

# III. E.

**DATE:** November 30, 2009  
**TO:** Mike Herring, CA  
**FROM:** Mike Geisel, DPW\CE



## **SUBJECT: Solar Thermal Installation**

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As has always been the case, the Department of Planning and Public Works continuously investigates building operations and applications for more efficient systems. City Hall is only 9 years old and was built with a state of the art energy management system. The HVAC system consists of 183 individual climate controlled zones which are managed through a computerized energy management system. Temperature, humidity, and composition of circulated air is managed centrally. Although we have repeatedly investigated alternative energy sources and renewable energy alternatives, we have not previously found any alternatives that provided a reasonable return on investment or which would result in an economically justifiable project.

Earlier this year, at your direction, we were fortunate to meet and discuss energy strategies with Mr. Harvey Rosenberg, who has been assisting and advising the Mayor on similar topics. We found Mr. Rosenberg to be extraordinarily well informed and a very useful resource to us. Initially, our interests were limited to a use of funding from an energy efficiency grant. While that opportunity ultimately could not be used for this purpose, I believe we have identified an opportunity to move forward with an alternative, renewable energy improvement for City Hall.

The City of Chesterfield has been aggressive in the acquisition and implementation of technology. However, each foray into an emerging technology has been the result of a good deal of review, investigation and a reasonable determination that the implementation was a financially sound decision. The City has elected not to pursue technology simply to set an example, but to utilize technologies which would make us more efficient, more independent, and ultimately prove to be a wise investment.

As a point of entry, the City contracted for a energy audit of the various City owned and managed facilities. I am pleased to report that the audit found that the City owned facilities were well constructed, energy efficient, well maintained, and represented state of the art facilities for the time they were constructed. In fact, since the City Hall HVAC system was constructed with the 183 individual zones incorporating a closed loop water system, the addition of a solar-thermal application could be incorporated at a relatively reasonable cost.

Briefly described, the proposed solar thermal project would consist of 129 collector assemblies, each with 25 solar tubes (not to be confused with photo-voltaic panels) placed on the roof of City Hall. These tubes would heat water in a closed loop

circulatory system, to a temperature of 210 degrees. This water would then be directed to a 10,000 gallon buffer tank located in the lower level of the parking garage, in which, the heated water would be mixed with domestic water to temper the discharge to a desired temperature. This tempered water would then be used within the HVAC system to “burn off” the humidity within the summer cooling season, used directly for heating during the winter months and also used in lieu of our water heaters for domestic water consumption. The net effect is to reduce, or eliminate to a large degree, use of our three boilers in the mechanical room, thereby reducing our consumption of natural gas.

One of the benefits of this specific project is that the technology and equipment is readily applied at the individual household level. The City’s entry into this technology serves as a demonstration for Chesterfield residents who desire to explore installation of identical technologies in their homes.

The proposed system is proprietary and sole sourced. In fact, the company which provides this system is Arctic Solar, a company based in Chesterfield. While the technology is widely available through multiple vendors, the efficiency and energy production of the solar tubes are not comparable. We have negotiated a price proposal and draft contract for Council’s consideration. Obviously, ***this was not a planned or budgeted project. If Council elects to proceed with this project, funds will have to be transferred from fund reserves. At this juncture, we estimate the total cost for the project to be approximately \$315,000. This amount includes the direct fixed contractual costs to Arctic Solar, and an allowance for work that is to be performed by the City, e.g. drilling through walls and roof penetrations. If recommended by the Planning and Public Works Committee, Staff would finalize the contract proposal and forward to the full City Council for consideration.***

A cursory review of the completed energy audit suggests that two separate projects are viable:

***The first, as described above, is a modest entry into the area of renewable energy through a solar thermal energy transference system which reduces our use of natural gas for HVAC and domestic water purposes. This system is capable of offsetting 650,000 kilowatt-hours of energy, roughly equivalent to 1,300,000 pounds of carbon dioxide annually. Conservative estimates suggest that the cost of implementation is to be recouped in approximately 7 – 8 years. This is the project that Staff recommends initially.***

The second project is a much larger investment and more significant

Mike Herring  
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commitment to the solar thermal concept. The second project involves extensive re-working of our HVAC system, using an absorption chiller for cooling support. It involves an installation of an additional 380 collector assemblies, three absorption chillers, and at least four buffer tanks. While this remains a viable project at an estimated cost of \$800,000, with an additional \$250,000 to \$500,000 for site work to accommodate the collector structures, tanks and piping. It is recommended that we consider this additional project only AFTER we have had a successful experience and established track record with our original solar thermal project.

Accordingly, at this juncture, ***we request direction from the Planning and Public Works Committee for the initial solar thermal project. If the direction is affirmed and the project moves forward, we will forward a final contract proposal to City Council along with a recommendation to transfer funds from fund reserves for this purpose.***

If you have any questions, please let me know.

Attachments

Energy audit  
Draft contract proposal

cc Kelly Vaughn, Director of Finance and Administration  
Brian McGownd, Public Works Director – City Engineer



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### ENERGY AUDIT

**Specification:** Final report with additions  
**Project:** Energy audit of the City Hall and an overview of additional facilities

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## DISCLAIMER

Any opinions, estimates or forecasts in the attached report regarding the predicted performance of the mentioned technical systems rely on the data given by manufacturers and clients. The simulations base on climate data by international agencies and may vary as to the nature of weather / climate data.

In no event shall S+P Ingenieure AG or its officers be liable for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information) arising out of the use or inability to use this report. Any liability for the expert opinion is disclaimed.

## ACKNOWLEDGEMENTS

S+P Ingenieure AG has prepared this report with the advice and help of the following persons we like to thank for their assistance, especially during the gathering of the required data on site:

Mike Geisel, P.E.  
(Director of Planning and Public Works, City of Chesterfield)

Les Siars  
(Building Maintenance Supervisor, City of Chesterfield)

Harvey J. Rosenberg  
(Special Assistant to Mayor John Nations Chesterfield, MO - Renewable Energy/Energy Alternatives)

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## I. CITY HALL - ENERGY AUDIT

### 1. Scope

This report of the energy audit is for use in the decision making process regarding the energy consumption and the use of renewable energy. The energy audit consist of the on site survey and the analysis of the gathered data. It includes the simulations for the use of renewable energy.

