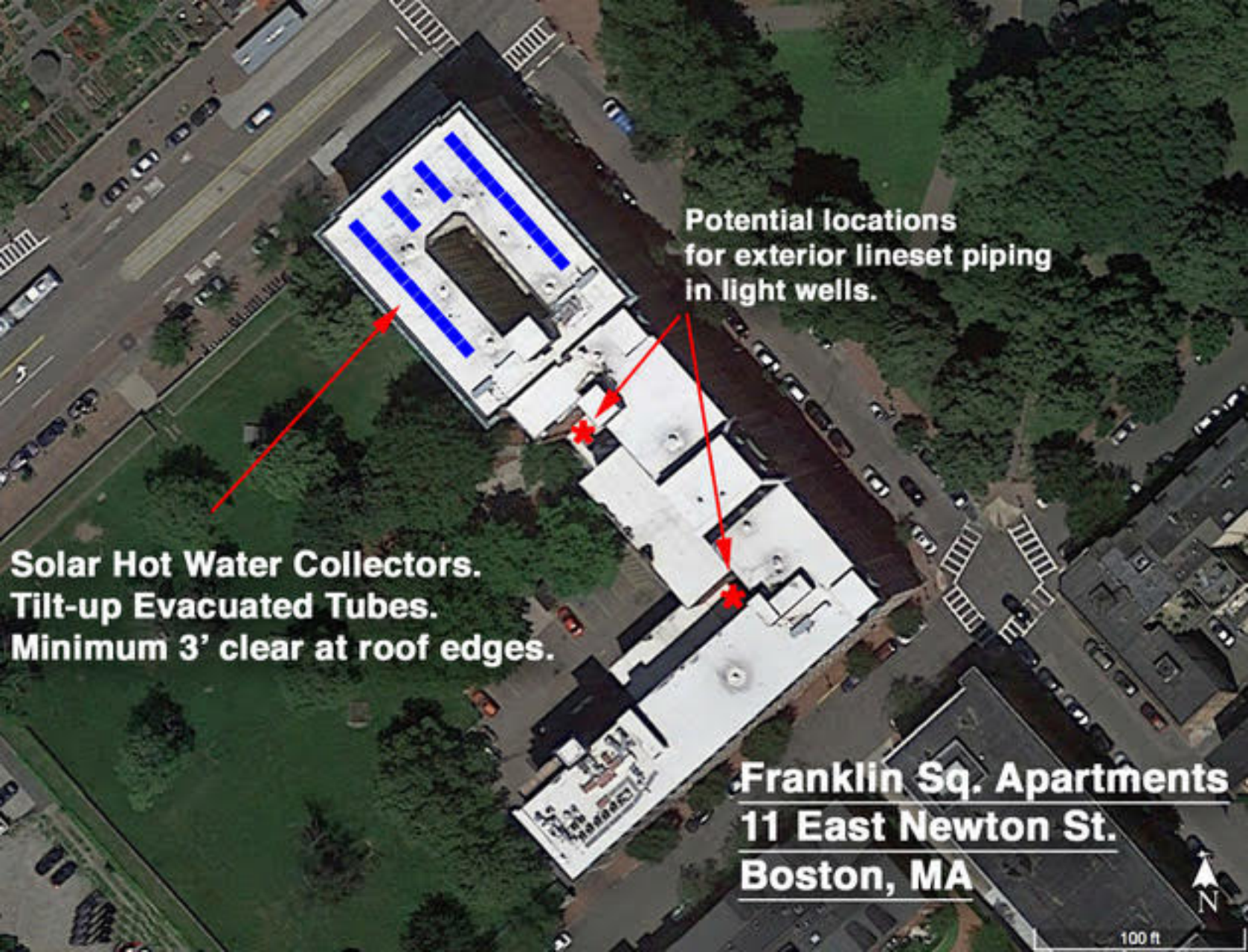
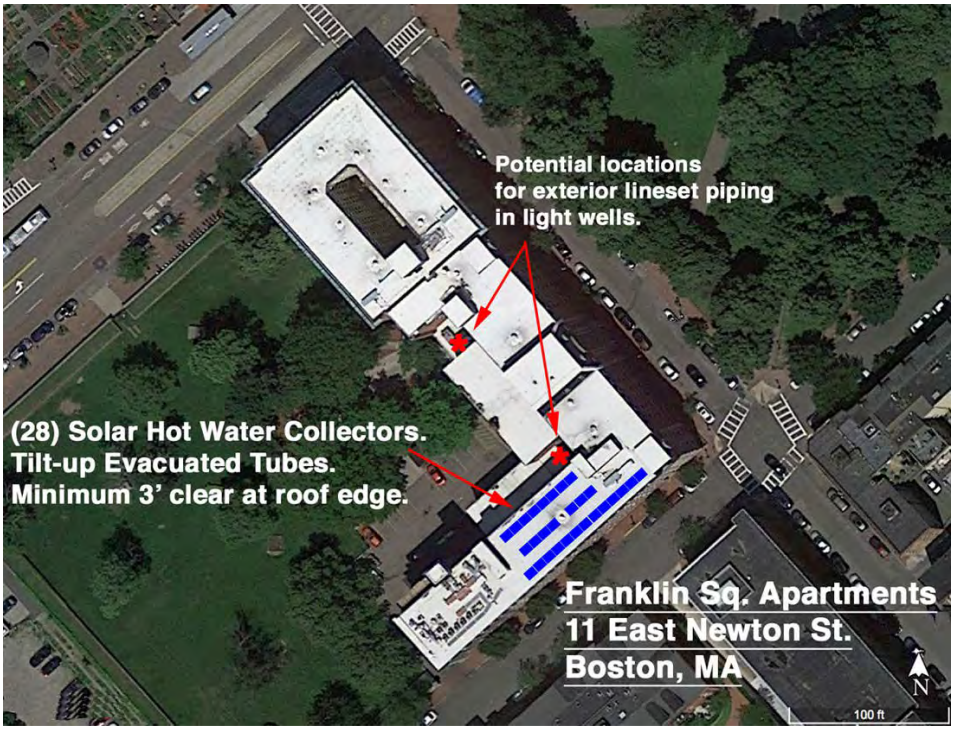
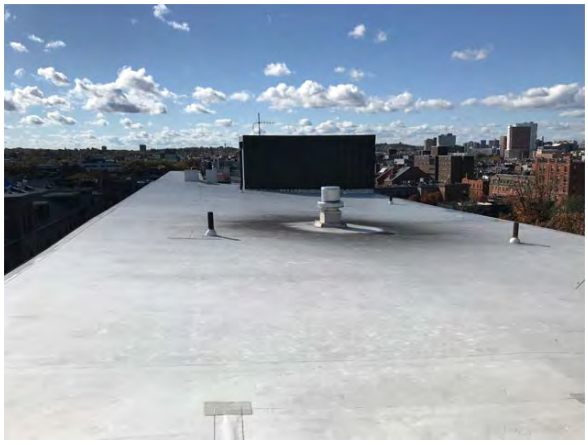

