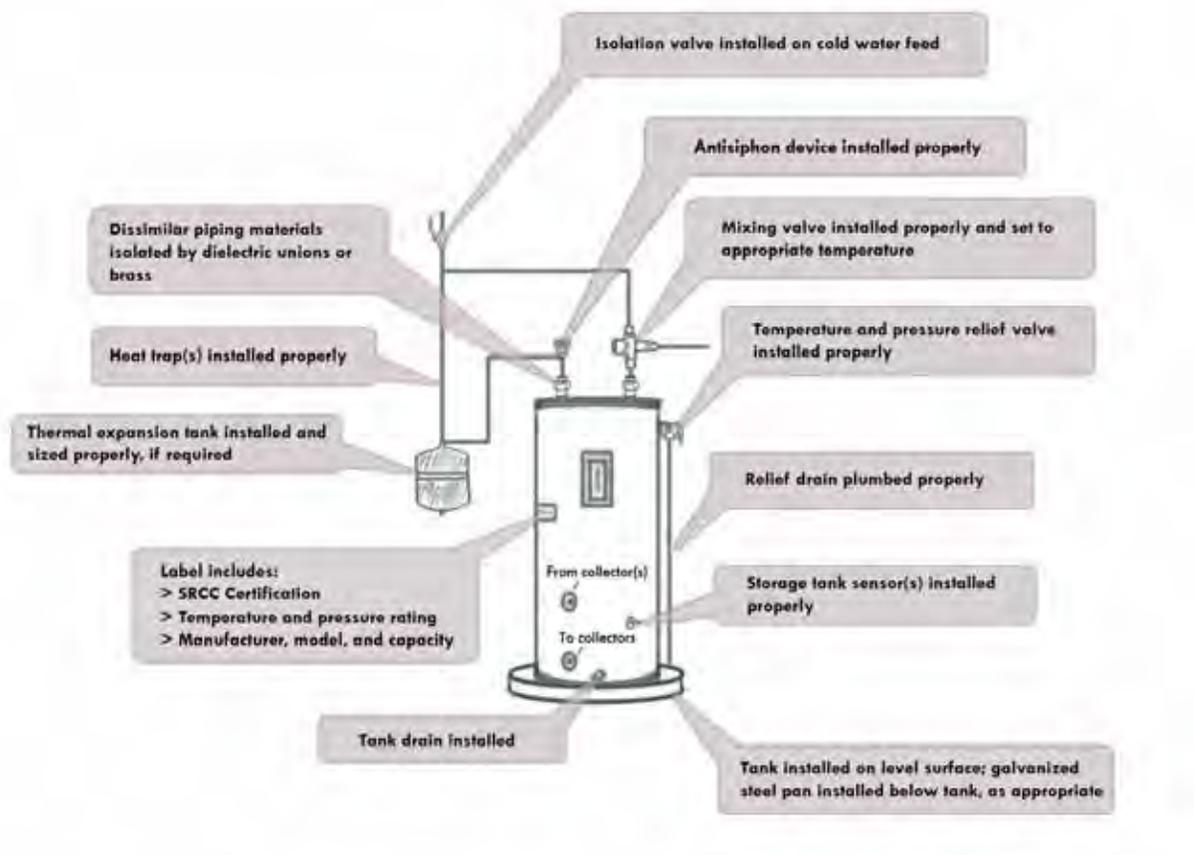


Figure 3-1 – Standard requirements for a pressurized solar storage tank in a one-tank system. Two-tank systems have similar requirements but will vary in plumbing configuration from the illustration above.

(A) STORAGE TANK

(i) Tank manufacturer, model, and capacity matches program application

Each storage tank will have a label that details the manufacturer, model, and storage capacity of the tank (see Figure 3-2). This information should be consistent with the information provided on the Application.

Evaluating

The Inspector shall verify that the tank matches the program application.

(ii) Tank labeled with pressure rating for pressurized storage tanks

By code, tanks must have a label that lists their pressure ratings (see Figure 3-3). Where this information is located will depend upon the manufacturer. The pressure rating of the tank must exceed the pressure rating of the temperature and pressure relief valve.