The energy audit of the City Hall has two main goals:

- Identification of the worst deficiencies regarding energy consumption and energy efficiency.
- Find a concept to deal with these deficiencies including the measures to be taken with the highest priority and the best return of investment. The concept should include the use of renewable energy.

The level of comfort is not an issue of the energy concept. All recommended measures have to maintain the given level of comfort.

### 2. Prerequisites / Description of Initial Situation

The City Hall of the City of Chesterfield is a modern building finished in 2001. The technical specifications of the building services were state of the art in 2000 / 2001.

The City Hall is used by the city administration and the city police. This includes the offices of the administration, the council chambers and the police offices with a detention area and a shooting range.

Five roof top units (RTU), a number of variable volume terminals (VAV) and one air handler unit (AHU) in the lower level supply the building with heating and cooling and the minimum outside air required.

Most of the heating is supplied by the VAVs by a water based system. The cooling is supplied by the RTUs.

The following documents were provided and are the basis of the analysis:

- As-build drawings (architectural, electrical, mechanical, etc.)
- Consumption documents (bills):
  - Gas from 01/19/2007 to 05/18/2009
  - Water from 06/11/2006 to 04/16/2009
  - Power from 01/09/2007 to 05/10/2009

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### 3. Analysis - Identification of Worst Deficiencies

The analysis of the gathered and the provided data regarding the energy usage and the energy efficiency of the City Hall results in the following findings:

**Building** - The building itself is solid with good insulation. The energy loss through the walls is inside the range of an energy efficient building.

**Windows** - The tinted windows provide a good insulations but would be better with blinds on the outside, especially in summer. Windows without blinds on the outside results in increased solar impact and increased energy usage for cooling in summer. There is typically small air leakage which occurs with window mountings. The windows in City Hall are well maintained. While not observed, it is assumed that minor leakage exists.

**Building Services** - The building services are state of the art of the year 2000 / 2001. The main technical systems are good maintained. There are some energy issues as found during the analysis. In particular:

**Humidity control** - to maintain an acceptable humidity during summer time, the supply air is cooled beyond the wet bulb temperature. Then it is reheated to match the needed temperature. This results in heating during summer and a major waste of energy/gas. While the humidity is controlled through the HVAC Energy Management system, the set points are manually entered. It is desirable to have the humidity controls respond automatically.

**Controls / Regulation** - Although the HVAC system is managed through the BacNet automated system, there is no automatic energy management. There is no automatic match between load and consumption. HVAC settings are manually entered into the management system.

**Lights** - The lights are not dimmed or shut off when there is enough light from the outside. This results in minor energy waste.

**Energy Recovery Unit** - The air handler for the supply of the lower level is equipped with an ERU. This unit has no bypass so the fan has to deliver the pressure to overcome the resistance of the ERU even when it is not in use. This results in minor energy losses.

**Hydraulic Balancing** - The water based heating system needs to be hydraulic balanced which it is not or only insufficient. This results in energy losses and mismatch of required room temperatures.

**Ramp Heating** - The access ramp to the lower level parking deck is heated in winter when the temperature drops below freezing. This causes minor energy wastage.

**Cost Allocation** - There is no cost allocation and no meters to put the actual costs for using special facilities as the council chambers to the responsible account.

**HVAC Refrigerant R-22** - The refrigerant of the HVAC system is R-22. After 2010, chemical manufacturers may still produce R-22 to service existing equipment, but not for use in new equipment. This will result in increasing maintenance costs. Unfortunately for the environment, releases of R-22, such as those from leaks, contribute to ozone depletion. In addition, R-22 is a greenhouse gas and the manufacture of R-22 results in a by-product (HFC-23) that contributes significantly to global warming.

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## 4. Sketch of Energy Concept

### 4.1. List of Possible Measures

- Installing a solar thermal system for supplying the necessary heat for the humidity control during summer and domestic hot water (DHW) including automatic humidity regulation.
- Installing a solar thermal based cooling system with an absorption chiller
- Conduct a hydraulic balancing of the water based heating system.
- Conduct an air leakage test.
- Installing outside blinds with automatic controls.
- Installing an energy management system as an addition to the already installed BACnet system.
- Installing meters for special facilities.

### 4.2. Description of Possible Measures

**Solar Thermal System for Heating and DHW** - Installing a solar thermal system for heating in summer (humidity control), heating support in winter and supply of domestic hot water would result in the following components:

160 solar thermal collector modules installed on the roof of the City Hall. **Alternative:** Installation of 160 solar thermal collector modules on top of car ports over the rectangular parking deck on the west side of the building.

2 buffer tanks with 1,000 gallons each installed on site. These tanks would be best placed in the lower parking deck.

Connecting the solar collectors and the tanks with pre-insulated steel pipes with valves, sensors, pumps, a regulation system and a security system.

Connecting the solar thermal system with the water based heating system in the mechanical room in lower level and connecting the control systems.

Adding automatic humidity regulation and sensors to the already installed BACnet system.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Solar thermal system consisting of 160 collector modules, 2 buffer tanks per 1,000 gal. and humidity regulation.	290,000	First year: 33,000 every year approx. 5% increase	7.5 (without funds)
30% from government funds Note: It is up to the city to verify their eligibility for these types of funds and to secure that funding.	-87,000		5.5 (with funds)

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

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**Solar Thermal Cooling** - Installing a solar thermal based system with an absorption chiller for cooling support and pre-heating of supply air during summer. This system consists of the following components:

Installing approx. 380 solar thermal collector modules on site. These modules would provide the necessary energy for 3 absorption chillers (100 kW each) that could cover the cooling for the City Hall.