Potential locations
for exterior lineset piping
in light wells.
Solar Hot Water Collectors.
Tilt-up Evacuated Tubes.
Minimum 3' clear at roof edges.
Franklin Sq. Apartments
11 East Newton St.
Boston, MA
N
100 ft

Franklin Square Apts., 11 E. Newton St., Boston, MA: SOLAR HOT WATER Installation





View SW- Existing Roof

Example similar installation (5'-6" height overall.)

View NE- from St. George St.

View SW- from E. Newton St.

Commonwealth Solar Hot Water Commercial Program
Solar Hot Water Feasibility Study

31 December 2019

FINAL

Franklin Square Apartments
11 E. Newton St., Boston, MA 02118

Owner Contact: **Mr. Nathaniel Dick**
Preservation of Affordable Housing (POAH)
40 Court St., Suite 700, Boston, MA 02108
ndick@poah.org/ 617-449-0871

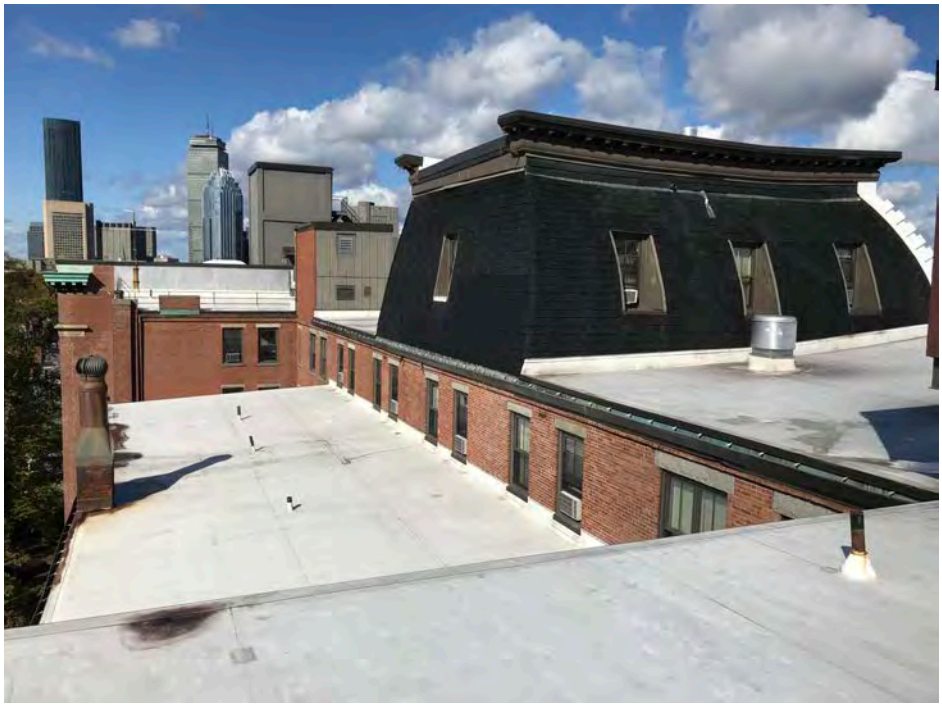
Installer Contact: **John Moore, Architect**
New England Solar Hot Water, Inc.
john@neshw.com / 508-269-3883