Figure 3-2 – Manufacturer's label with information regarding the model and storage capacity



Figure 3-3 – Example of tank label with pressure rating

Evaluating

The Inspector shall verify the pressure rating of the tank.

(iii) Temperature and pressure relief valve installed properly for pressurized storage

(iv) Relief drain plumbed properly for pressurized storage

Pressurized storage tanks must be equipped with a relief valve to protect the tank from excessive temperature and pressure. The relief valve must be installed within the top 6 inches of the tank vessel and cannot have any valves located between it and the tank. The temperature probe of the valve should be located *in the tank*.

The discharge piping for the relief valve must be plumbed to within 6 inches of the floor, cannot contain any traps, reducers, or valves, and must drain to an area that is visible and will not cause damage to the structure or its inhabitants.

Evaluating

The Inspector shall verify that there are no means by which to isolate the tank from the temperature and pressure relief valve and that the discharge piping is installed properly.

(v) Tank drain installed for pressurized storage

It is critical that the tank is able to be drained conveniently for routine maintenance and service. In order to facilitate this, a low point drain must be installed.

Evaluating

The Inspector shall verify installation of a drain.

(vi) Tank vented to atmosphere for atmospheric tank

(vii) Tank water adjusted to proper pH level for atmospheric tank

Unpressurized tanks typically utilize synthetic vessel liners and copper heat exchangers (see Figure 3-4). The fluid contained in an unpressurized tank is stationary – it is used solely as a medium for storing transferring heat from the solar collectors to the various demands in the facility. Heat may be transferred to the tank fluid directly (in the case of atmospheric drainback systems) or indirectly (through a heat exchanger). The water in the tank is not connected to the potable water source for the facility and must maintain certain characteristics to ensure proper performance of the system. These requirements include venting the tank to the atmosphere to ensure that it does not pressurize and to ensure the pH of the stored water does not cause deterioration of the heat exchanger(s). The Installer and Inspector should refer to the manufacturer’s documentation for specifications regarding the pH level.



Figure 3-4 – Interior view of unpressurized tank (image courtesy of Liquid Solar Systems).

Evaluating

The Inspector shall verify that a vent has been installed, and that the pH of the water is within acceptable limits. The Installer shall provide manufacturer’s specification on required pH levels and a pH testing kit for the Inspector’s use.

(viii) Galvanized steel pan installed below tank, as appropriate

When solar storage tanks are installed in areas where leakage would cause damage (such as when installed on wood-framed floors), a galvanized pan must be installed beneath the water heater. The pan drain must be piped to an appropriate location with ¾” piping, minimum.

Evaluating

The Inspector shall verify the installation of a pan and drain, where appropriate.

- (ix) **Tank installed on level surface**
- (x) **Tank supported for seismic loads, if applicable**

It is critical that the storage tank is sited in a stable location. An 80-gallon stone-lined tank weighs approximately 1000 pounds when filled! It is critical that the surface is capable of supporting the weight of the filled tank, that the tank is installed on a level surface to ensure stability of the tank, and that the tank is braced properly in jurisdictions that require support for seismic loads.

For most residential applications in New York, seismic considerations for tanks are negligible. Where required, possible seismic support includes: properly strapping the tank to a wall that is capable of supporting such loads –or- anchoring the feet or sidewalls of the water heaters into the support structure. Seismic requirements will depend upon the application and jurisdiction.

Evaluating

The Inspector shall verify the suitability of the tank foundation and whether seismic support is adequate, where required.

- (xi) **Tank meets requirements for installation in attic or garage, if applicable**

In rare instances, storage tanks may be installed in an attic or garage. When installed in an attic, the tank must be able to fit through the access to the attic to accommodate future replacement, a drain pan must be installed, and a passageway must be provided to service the appliance. Water heaters installed in a garage must be elevated 6 feet above the floor or must be protected from being hit by a vehicle by a permanent wall or properly-rated guardrail.