This would result in retrofitting the RTUs with a water/glycol based system. In addition the waste heat of the absorption chillers could be used to pre-heat the supply air after it is cooled down and dehumidified. For this the main air ducts have to be retrofitted with water based heat exchangers.

This system could also be used to provide most of the heating during the whole year.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Solar thermal system consisting of 380 collector modules, 4-5 buffer tanks per 2,000 US.liq.gal. and 3 absorption chillers per 100 kW.	800,000	First year: approx. 75,000 every year 5% increase	8.5 (without funds)
30% from government funds Note: It is up to the city to verify their eligibility for these types of funds and to secure that funding.	-240,000		6.5 (with funds)

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

**Hydraulic Balancing** - The hydraulic balancing of the heating system consists of the following measures. Installing balancing valves in the piping of the water based heating system and adjust the valves to the right settings. This would not only save energy but results also in matching the requested room temperatures which is right now not achieved for every room / zone in the building.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Hydraulic balancing consisting of approx. 4 valves	3,000	First year: approx. 400 every year 5% increase	6.5

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

**Air Leakage** - Conducting an air leakage test to make sure that there is no major issue and a problem unsolved. Air leakage causes an energy loss during the whole year.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Air leakage test	3,500	-	-

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

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**Window Blinds-** Installing outside window blinds with automatic controls reduce the solar impact in summer and therefore reduce the energy needed for cooling. The downside is that the architectural appearance of the building is influenced by this measure.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Outside window blinds including automatic controls	50,000	First year: approx. 1.500 every year 5% increase	20

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

**Energy Management -** Adding an energy management to the already installed automation system. This would result in better matching of energy demand and energy consumption. This would increase the efficiency of the building services by approx. 5-10%.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Energy management for BACnet automation system	60,000 - 80,000	First year: approx. 7.500 - 15.000 every year 5% increase	5 - 9

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

**Metering actual consumptions -** This measure is not for saving energy but to know which system or user is consuming the most energy. The exact number of meters depends on the usage of the data. This data could be used in different ways, i.e. accounting and increasing awareness of energy related issues.

### 4.3. Energy Concept

An energy concept with renewable energy that makes sense should be at least based on the following measures:

- Installing a solar thermal system for supplying the necessary heat for the humidity control during summer and domestic hot water (DHW) including automatic humidity regulation.
- Conduct a hydraulic balancing of the water based heating system.
- Installing an energy management system as an addition to the already installed BACnet system.

These measures as described above have the strongest impact on the energy consumption of the City Hall and also have the best return of investment. In addition these measures have no or only minor need of retrofitting already installed systems inside the building services.

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## 5. Recommendations

As a result of the qualitative and quantitative analysis of the possible measures to improve energy efficiency and making a first step to reduce carbon dioxide and use renewable energy sources we recommend the following approach.

### 5.1. Solar Thermal System - First Step to Renewable Energy

First we strongly recommend the installation of a solar thermal system for supplying the necessary heat for the humidity control during summer and domestic hot water (DHW) including automatic humidity regulation as it is shown in the appendix. This measure has the greatest impact on energy usage accompanied by a good ROI.

The necessary modules can be put on the roof or on a car port spanning the rectangular parking deck on the west side of the City Hall. The cost of the car port is not included in the above mentioned system cost.

### 5.2. Hydraulic balancing

Second, install balancing valves in the current system concurrently with the installation of the piping for the solar thermal system. A cost savings will be realized as the system will already be drained at that time.

### 5.3. Energy Management

A very useful complementary measure is adding an energy management to the building automation system on BACnet basis. This would not only make the building more energy efficient but would also provide the building maintenance staff with the more robust tools to run the building services more smoothly.

### 5.4. Additional Steps

After gaining some experience with the above recommended installations a possible next step is using renewable energy for all the energy needs. This would be installing a solar thermal system for cooling and heating in addition to the system already in place. But we recommend this no sooner than after the first year of experience with solar thermal systems. An unsolved problem is where to put the additional solar collectors. This system needs after all nearly 400 modules.

After gaining some experience with the above recommended installations, a possible next step is using renewable energy for all the energy needs. This would involve the installation of a solar thermal system for cooling and heating in addition to the system already in place. However, we recommend this option be considered no sooner than after one full year of operation experience with primary recommended solar thermal systems.

Additionally, there are some unsolved problems related to this addition, such as where to put the additional solar collectors for such a system, considering that this system would require nearly 400 modules and a minimum 8,000 US.liq.gal. buffer tank storage space.

Conducting an air leakage test is something that can be done but is not necessary. The building maintenance is dealing very well with the loosening mountings of some windows so this is no major issue.

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Installing dimmable lights with all the necessary controls is also something that can be done in the future. But this only fine tuning of the building services. As long as the cost for energy increases only in minor steps there is no ROI for this measure.

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## II. CHESTERFIELD FACILITIES

### 1. Scope

The City of Chesterfield maintains several facilities. There is among others Central City Park, Public Works Facility and Parks.

For the following report short on site survey was conducted not comparable to an energy audit. The goal is to identify any obvious energy related issues and make an assumption whether use of renewable energy especially solar thermal systems are a feasible solution for these buildings.

### 2. Prerequisites

The following documents were provided and are the basis of the analysis:

- As-build drawings (architectural, electrical, mechanical, etc.). Not complete.
- Several consumption documents (bills) showing gas, water and electrical power of the last year. There is no differentiation whether the energy is used for lighting, water heating, space heating or cooling.

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### 3. Energy Issues and Evaluation for Use of Solar Thermal Energy

#### 3.1. Central City Park

In this facility there are only two consumers of gas. One is the kitchen which can not be replaced by using a solar thermal system. The other one are the 12 showers in the locker room area. The showers can be completely provided with hot water by a solar thermal system. This is a perfect match because people only use the Central City Park when there is enough sunshine for heating the water.