TABLE OF CONTENTS:

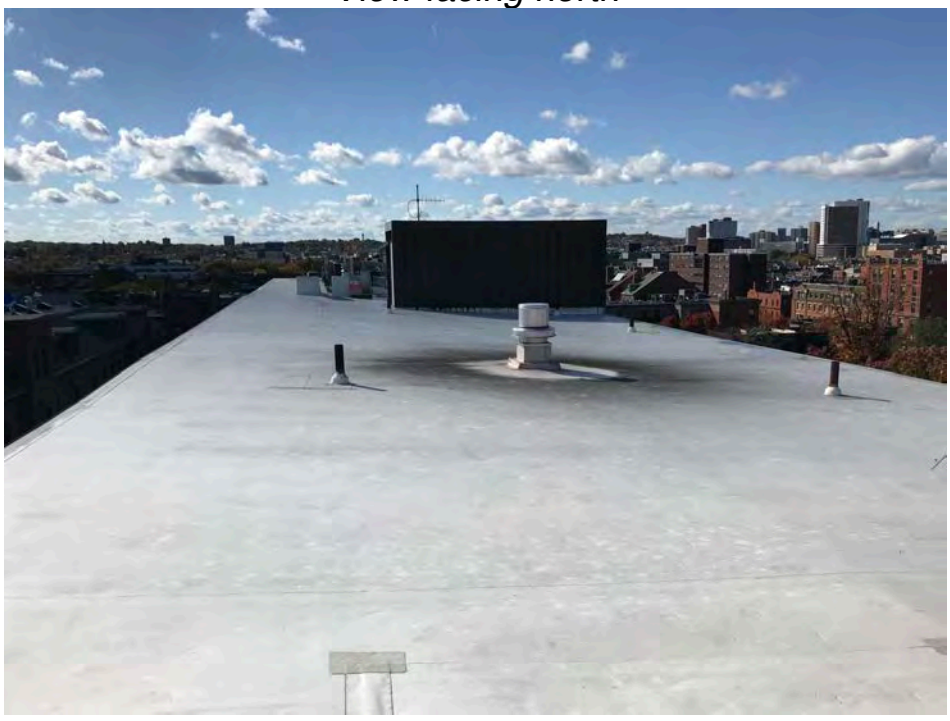
A. Current Building Conditions

Roofing and Structural Information:

Franklin Square Apartments was originally built in 1923 and rehabilitated in 2012. The roofs were installed in 2012 and are under warranty.



View facing north



View facing west.

Existing Hot Water Heating System:

The existing system consists of (2) 119 gallon Vaughn indirect HW tanks (2003) connected to a dedicated RBI gas-fired boiler (2009.) See photo below:

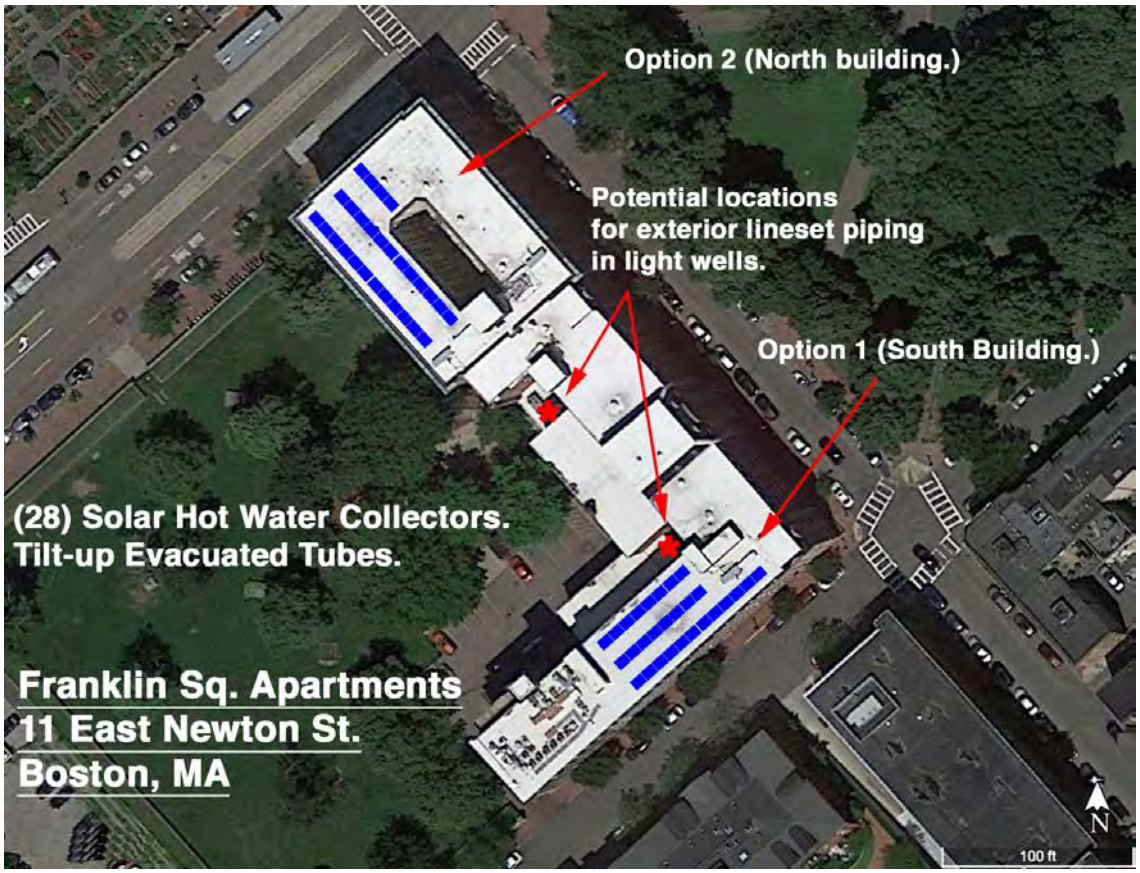
Load Profile:

The building includes 193 apartments housing 225 residents with 90% elderly. Based on our experience with low-income elderly populations, hot water usage will average 10 gallons at 120°F per day per occupant.

B. *Solar Hot Water Design Specifications*

1. Solar Thermal Collectors.

Design calls for (28) Apricus ETC-30 evacuated tube collectors. Collectors location will be determined by structural analysis. See below for optional locations:



Typical mounting detail.

2. Tank Size, Type, and Location.

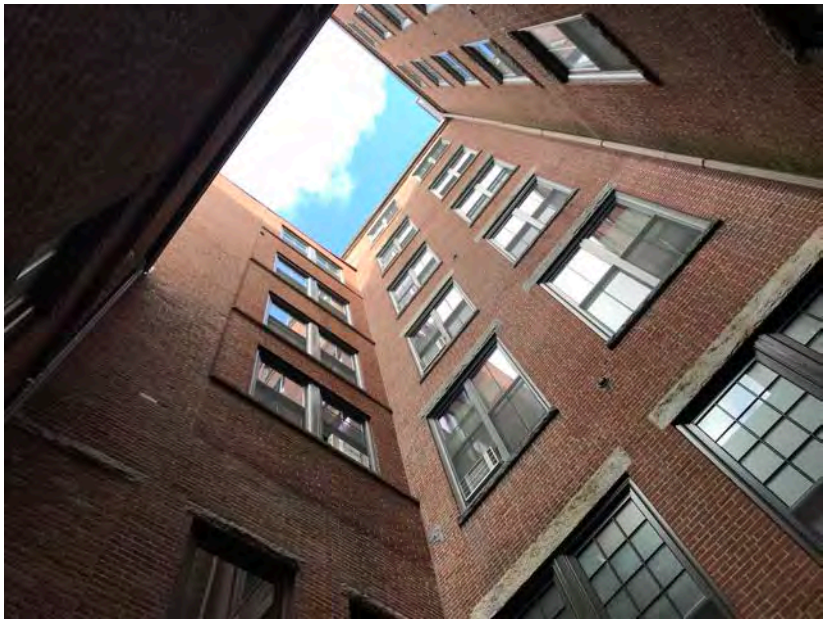
Design calls for (1) Custom EverStor EPDM-lined insulated solar storage tank. Size to be 1450 gallons. There is adequate space for the solar tank in the mechanical room. See specification attached and photo below:

Area for Solar Tank in Basement Mech. Room

Typical EverStor Tank w/ controls

3. Pipe runs.

A combination of hard copper and corrugated stainless steel tubing (CSST) will be used. The new pipe will run from the collectors across the roof to a lightwell down to the mechanical room and the new tank. Pipe run distances are not beyond the capacity of standard pumps.



4. Structural Design.

Roof approved for proposed loading by Structural engineer. See below:

Richard B. Gordon, P.E.
P.O. Box 264•Farmville•VA 23901
E-mail: grichardpe@aol.com

January 29, 2020

Boston Building Dept.
Boston, MA

Re: Solar Thermal Collectors (for hot water) Roof Structural Framing Support

To Whom It May Concern:

I hereby certify that I am a Licensed Professional Engineer in the State of Massachusetts. Please note the following conclusions regarding framing structure, roof loading, and proposed site location of installation:

1. Existing roof framing at Buildings:
   Conventional wood framing true 2x9 at 16" o.c. with 13'-6" & 15'-3" span (horizontal rafter projection). This existing framing is definitely capable to support all of the loads that are indicated below for this solar heating project.
2. Roof Loading
   - 8.5 psf dead load (modules plus all mounting hardware)
   - 24 psf snow live load min. (40 psf ground snow live load reference)
   - 5.8 psf dead load roof materials (3.6 psf 2x9, 0.7 psf rubber roof, 1.5 psf wood sheathing)
   - Exposure Category B, 129 mph wind uplift live load of 24.59 psf (wind resistance)
3. Address of proposed installation: Residence of Franklin Square Apts., 11 E. Newton St., Boston, MA

This installation design is in general conformance to the manufacturer's specifications, and is in compliance with all applicable laws, codes, and ordinances, and specifically, International Residential Code/ IRC 2015. The spacing and fastening of the OMG Power Grip Solar attachment/mounting is to have a maximum of 48" o.c. span along the SnapNRack UR60 rail between mounting brackets and secured using #15 XHD corrosive resistant steel lag screws min. 3" penetration of lag screw into roof joist, which is adequate to resist all 129 mph wind live loads including wind shear. This letter is referencing the (28)-twenty-eight Apricus ETC30 collectors with tilt-up hardware to produce hot water.