Evaluating

The Inspector shall verify clearances, access, and protection for tanks located in an attic or garage.

- (xii) **Storage tank sensor(s) installed properly**

It is critical for proper operation of the differential controller, for system efficiency, and to protect the tank against overheating that the tank sensor(s) are located and installed properly.

Lower tank sensor

The lower tank sensor is a requirement for systems with differential controls. This sensor measures the temperature of the potable water near the heat exchanger in order for the controller to determine then temperature differential between the tank and the collector. If the sensor is placed inappropriately, the controller will be unable to accurately respond to the conditions of the system, which may lead to the pump or circulator running longer than optimal, shorter than optimal, or cycling on and off. All of these situations affect the efficiency of the system.

Upper tank sensor

Depending upon the system, the upper tank sensor may be optional or required. Where it is optional, an installed sensor acts a reference sensor for monitoring the potable water temperature at the top of the tank. In systems that utilize a second relay for dumping or recirculating heat, the upper tank sensor may be used for determining the temperature at which the second relay should be activated. When this configuration is used, a fourth sensor (including the collector sensor) may be required on a secondary tank.

Appropriate sensor locations include:

- **Sealed in an immersion well.** Many solar storage tanks are equipped with a pre-installed immersion well that allows the sensor to be positioned within a channel in the tank. When installed correctly, this is the most effective method for determining the tank temperature. Correct installation includes:
 - Coating the sensor probe with heat transfer paste
 - Feeding the entire probe into the immersion well
 - Sealing the immersion well with silicone caulk
 - Securing the sensor wire to protect against displacement

For tanks without a pre-installed immersion well, immersion wells can be purchased and installed in appropriate ports in the tank or tees in piping that allows for the well to be situated in the tank.

- **Against the vessel.** Where immersion wells are unavailable, the sensor probe can be installed between the tank vessel and the insulation or a bolt-on style sensor can be used. This location is less responsive and less accurate than an immersion well, but is appropriate when insulated properly.
- **Clamped to outlet piping:** When measuring the temperature of the top of the storage tank, it is common practice to clamp a sensor on the hot outlet piping with a stainless steel hose clamp. This method requires pipe insulation for reasonably accurate temperature readings.

The sensor wire should be supported within 12 inches of the sensor (minimum) and the controller and intermediately every 36 inches.

Important note: There are several different types of sensors (e.g. 5k, 10k, Pt1000) commonly used in SWH installations. It is critical that the sensors used in the system are supported by the specific controller being used.



Figure 3-5 – Properly installed sensor in immersion well. Care must be taken to ensure bend in sensor wire is at an appropriate radius.



Figure 3-6 – Sensor placed between insulation and vessel wall. This area should be insulated before replacing plastic cap to limit heat loss and increase accuracy of sensor location.



Figure 3-7 – Bolt-on style sensor (image courtesy of Resol)

Evaluating

The Inspector shall verify that:

- the sensor is installed in an appropriate location,
- the sensor is insulated appropriately,
- the sensor wire is proper secured.

(B) POTABLE PIPING

- (i) Mixing valve installed properly**
- (ii) Mixing valve set to appropriate temperature**

The water temperatures produced by SWH systems can reach 180F or higher. In order to protect residents, a thermostatic mixing valve must be installed to temper the water below 140F. The recommended set temperature for the mixing valve is 110F based on the Energy Conservation Construction Code of New York.

The mixing valve must be rated for potable use and should be an anti-scald type valve to protect the building occupants. The mixing valve should be installed to eliminate heat migration and to ensure that hot water does not enter the cold lines. This is typically accomplished with check valves that are installed on the cold and hot feed piping. Some models come with check valves already integrated into the mixing valve body.

The Inspector should verify that the mixing valve set temperature is 110F-125F. The Installer should install a thermometer at the mixed outlet of the mixing valve for verification.