Also the buffer tank that is already installed can be used for the solar thermal system.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Solar thermal system consisting of 10 collector modules with piping and controls.	15,000	First year: approx. 500 every year 5% increase	18.5 (without funds)
30% from government funds Note: It is up to the city to verify their eligibility for these types of funds and to secure that funding.	-4,500		14.5 (with funds)

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

#### 3.2. Public Works Facility

In this facility there are two energy issues. One is closing and by that insulating the wall between work shop and office. This is easy and simple and can be done when the additional storage level is put in this area.

The space heating is provided by gas. This can be partly covered by using a solar thermal system in form of a low tech system consisting of 10 solar collector modules and water based heat radiators with thermostatic valves.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Solar thermal system consisting of 10 collector modules with piping, controls and radiators.	25,000	First year: approx. 500 every year 5% increase	>25 (without funds)
30% from government funds Note: It is up to the city to verify their eligibility for these types of funds and to secure that funding.	-7,500		21.5 (with funds)

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Board of directors: Dieter Sedlacek (CEO), Sabine Sedlacek (CFO) • Supervisory board chairman Hubert Vogel • District court Stuttgart • HRB 109053 • tax number DE145787814

Certified as per: DIN 14675, DIN ISO 9001:2000



S+P INGENIEURE

BUILDING SERVICES  
ENGINEERING

### 3.3. Parks CVAC

In this facility all energy consuming system are based on electrical power. The simple way to implement a system powered by solar would be a low tech system consisting of 10 solar collector modules and water based heat radiators with thermostatic valves.

Description	approx. cost (USD)	annual savings (USD)	ROI (years)
Solar thermal system consisting of 10 collector modules with piping, controls and radiators.	25,000	First year: approx. 500 every year 5% increase	>25 (without funds)
30% from government funds Note: It is up to the city to verify their eligibility for these types of funds and to secure that funding.	-7,500		21.5 (with funds)

The numbers are an estimate and need to be verified by actual quotes. No additional costs for retrofitting the building or other systems included.

### 3.4. Recommendations

Even with government funds it is economically nearly not feasible to implement renewable energy systems. As long as energy is at 0.03 USD per kWh these systems can only compete when the existing equipment is a good match as it is in the City Hall where there is water based space heating.

For the facilities at Central Park, Chesterfield Valley Athletic Complex and the Public Works Facility, the expense of a system based on renewable energy makes economic sense only when the environmental costs are considered in addition to the direct energy savings.

The best use for a solar thermal system would be the Central City Park facility. There the economical feasibility is within a ROI of 14.5 to 18.5 years which is still inside the life cycle of the solar thermal system.

Registered office  
Ferdinand-Braun-Straße 12  
D-74074 Heilbronn - Germany

Project office  
7201 N Lindbergh Blvd  
Hazelwood, MO 62042 - USA

BIC-VBHN: GENODE33 VHN  
IBAN 29620901000299213013  
Account No. 0299213013

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S+P INGENIEURE

BUILDING SERVICES  
ENGINEERING

### III. APPENDIX

- Functional diagram of solar thermal system, City Hall
- Plan of car port with solar modules, City Hall

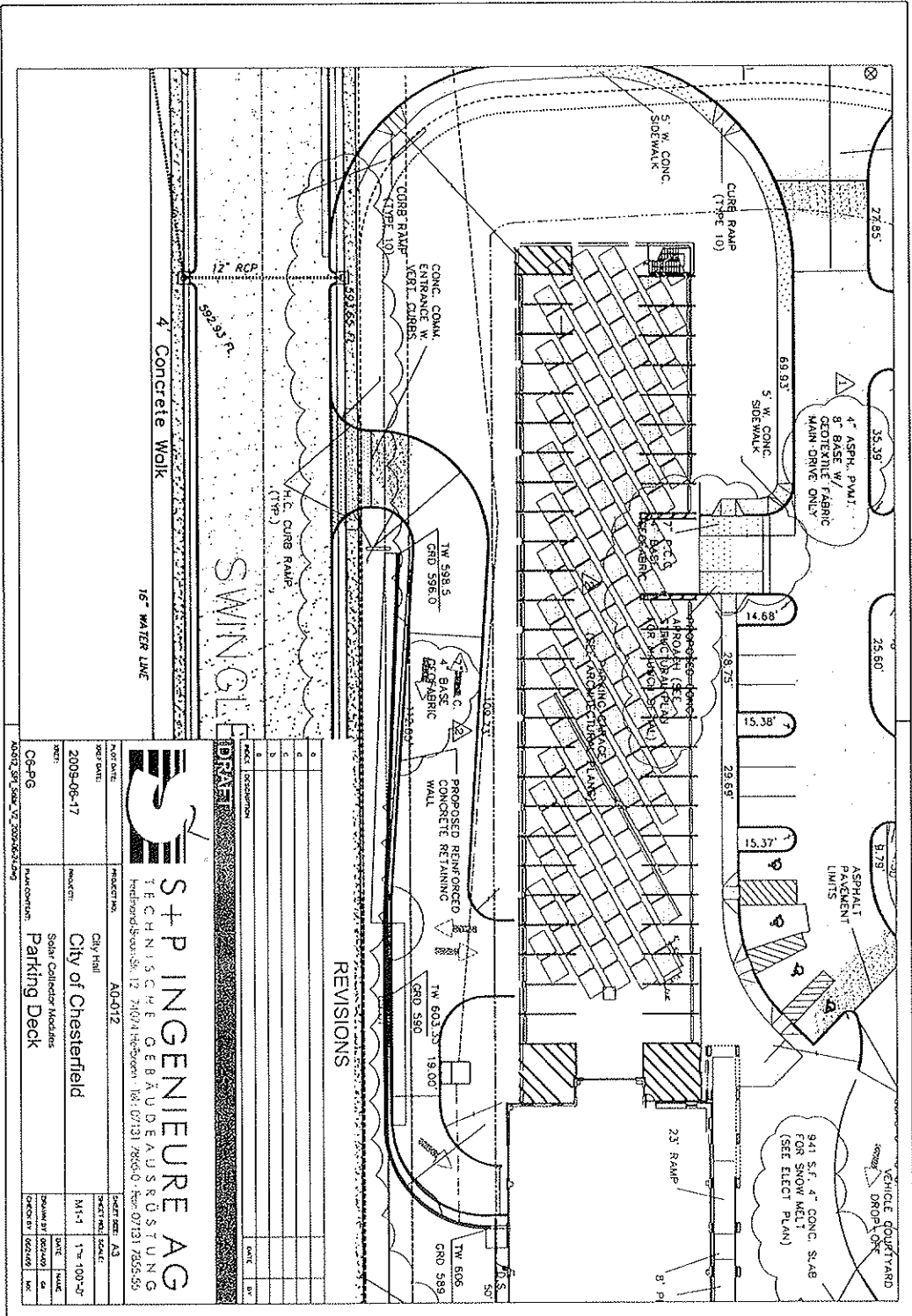
Registered office  
Ferdinand-Braun-Straße 12  
D-74074 Heilbronn - Germany