Very truly yours,

ELECTRICAL ENGINEERING
CIVIL ENGINEERING

Richard B. Gordon, P.E.
Massachusetts P.E. License No. 49993
CIVIL, MECHANICAL, & ELECTRICAL ENGINEERING

5. Control System.

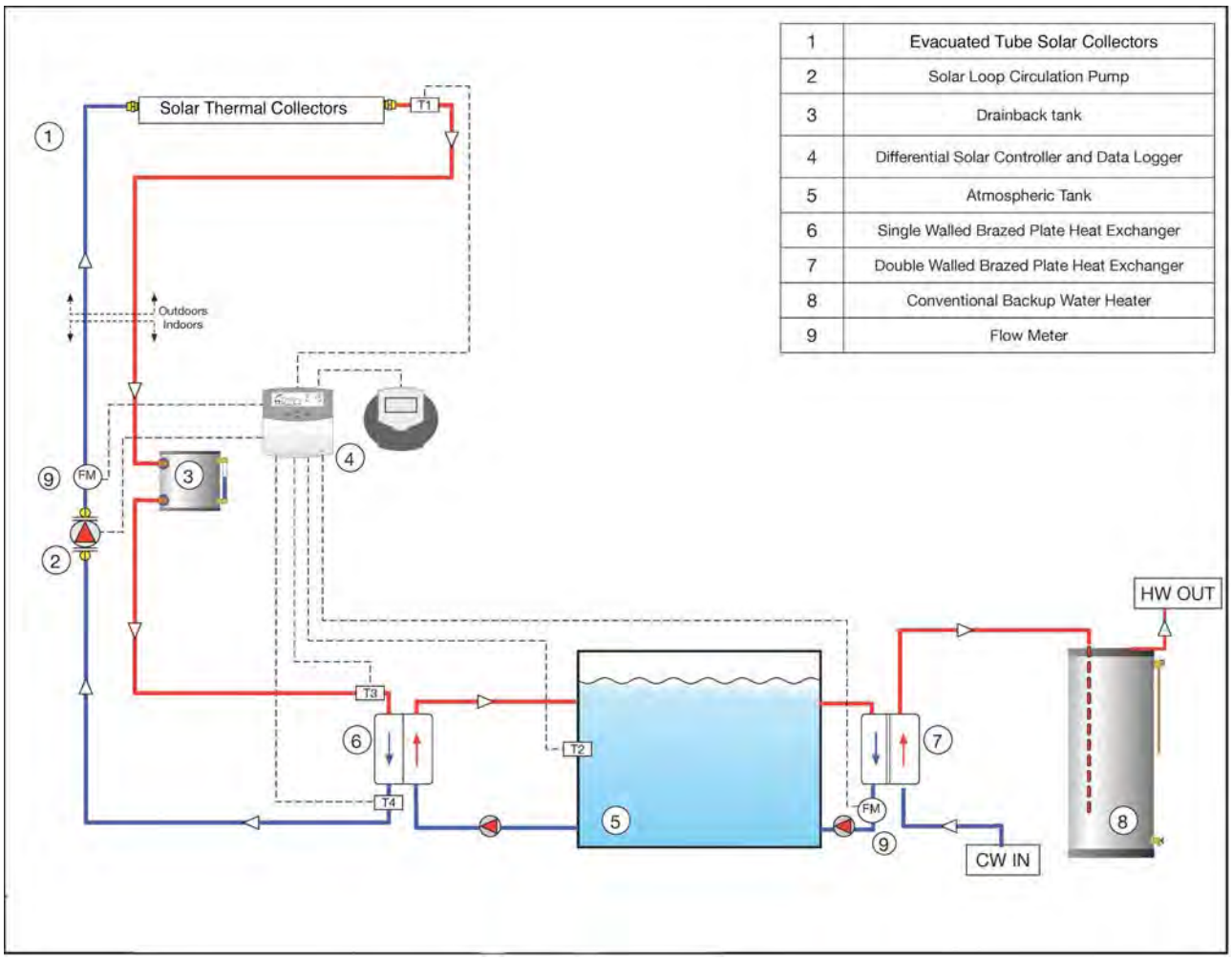
Standard Resol BX controller. 20A, 120VAC 50-60 Hz power branch circuit required. The control unit, pump and monitoring unit shall be located near the buffer tank. The system can be restarted manually or automatically should the unit shut down due to a power outage. All electrical equipment must adhere to 70 National Electrical Code.