Figure 3-8 – Thermostatic mixing valve with integrated thermometer (image courtesy of Caleffi)

Important note: In two-tank systems, where the solar storage tank preheats water before it enters an auxiliary water heater, the mixing valve should be installed on the hot outlet of the auxiliary tank. This increases system performance by keeping the solar storage tank temperatures lower and increasing collection efficiency. It is critical in two-tank systems to verify that cold water is feeding the mixing valve, rather than preheated water from the solar storage tank (see Figure 3-9 and Figure 3-10).

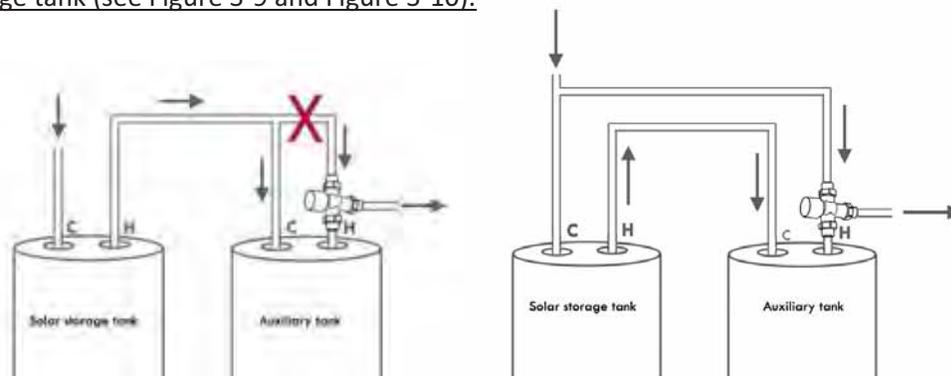


Figure 3-9 (left) and Figure 3-10 (right) – In the schematic on the left, the mixing valve is tempered by water from the solar storage tank, which could exceed the setpoint on the mixing valve and expose the user to scalding temperatures. The arrangement on the right shows correct plumbing – the mixing valve is tempered by water from the cold supply.

Evaluating

The Inspector shall verify that:

- the mixing valve has been installed per system and manufacturer specifications,
- the mixing valve is rated for potable use, and
- the set temperature is appropriate.

(iii) Isolation valve installed on cold water feed to water heater

In order to isolate the tank for servicing, a ball valve must be installed on the cold water feed to the water heater. If this valve is installed after the tee for supplying the mixing valve, a separate ball valve is required on the feed line between the tee and the mixing valve.

Evaluating

The Inspector shall verify that the isolation valve is installed.

(iv) Isolation valves installed to allow bypass of solar storage tank

In a two-tank system, a three-valve configuration must be used to allow for proper operation and to allow isolation of the solar storage tank for maintenance. In this configuration, the ball valve on the line to the solar storage tank and the ball valve on the line from the solar storage tank remain open during normal operation, while the third ball valve remains closed to divert flow through the auxiliary water heater (Figure 3-11). When the solar storage tank is serviced, the ball valves to and from the tank are closed and the third ball valve is opened to allow cold water to feed the auxiliary water heater (Figure 3-12). This arrangement allows continuous hot water service in the building while servicing the SWH system.

Evaluating

The Inspector shall verify that the isolation valves are installed correctly for two-tank systems.

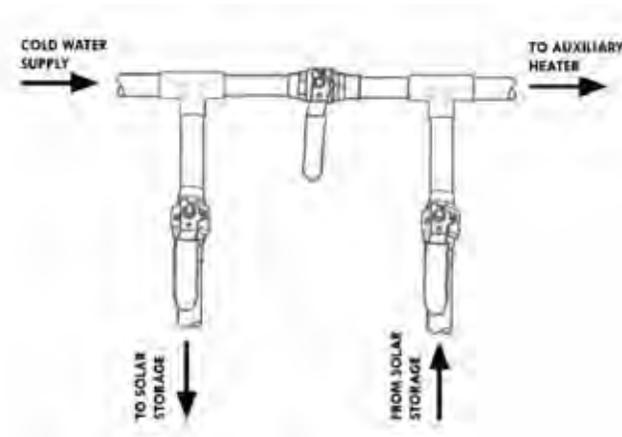


Figure 3-11 – Ball valve configuration for two-tank system during normal operation