Project office  
7201 N Lindbergh Blvd  
Hazelwood, MO 62042 - USA

BIC-VBFN: GENODE31 VHN  
IBAN 29620901000299213013  
Account No. 0299213013

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REVISIONS

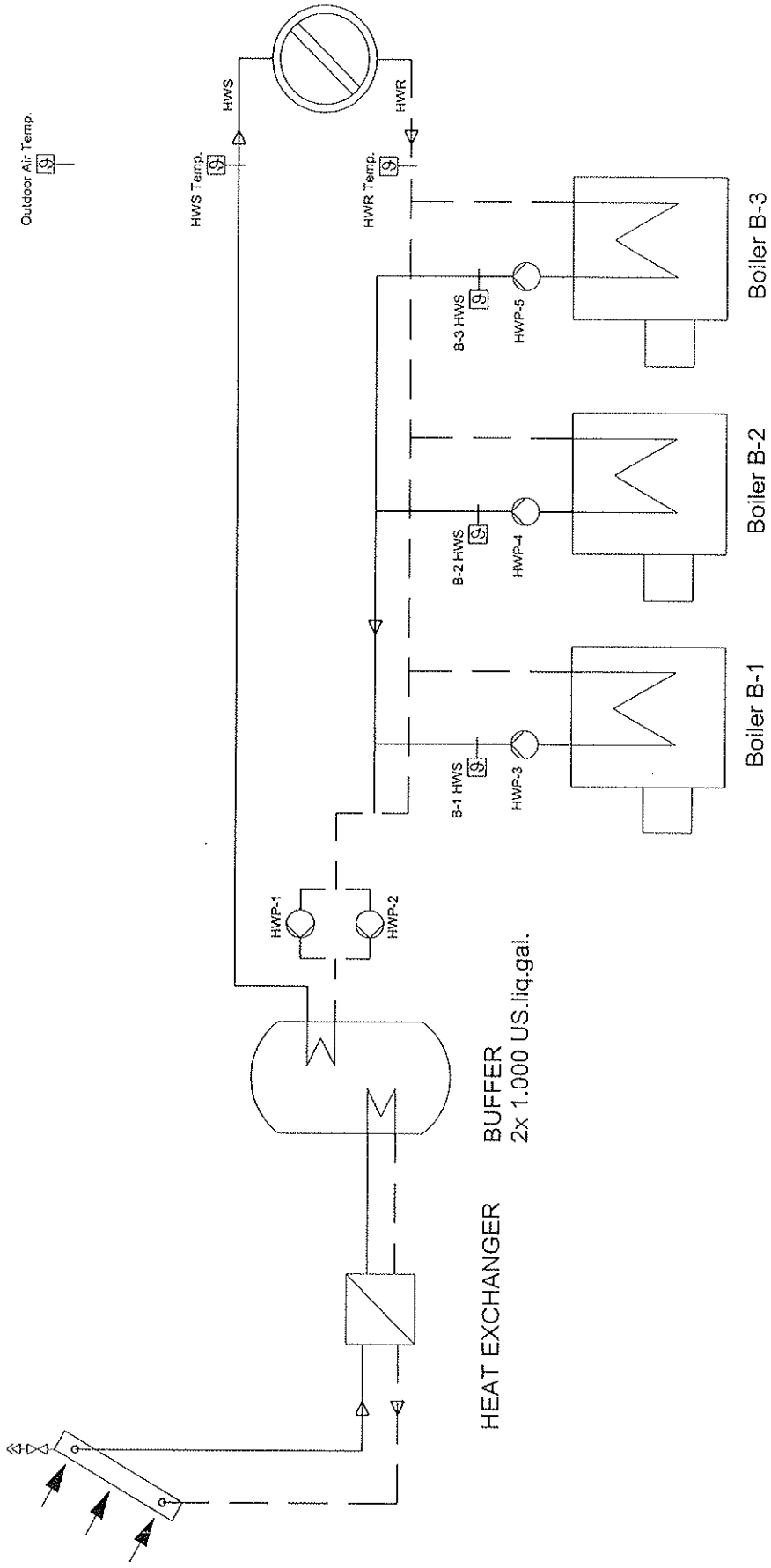
SWINGLE

**S+P INGENIEURE AG**  
 TECHNISCHE GEBAUDEINGENIEURUNG  
 Hindenburgstr. 12 74674 Heidenheim · Tel: 07131 7855-0 · Fax: 07131 7855-55

PROJEKT	CONSTRUCTION	PROJEKT NR.	A3
PROJEKT DATUM		PROJEKT DATUM	2009-06-17
PROJEKT ORT	City Hall	PROJEKT ORT	City of Chesterfield
PROJEKT ANWENDER	Solar Collector Modules	PROJEKT ANWENDER	Solar Collector Modules
PROJEKT ANWENDER	Parking Deck	PROJEKT ANWENDER	Parking Deck
PROJEKT LEITER		PROJEKT LEITER	
PROJEKT MITARBEITER		PROJEKT MITARBEITER	
PROJEKT MITARBEITER		PROJEKT MITARBEITER	
PROJEKT MITARBEITER		PROJEKT MITARBEITER	
PROJEKT MITARBEITER		PROJEKT MITARBEITER	
PROJEKT MITARBEITER		PROJEKT MITARBEITER	