6. Performance Monitoring.

System measures the temperature of the cold water ‘in’ and the hot water ‘out’. This and the mass (flow) gives the solar contribution to DHW System. Hardware to include Resol BX Controller, V40 flowmeters, and D12 Datalogger and monitoring system. Unit is ethernet enabled, MassCEC rebate and MA DOER compliant. Internet enabled data logging of collector loop ‘production’ and domestic HW ‘consumption’ required. Ethernet line with connection to "always on" internet service required (by owner.)

7. Solar Circuit.

Closed loop 40% glycol 60% water system, with "drainback" stagnation control. System diagram as indicated below. System to include variable speed pumps, and external flat plate heat exchangers.



1	Evacuated Tube Solar Collectors
2	Solar Loop Circulation Pump
3	Drainback tank
4	Differential Solar Controller and Data Logger
5	Atmospheric Tank
6	Single Walled Brazed Plate Heat Exchanger
7	Double Walled Brazed Plate Heat Exchanger
8	Conventional Backup Water Heater
9	Flow Meter

8. Thermal Insulation.

The piping and fittings will conform to ASTM and ASME standards with either 3⁄4" EPDM (rubber) or 1" of fiberglass insulation. On the exterior piping, the CSST lines will have a UV proof film or be sleeved in schedule 40 PVC.

9. Heat Rejection.

No heat rejection necessary given solar fraction, and stagnation control (drainback system.)

10. Code Requirements, Warranties, etc.

1 year system maintenance and monitoring required. 10 year collector, 20 year tank, and 4 year labor and 'balance of system' warranties required. Contract will be "design-build" and general conditions, all trades, equipment, fittings, appurtenances, soffits and finish work, engineering, permitting, rigging/hoisting, rubbish removal etc. need be included in bid price. See preliminary cost estimate/proposal Exhibit D.

In addition, the following reference standards must be adhered to:

IAPMO Codes:
- Uniform Solar Energy Code, 2009
- Uniform Plumbing Code, 2009
- Uniform Mechanical Code, 2009

ASHRAE Manuals:
- ASHRAE 90003 Active Solar Heating Design
- ASHRAE 90336 Active Solar Heating Systems Oper. & Maint.
- ASHRAE 90342 Active Solar Heating Systems Installation
- ASHRAE 93 Methods of Testing

National Fire Protection Association (NFPA)

American Society of Civil Engineers (ASCE)
- 7-05 Minimum Design Loads for Buildings

Massachusetts Building Code, 8th edition.

70 National Electrical Code Chapter 2

National Roofing Association (NRCA)

C. Project Economics

1. Energy Production, etc.

For detail on system production and solar fraction please see attached Exhibit B. TSOL Report.)

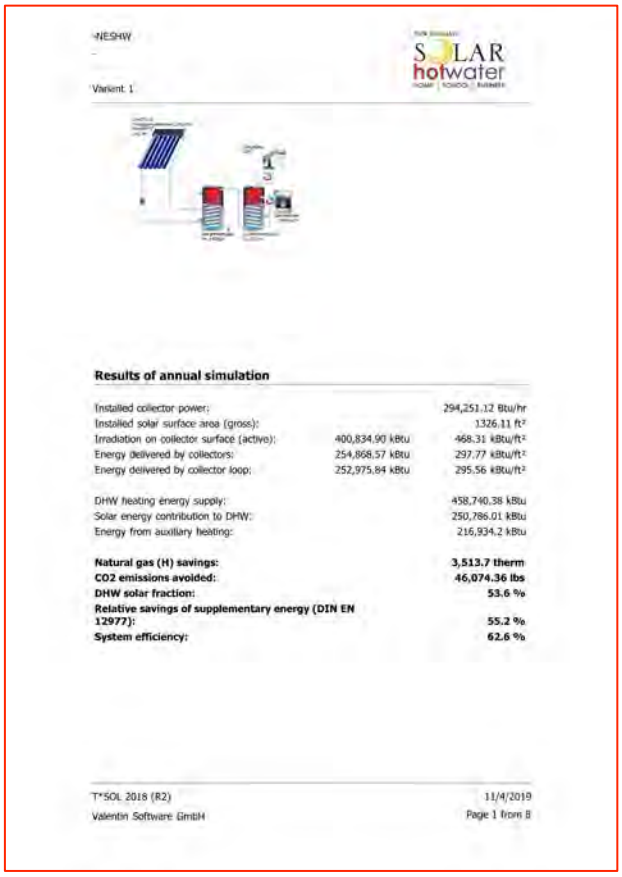
2. Financial Analysis

For detailed financial analysis, please see attached Exhibit A.

3. Incentives.

The owner is a for-profit entity but federal tax incentives are not available given the choice to opt for the MassCEC Commonwealth Solar Hot Water Commercial Affordable Housing rebate. A rebate "adder" is available for an approved monitoring system (+$1,500.) MA DOER large system Alternative Energy Certificates (AECs) will be available for this system after installation. Total estimated incentives are shown in Exhibit A. Financial Analysis.