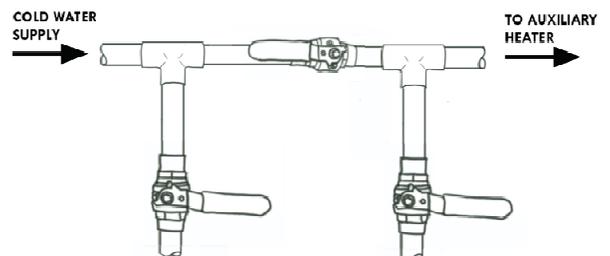


Figure 3-12 – Ball valve configuration for two-tank system during service of solar storage tank

(v) Heat traps properly installed

Heated water rises due to its lower density than cooler water. Due to this phenomenon, fittings at the top of a hot water tank – either from potable piping or from auxiliary heat sources – can be significant sources of heat loss if piped improperly. To avoid losses due to this thermosiphoning, all piping in the upper portion of a solar storage tank must have heat traps installed. Some tanks have heat traps integrated into the nipples where potable piping is connected. If these integrated heat traps are not present, a 6" heat trap must be installed.

Figure 3-13 is an infrared image that illustrates the effectiveness of a heat trap on a boiler feed line into the top of a solar storage tank. As can be seen, the trap isolates the hot water at the trap, giving it limited surface area to radiate heat.

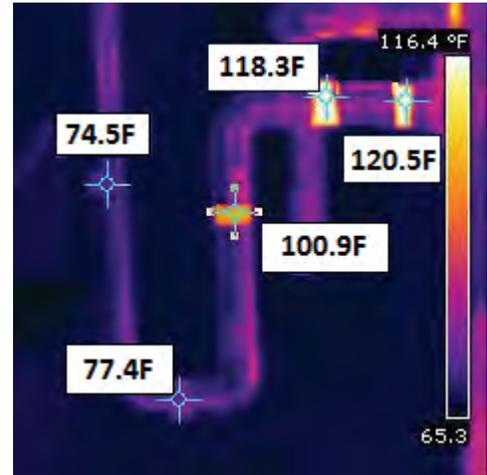


Figure 3-13 – Pipe temperatures at a properly installed heat trap. Without a heat trap, the heat from the tank would flow up the pipe and increase standby losses.

Important note: Alternately, a spring check valve can be used as a heat trap *on the hot outlet*. A spring check on the cold inlet will eliminate the ability for heated water to expand through the cold water lines and will lead to overpressurization of the potable water system. See 3(B)(viii) in this manual for properly addressing systems where a check valve is already installed.

Evaluating

The Inspector shall verify that all fittings in the upper half of the tank have integrated heat traps or that appropriate traps have been installed in the system piping. This applies to the cold inlet, the hot outlet, and any inlets and outlets for auxiliary water heating, such as an upper heat exchanger.

(vi) Antisiphon device installed properly

A vacuum relief valve must be installed immediately before the cold inlet to a water heater on bottom-fed water heaters and should be installed at a height above the top of the tank (see relief valve installation instructions). There can be no valve between the vacuum relief valve and the tank. This valve protects the tank vessel from negative pressures and prevents siphoning of the fluid from the tank into the potable water supply. For top-fed water heaters, a hole in the cold water dip tube qualifies for antisiphon protection.

Evaluating

The Inspector shall verify that the dip tube or an external vacuum relief valve provides antisiphon protection.

(vii) Dissimilar metals isolated properly, if required

Black iron or galvanized steel should not be used for potable piping. Where cast iron components are necessary, such as tappings in the tank vessel, a dielectric fitting or brass fitting must be used to transition to copper.

Evaluating

The Inspector shall look for any joints in the piping to ensure proper material compatibility. Particular points of interest include transitions between piping materials, most notably at the storage tank.

(viii) Thermal expansion tank installed and sized properly for cold water supply with check valve or backflow prevention

In buildings with backflow prevention or a check valve (such as is used in a well pump), a thermal expansion tank must be installed to absorb the expansion of water as it is heated (see Figure 3-15). The Inspector should verify that the expansion tank is rated for potable applications.