06-06 2009.06.17 2009-06-17

160 x SOLAR - MODULES



PROJECT: CITY HALL , CITY OF CHESTERFIELD  
FUNCTIONAL DIAGRAM SOLAR THERMAL SYSTEM

MASTER AGREEMENT

FOR

SOLAR THERMAL SYSTEM SALE AND INSTALLATION

BY AND BETWEEN

ARCTIC SOLAR, LLC  
("ASE")

AND

THE CITY OF CHESTERFIELD, MISSOURI

a Municipal Corporation and Political Subdivision of the State of Missouri  
("Customer")

DATED

OCTOBER \_\_, 2009

By the signatures of their duly authorized representatives below, ASE and Customer, intending to be legally bound, agree to all of the provisions of this Master Agreement.

ARCTIC SOLAR, LLC

CITY OF CHESTERFIELD, MISSOURI:

By: \_\_\_\_\_

By: \_\_\_\_\_

Print: \_\_\_\_\_

Print Name: \_\_\_\_\_

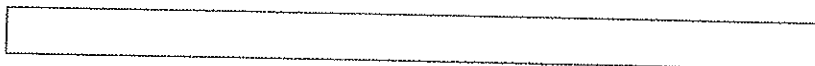
Print Title: \_\_\_\_\_

Print Title: \_\_\_\_\_

Date Signed: \_\_\_\_\_

Date Signed: \_\_\_\_\_

This Agreement is comprised of the general terms and conditions set forth below, and the terms and conditions set forth in one or more schedules executed by the parties hereto. The general terms and conditions set forth below are referred to collectively as the "Master Agreement." The projects to be performed by ASE shall be set forth on a schedule(s) (each a "Schedule"). Each Schedule entered into hereunder represents a separate contract between ASE and Customer that incorporates and is governed by all of the terms of this Master Agreement. No Schedule shall be valid, binding or enforceable unless executed by both Customer and ASE. If there is a conflict between the general terms and conditions set forth below, and a Schedule, the order of precedence shall be as follows: 1) the Schedule and 2) these general terms and conditions.



## GENERAL TERMS AND CONDITIONS.

1. PURCHASE - Customer agrees to purchase an evacuated tube solar collector system including the equipment necessary for the operation of such system to the design and performance specifications all as described on a Schedule (the entire integrated system being the "System," the equipment identified on such Schedule being the "Equipment" and such design and performance specifications being the "Specifications") for the price shown on each Schedule. ASE agrees to sell to Customer and install at the Premises (as hereafter defined) such System for the price shown on the applicable Schedule (the sale and installation of the System being sometimes referenced to as the "Project").
2. DELIVERY; TITLE - ASE hereby warrants that it is the sole owner of the Equipment and has full authority to transfer ownership of the Equipment to Customer without the consent of any other person. ASE will ship the Equipment to and install the Equipment at the location described in the applicable Schedule (each such location being the "Premises"). Title to and risk of loss on the Equipment shall pass to Customer upon delivery of the Equipment to the applicable Premises.
3. CHANGES AND ADDITIONS - If Customer desires ASE to modify the System following execution of a Schedule relative to such System, then following a request by Customer, ASE shall submit in writing to Customer a change order specifying the modification or additions to be made and the cost estimates therefore based on Customer's request. If the change order is accepted in writing by Customer as (an "Approved Change Order"), then ASE shall proceed to make the changes or additions specified in such Approved Change Order and the costs and expenses relative to such Approved Change Order shall be included in Project Price Additions (as defined in a Schedule). If written notice of the acceptance of a change order is not received by ASE within ten (10) days from the date of the change order, then ASE shall not make the requested changes or additions. Except as otherwise set forth in an Approved Change Order, all changes or additions made pursuant to an Approved Change Order shall be subject to the terms and conditions of this Agreement. Unless otherwise set forth in the Approved Change Order, equipment provided pursuant to an Approved Change Order shall be provided at ASE's normal and customary rates and shall be deemed Equipment hereunder. Customer agrees and covenants that, unless Customer otherwise notifies ASE in writing, the only person who may accept Approved Change Order on its behalf is Customer's Authorized Representative (as identified in the applicable Schedule).
4. INSTALLATION - Customer shall give ASE, its agents, representatives and contractors, full, free, and safe access to the Premises for such installation during the hours described in the applicable Schedule. Customer represents and warrants that, except as previously disclosed to ASE in writing in the applicable

Schedule, Customer is not aware of any asbestos or asbestos containing materials at, in or about the applicable Premises. Customer agrees promptly to notify ASE in writing if, at any time during installation, Customer becomes aware of asbestos or asbestos containing materials at, in or about the applicable Premises. ASE assumes no liability for (i) any conditions, including the presence of asbestos or asbestos containing materials, existing prior to ASE's performance under a Schedule, or (ii) increased levels of asbestos at any location at the applicable Premises other than that where ASE is in physical contact with asbestos or asbestos containing materials, provided that ASE follows customary safety practices when working with asbestos or asbestos containing materials. ASE's obligation shall be limited to restoring, at Customer's expense, the immediate areas of the applicable Premises in which ASE or its subcontractors worked during the installation to the same level of fireproofing protection as existed immediately prior to ASE's work. ASE's obligation to install a System shall be satisfied when the entire System has been installed at the applicable Premises in accordance with the applicable Schedule (the "Installation Date").

5. CUSTOMER RESPONSIBILITIES - As a condition to ASE's obligations under any Schedule, Customer shall provide ASE with the following:

- a. True and accurate as built plans and current survey for the applicable Premises.

- b. Current and complete copy of all covenants, conditions and restrictions encumbering the applicable Premises.