EXHIBIT B. TSOL Energy Analysis



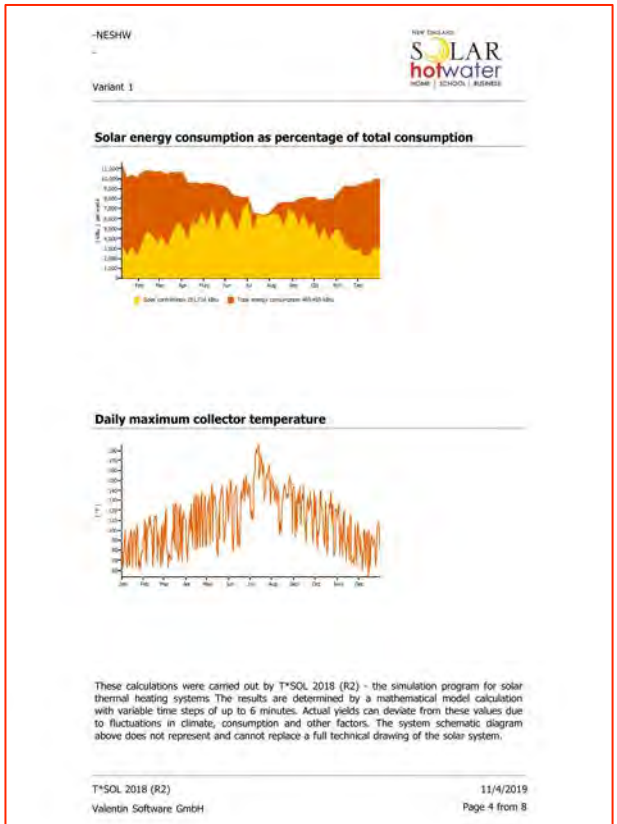
-NESHW

Variant 1

Results of annual simulation

Installed collector power:		294,251.12 Btu/hr
Installed solar surface area (gross):		1326.11 ft²
Irradiation on collector surface (active):	400,834.90 kBtu	468.31 kBtu/ft²
Energy delivered by collectors:	254,868.57 kBtu	297.77 kBtu/ft²
Energy delivered by collector loop:	252,975.84 kBtu	295.56 kBtu/ft²
DHW heating energy supply:		458,740.38 kBtu
Solar energy contribution to DHW:		250,786.01 kBtu
Energy from auxiliary heating:		216,934.2 kBtu
Natural gas (H) savings:		**3,513.7 therm**
CO2 emissions avoided:		**46,074.36 lbs**
DHW solar fraction:		**53.6 %**
Relative savings of supplementary energy (DIN EN 12977):		**55.2 %**
System efficiency:		**62.6 %**

T*SOL 2018 (R2) 11/4/2019
Valentin Software GmbH Page 1 from 8



-NESHW

Variant 1

Solar energy consumption as percentage of total consumption

Daily maximum collector temperature

These calculations were carried out by T*SOL 2018 (R2) - the simulation program for solar thermal heating systems The results are determined by a mathematical model calculation with variable time steps of up to 6 minutes. Actual yields can deviate from these values due to fluctuations in climate, consumption and other factors. The system schematic diagram above does not represent and cannot replace a full technical drawing of the solar system.

T*SOL 2018 (R2) 11/4/2019
Valentin Software GmbH Page 4 from 8

EXHIBIT C. Hardware Cut Sheets

Submittal Data Information

ETC-30 Solar Collector

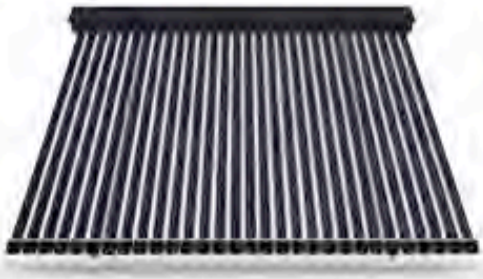
USA Version
A11-01.2.1.3-PB-V3 – June 2015

Job: _____ **Engineer:** _____ **Contractor:** _____ **Rep:** _____

Part Codes

ETC-30 Solar Collector Complete is comprised of:

1 x ETC-30-KIT (Manifold and standard frame)
3 x BOX-ET/HP-10/10 (Tubes and heat pipes)



Applications

The Apricus ETC-30 collector is designed to be used in a wide variety of solar thermal (heat) applications in almost any climate. The evacuated tube and heat pipe technology provides very efficient and reliable solar thermal production in a simple to install design.