Evaluating

The Inspector shall verify the presence (or lack thereof) of backflow prevention on systems connected to public water supply. In systems where backflow prevention is present and on all systems connected to a private water supply, the Inspector shall verify that an appropriate thermal expansion tank is installed.

(ix) Interconnecting piping insulated properly

Types of insulation

Potable piping temperatures (<180F) allow for a variety of different pipe insulation materials. These include polyethylene, fiberglass, mineral wool, and elastomeric, among others.

Thickness of insulation

The Energy Conservation Construction Code of New York State states that mechanical system piping in residential systems must be insulated to a minimum of R-3 when carrying fluids above 105°F. The minimum thicknesses for various types of pipe insulation are listed below:

- Elastomeric: ½"
- Mineral wool: 1"
- Fiberglass: 1"
- Polyethylene: ¾"

Installation

Pipe insulation must be installed on cold water piping within 5 feet of the solar storage tank and water heater and on all accessible hot water piping. When split-style insulation is used, the seam must be sealed. Care should be taken to fully insulate fittings. Additionally, any spare ports on the water heater must be insulated.

Evaluating

The Inspector shall verify that the interior pipe insulation on potable piping is either elastomeric with a minimum thickness of ½", polyethylene with a minimum thickness of ¾", or fiberglass or mineral wool pipe insulation with a minimum thickness of 1".



Figure 3-15 - Thermal expansion tank (image courtesy of Amtrol)

(x) All valves and fittings are rated for potable systems

There are a number of components used in SWH systems that might not be rated for use in potable water systems. The Inspector must ensure that any components used in the potable portion of the system meet the low-lead guidelines to protect homeowners and are resistant to the corrosion that can occur between certain materials and water with entrained air, such as service water.

Components that are rated for use in hydronic systems that might be mistakenly installed in potable piping include:

- Backflow preventers
- Mixing valves
- Diverting valves
- Expansion tanks
- PEX tubing
- Circulators
- Leaded solder

Evaluating

The Inspector shall verify that the components listed above are rated for potable applications. The Installer must provide proper documentation.

(xi) Isolation valves labeled with normal operating position

To ensure proper system operation, isolation valves must be labeled with a description of their normal operating position. Labeling can be accomplished in one of two ways:

- The valves can be labeled with numbers and a sheet with description of the valve and its functioning can be posted in a visible location near the solar storage tank, or
- Laminated labels with a full description of the purpose of the valve can be placed at each valve

All systems that are SRCC OG-300 certified will have a list of labels needed for the system (see Figure 3-16)

<p style="text-align: center;">VALVE NO. 23 COLD WATER SUPPLY LINE ISOLATION BALL VALVE</p> <p>THIS VALVE IS NORMALLY OPEN AND ALLOWS POTABLE WATER TO FILL THE SOLAR STORAGE TANK. WHEN CLOSED THE SOLAR STORAGE TANK IS ISOLATED FROM THE PRESSURIZED CITY COLD WATER SUPPLY LINE PIPING.</p>
<p style="text-align: center;">VALVE NOS. 5 AND 10</p> <p>VALVES 5 AND 10 ARE NORMALLY OPEN. WHEN CLOSED THE SOLAR STORAGE COLLECTOR LOOP PIPING IS ISOLATED FROM THE SOLAR STORAGE TANK.</p>
<p style="text-align: center;">VALVE NOS. 12 AND 14</p> <p>VALVES 12 AND 14 ARE NORMALLY OPEN. WHEN CLOSED THE CIRCULATING PUMP IS ISOLATED FROM THE SOLAR COLLECTOR LOOP PIPING. NEVER SHUT THESE VALVES WHILE THE CIRCULATING PUMP IS IN OPERATION. TURN THE TOGGLE SWITCH, NO. 21, TO THE "OFF" POSITION</p>

Figure 3-16 - Sample labels for the isolation valves in a SWH system (courtesy of SunEarth)

Evaluating

The Inspector shall verify that isolation valves are properly labeled.