In addition, Customer shall cooperate with ASE in obtaining all necessary governmental and subdivision approvals necessary for ASE to be able legally to install or have installed the System.

6. ACCEPTANCE TESTING - Customer is deemed to have accepted the System on the Installation Date provided on such Installation Date, the System operates in accordance with the Specifications and does not, at such time, leak.

7. LIMITED WARRANTY - Except for a warranty of title to the Equipment in ASE until risk of loss has passed to Customer, ASE DISCLAIMS ALL WARRANTIES WITH RESPECT TO THE SYSTEM OR THE PROJECT WHETHER STATUTORY, BY OPERATION OF LAW, WRITTEN OR ORAL, EXPRESS OR IMPLIED INCLUDING WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND ANY WARRANTY ARISING OUT OF USAGE OR CUSTOM. ASE SHALL CAUSE TO BE DELIVERED TO CUSTOMER THE THE PRODUCT WARRANTY IN THE FORM ATTACHED TO THE APPLICABLE SCHEDULE.

8. LATE CHARGE - All fees which are due and payable by Customer under this Agreement which are not paid when due shall bear interest after the due date at the lesser of one percent (1%) per month, but not less than \$10.00, or at the highest applicable legal rate for open account business credit. Customer acknowledges that this paragraph shall not constitute an agreement by ASE to accept payments after they are due or commitment by ASE to extend credit or otherwise finance Customer's business.

9. INDEMNITY

A. Each Party (the "Indemnifying Party") agrees to indemnify, defend and hold the other Party, its employees, agents and representatives (the "Indemnified Party") harmless from and against any and all claims, lawsuits and other civil actions or proceedings commenced or threatened against any Indemnified Party by any party other than Customer or ASE (such party being a "Third Party" and such claims by any Third Party or Third Parties being "Third Party Claims"), and damages, awards, losses, liabilities, settlements, judgments, costs and expenses (including, without limitation, interest awards, litigation costs, and attorneys' fees awards) incurred by any Indemnified Party and resulting from or arising out of Third Party Claims ("Losses") in each case, to the extent resulting from or arising out of any of the following: (i) the negligence or willful misconduct of any affiliate of the Indemnifying Party, any employees, agents or contractors of ASE or of anyone acting by or through ASE (in the case of ASE as Indemnifying Party), any employees or agents of Customer (in the case of Customer as Indemnifying Party); (ii) failure of the Indemnifying Party to comply with the terms of this Agreement, including any representations or warranties hereof (or an allegation which, if true, would be a breach of this Agreement); (ii) the Indemnifying Party's failure to obtain in a timely fashion any Party or Third Party consents it is expressly obligated to obtain under this Agreement; but excluding claims that are found to have resulted from the negligence or willful misconduct of the Indemnified Party.

B. If a Third Party Claim is commenced against any Indemnified Party entitled to receive indemnity and defense under this Agreement in respect of such Third Party Claim, the Indemnified Party shall give notice to the Party that is obligated to provide indemnification under this Agreement as promptly as practicable but in any event, within a period that will not prejudice the rights of the Indemnified Party under this Agreement or the ability of the Indemnified Party to defend the Third Party Claim. After such notice, the Indemnifying Party shall assume the defense of such Third Party Claim, and may employ and engage attorneys reasonably acceptable to the Indemnified Party to handle and defend the same, at the Indemnifying Party's sole cost and expense. The Indemnified Party shall cooperate in all reasonable respects with the

Indemnifying Party and its attorneys in the investigation, trial, defense and settlement of such Third Party Claim and any appeal arising there from, and the Indemnifying Party shall reimburse the Indemnified Party for out-of-pocket expenses incurred in providing such cooperation. The Indemnified Party may participate in such investigation, trial, defense and settlement of such Third Party Claim and any appeal arising there from, through its attorneys or otherwise, at its own cost and expense, except that if the Indemnifying Party fails to deliver notice acknowledging its obligations to provide defense and indemnity in respect of the Third Party Claim, and to commence defense, within a reasonable time given the nature of the Third Party Claim and the notice and response time permitted by law or the facts and circumstances, then the Indemnified Party shall have the right to defend, settle or otherwise resolve the Third Party Claim insofar as it relates to the Indemnified Party in such manner as the Indemnified Party may deem appropriate, at the cost and expense of the Indemnifying Party, and without the consent of the Indemnifying Party, and the Indemnifying Party may participate in such defense, at its sole cost and expense. An Indemnifying Party may not settle any Third Party Claim without first obtaining the written consent of, as applicable, the Indemnified Party if such settlement admits liability on the part of such Client Indemnified Party or imposes any liability or obligation upon such Client Indemnified Party.

10. INSURANCE - ASE shall provide and maintain and shall cause its contractors to provide and maintain insurance of the following types and limits of liability:

A. Workers' Compensation, which shall apply to all persons employed by ASE and which shall conform to the statutory requirements of each state in which ASE performs work.

B. Comprehensive General Liability, with a combined single limit of liability of \$1,000,000 for bodily injury and property damage for each occurrence.

C. Business Automobile Liability, covering all owned, non-owned and hire automobiles of ASE with a combined single limit of liability of \$1,000,000 for bodily injury and property damage for each accident.

ASE shall furnish the Customer with certificates of insurance for the foregoing insurance requirements. The certificates for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf, and are to be received and approved by the Customer before work commences. The Customer reserves the right to require complete, certified copies of all required insurance policies, at any time.

11. PREVAILING WAGE - ASE covenants and agrees to take all such actions as are necessary to ensure that not less than the prevailing hourly rate of wages shall be paid to all workmen performing work under this Agreement. Pursuant to Section 290.250, RSMo., ASE

shall forfeit as a penalty to the Customer one hundred dollars for each workman employed, for each calendar day, or portion thereof, such workman is paid less than the said stipulated rates for any work done under said Agreement, by ASE or by any subcontractor under ASE.