Materials of Construction

Evacuated Tubes:	Borosilicate 3.3 Glass
Absorber:	Cu-AL/N-SS
Heat Pipes:	High purity copper
Rubber Components:	HTV Silicone Rubber
Mounting Frame:	6005-T5 Anodized Aluminum 316 SS Fasteners
Manifold Casing:	3003 AL, PVDF coating

Flow Guidelines

Recommended Flow Rate:	0.5 gpm
Max Flow Rate:	4 gpm
Heat Transfer Liquid:	Water or 50% Glycol/water

Physical Specifications

Dimensions (WxHxD):	78.9" x 96.4" x 5.35"
Aperture Area:	30.77 ft²
Gross Area:	47.33 ft²
Gross Dry Weight:	209 lbs
Fluid Capacity:	0.2 gal
Max Operating Pressure:	116 psi
Stagnation Temperature:	442°F

Warranty

- 10 year limited warranty on tubes and heat pipes
- 15 year limited warranty on copper header and mounting frame

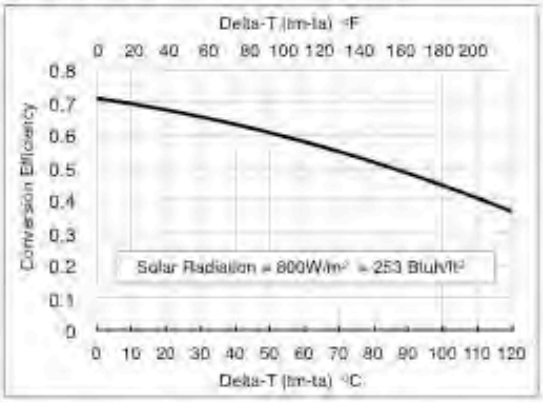
Certifications

SRCC OG-100:	10001909
USEC:	S-5995
NSF-61 Tested:	17248

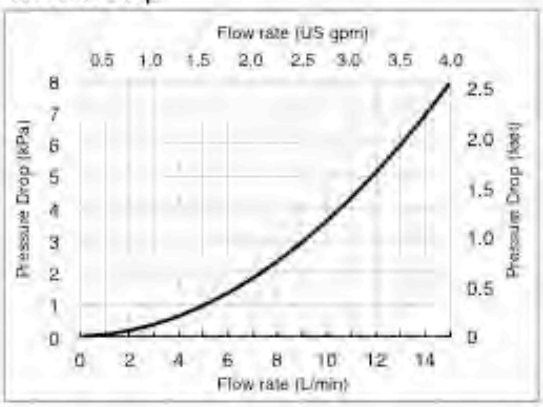
OG-100 Performance Ratings

Climate Category (Ti-Ta)	High Radiation (2000 Btu/ft²/day)	Medium Radiation (1500 Btu/ft²/day)
A (-9°F)	45.3	34.2
B (9°F)	43.7	32.6
C (36°F)	40.9	29.8
D (90°F)	34.4	23.5
E (144°F)	26.7	15.8

Collector Performance (aperture area)



Pressure Drop



Sustainable HOT WATER Solutions, Delivered by APRICUS

Apricus Inc | 1150 S Milliken Ave, Ontario, CA, USA | inquiry-usa@apricus.com | +1 877 458 2634 | www.apricus.com

August 2016

Apricus®
SOLAR HOT WATER

ETC SOLAR COLLECTOR

PRODUCT OVERVIEW

Product Highlights

- High Efficiency Evacuated Tube Solar Thermal Collector
- Suitable for Residential and Commercial Projects
- Steam-back and Drain-back Compatible Header Design
- Cyclone Rated, Marine Grade Mounting Frame and Fasteners
- Comprehensive 15 Year Limited Warranty*

A11-01.3.7-V10

* See limited warranty policy for complete details

 | 6060 W Manchester Ave, Ste 109, CA, USA | inquiry-usa@apricus.com | +1 909 374 9800 | www.apricus.com

54 Corporate Park Drive, Suite 510, Pemborke, MA 02359
(781) 536-8633 / Bruce@NESHW.com

EverStor
Integrated Solar Thermal Storage

ES' SERIES NON-PRESSURIZED
SUBMITTAL SHEET

DATE: *1/1/2018*

JOB NAME: _____

LOCATION: _____

ARCHITECT/ENGINEER: *NESHW, Inc.*

CONTRACTOR: *TBD*

ES MODEL NUMBER: *ES600-1000 (600 gallon min)*

- Non- pressurized (NP) storage tank for solar thermal energy buffer mass
- Allows less than 2 degrees per day heat loss at 130F tank temp and 68F ambient (6" insulation variant)
- 4" or 6" rigid polyurethane insulation (top and sides), 4" (bottom)
- Surface mounting of all piping and electrical subsystems
- .060" EPDM liner
- Temperature rating:
  - 180F (constant)
  - 195F (intermittent)
- NSF-61 approved external heat exchangers (field installed) required for potable water heating

Specification

The ES series non-pressurized (NP) commercial storage tanks shall be fabricated by Everstor Inc. The external frame shall be ¼" x 2 ½" CRS steel tube, welded throughout. Frame to be primed and painted metallic silver. The cladding to be stucco embossed aluminum sheet. Insulation to be either 4" or 6" in thickness comprised of 2" rigid sheet of polyurethane board. Lid shall be 6" polyurethane board with EPDM applied on 5 sides. Lid gasket material to be 1" closed cell EPDM foam. Tank frame walls shall be configured with removable hardware for field assembly.

Typical Commercial Installation

www.NESHW.com
A SOUTH SHORE SUSTAINABLE BUSINESS
1000 Turnpike St., Canton, MA 02021
(781) 536 8633 info@NESHW.com