SECTION 4: CONTROLS

While many of the technologies utilized in SWH systems have remained fairly consistent in recent years, the field of controls has seen rapid development. The introduction of affordable advanced controllers and heat measurement equipment has led to – and will continue to lead to – changes in control strategies and increased ability to troubleshoot systems.

It is extremely important the Installer is knowledgeable in controls and properly configures the settings of the control system, whether it is a differential control or a PV-control. The Inspector must review the system to determine whether the controls meet electrical codes and operate correctly.

Section 4 discusses the electrical requirements of solar heating controls.

(i) Wiring between controller and outputs (pumps, motorized valves, external relays, etc.) installed properly

The *minimum* cable size used between the controller and any output powered by line voltage (120V) is 14 AWG and the wire gauge must be sized appropriately for the load per NEC. A properly insulated and protected conductor shall be used – this may include either or a conductor enclosed in conduit or an appropriately rated cord. All cable systems shall be supported in accordance with the NEC. Wiring shall also have strain relief to prevent the wiring and equipment from being damaged or disconnected (see Figure 4-1). Any splices or connections must be concealed in a junction box.



Figure 4-1 – Strain relief clamp used at circulator junction box to protect the integrity of the corded connection.

Evaluating

The Inspector shall verify that the wiring between the controller and output(s) is/are installed properly.

(ii) (a) Controller relay(s) rated higher than each output -OR- (b) Appropriately rated intermediate relay(s) installed between controller and output(s)

The outputs for small residential systems typically include circulators, pumps, and motorized valves. Typically these loads draw less than 1A of current at 110V. For loads over 1A, the rating of the controller relay should be verified to ensure that it exceeds the draw. If the output load is higher than the rating of the load, an exterior relay must be used (see Figure 4-2).

Typical amperage requirements for standard solar heating system components are as follows:

- Standard circulator: 0.5A-1.0A
- Large circulator or drainback pump: 1.5A-2.5A
- Motorized diverting valve: <0.1A



Figure 4-2 – Example of an external relay used when the load exceeds the amperage rating of the controller relay. The external relay must be rated higher than the load (image courtesy of Functional Devices, Inc.).

Evaluating

The Inspector should verify the load of each output and compare it to the amperage rating on the controller, which is found in the controller instruction manual.

(iii) Wiring between controller and power source (line voltage) installed properly

The minimum cable size used between the controller and the power source is 14 AWG. For large systems that exceed 15A, the National Electrical Code (NEC) must be referenced to determine the appropriate wire gage. A properly insulated and protected conductor shall be used – this may include either or a conductor enclosed in a conduit or an appropriately rated cord. Wiring shall be supported within 12” of the controller and power source and at 54” intervals intermediately. Wiring shall also have strain relief to prevent the wiring and equipment from being damaged or disconnected. Any splices or connections must be concealed in a junction box.

Evaluating

The Inspector shall verify that the wiring between the controller and power source is installed properly.

(iv) Wiring to PV module installed and sized appropriately for PV-controlled systems

In PV-controlled systems, the wiring between the module and the circulator (or controller, if used) must have a disconnect switch and be sized to carry 125% of the maximum amperage output of the module (refer to NEC for specific wiring and switch requirements). Outside wiring and junction boxes must be rated for outdoor use and be resistant to water and sunlight. Interior wiring must be contained inside metal raceways, such as metal-clad conduit.

Evaluating

The Inspector shall verify that the wiring between the module and circulator (or controller) is installed properly.

(v) PV module sized appropriately for DC pump for PV-controlled systems

DC-pump manufacturers will specify the output requirements of the PV panel used to power their equipment. The Installer must verify that the system operates at the desired flow rate under typical solar loads.

Evaluating

The Inspector must ensure that the PV module meets the pump manufacturer’s requirements.

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Field Inspection Guidelines for Solar Heating Systems

State of New York

New York State Energy Research and Development Authority
Francis J. Murray, Jr., President and CEO