12. LIMITATION OF REMEDY - ASE's entire liability and the Customer's exclusive remedy for damages from services performed pursuant to any Schedule from any cause whatsoever, and regardless of the form of action, whether in contract or in tort, including negligence, shall be limited to an amount equal to the total amounts paid by the Customer to ASE under such Schedule. In no event will ASE be liable for any lost profits, lost savings, incidental damages or other consequential damages, even if ASE has been advised of the possibility of such damages. ASE will not be liable for any claim by the Customer based on a claim made against the Customer by any third party. ASE shall not be liable for any damage to non-ASE products connected to the System unless such damage is caused directly by ASE's negligence and even then, ASE's liability shall be limited as provided in this Section 12.

13. ATTORNEYS' FEES - If either party prevails in any claim, action, or proceeding arising out of or relating to this Agreement, or any appeal thereof, then the prevailing party shall be awarded its costs and expenses, including, but not limited to, reasonable accounting, paralegal, expert witness, and attorneys' fees, whether incurred prior to, in preparation for or in contemplation of the filing of any such claim, action, or proceeding, or any appeal thereof.

14. CUSTOMER REPRESENTATIONS AND WARRANTIES - Customer represents and warrants that the individual signing this Agreement on its behalf has the power and authority to enter into this Agreement and that this Agreement constitutes a valid and binding obligation of Customer.

15. ASE REPRESENTATIONS AND WARRANTIES - ASE represents and warrants that it is in compliance with any and all federal and state immigration laws, including without limitation, the Federal Immigration Reform and Control Act and the Illegal Immigration Reform and Immigrant Responsibility Act, and sections 285.500 to 285.555, RSMo. (the "Acts"). ASE, on behalf of itself and any affiliated entity, further agrees that it shall cause to be inserted in its contracts with all subcontractors a similar representation and warranty from such subcontractors and an acknowledgement from such subcontractors that the Acts prohibit the hiring and continued employment of unauthorized aliens and further agrees that it shall require verification and record keeping with respect to identity and eligibility for employment, including the use of "E-Verify", when applicable and required by law.

16. MERGER CLAUSE - The entire agreement of ASE and Customer is embodied in this writing, including the Schedules attached hereto and made a part

hereof by the terms of this Agreement. This writing constitutes the final expression of the parties' agreement.

It is a complete and exclusive statement of the terms of that agreement and it supersedes all prior understandings or agreements of the parties, if any, relating to the subject matter of this Agreement.

17. UNCONTROLLABLE CIRCUMSTANCES - ASE shall not be liable for any delay or failure to perform its obligations under this Agreement, any Schedule or otherwise if such delay or failure arises from any cause or causes beyond its reasonable control, including but not limited to, labor disputes, strikes, other labor or industrial disturbances, adverse actions of the elements, including floods or lightning, shortages of materials, rationing, utility, or communication failures, earthquakes, casualty, war, acts of the public enemy, riots, insurrections, embargoes, blockages, actions, restrictions, regulations or orders of any government, agency or subdivision thereof. In any such event, the date for ASE's performance shall be deferred for a period of time equal to the time lost by reason of such event.

18. GOVERNING LAW - This Agreement shall be governed by the laws of the State of Missouri and shall be deemed to be entered into and performed in such state. The Customer consents to the jurisdiction and venue of the courts of the State of Missouri and to any federal court situated in such state.

19. DISPUTE RESOLUTION - In an effort to resolve any disputes that arise during the scope of this Agreement, ASE and the Customer agree in good faith to attempt to resolve amicably, without litigation, any dispute arising out of or relating to this Agreement. In the event that any dispute cannot be resolved through direct discussions, the parties agree to endeavor to settle the dispute by mediation. Either party may make a written demand for mediation, which demand shall specify in detail the facts of the dispute. The matter shall be submitted to a Mediator who shall hear the matter and provide an informal opinion and advice. Said informal opinion and advice shall be nonbinding on the parties but shall be intended to help resolve the dispute. The Mediator and the location where the mediation is held will be mutually agreeable between the parties. The Mediator's fees shall be shared equally by the parties.

ASE and the Customer further agree to include a similar mediation provision in all agreements with independent contractors and consultants retained for the Project and to require all independent contractors and consultants also to include a similar mediation provision in all agreements with subcontractors, subconsultants, suppliers or fabricators so retained, thereby providing for mediation as the primary method for dispute resolution between the parties to those agreements.

Unless otherwise resolved in accordance with this Article, all claims and disputes between ASE and the

Customer shall be resolved by litigation, and not by arbitration.

20. NOTICES - All notices and other communications which are required or permitted hereunder, shall be in writing and shall be deemed to have been duly given when delivered personally, when sent when mailed, certified mail, return receipt requested postage prepaid, when sent by a nationally

known overnight delivery service, or when sent by telephone facsimile confirmed by overnight delivery service, to the parties at the addresses or facsimile numbers indicated following the parties' signatures to this Agreement (or at such other address as shall be specified by notice).

[Signatures appear on next page]

IN WITNESS WHEREOF, the duly authorized representatives of ASE and Customer have executed this Agreement, effective as of the date on the first page.

**ARCTIC SOLAR, LLC**

BY: \_\_\_\_\_

DATE: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Facsimile: \_\_\_\_\_

**CITY OF CHESTERFIELD, MISSOURI**

\_\_\_\_\_

BY: \_\_\_\_\_

DATE: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Phone: \_\_\_\_\_

Facsimile: \_\_\_\_\_



SCHEDULE A

TO

SOLAR THERMAL SYSTEM PROJECT AGREEMENT  
BETWEEN  
ARCTIC SOLAR ENGINEERING, LLC  
("ASE")

AND

THE CITY OF CHESTERFIELD, MISSOURI

a Municipal Corporation and Political Subdivision of the State of Missouri

("Customer")

DATED

October \_\_\_\_, 2009

Project: Chesterfield City Hall Solar Thermal Installation

Owner: The City of Chesterfield

Article 1

1.1 ASE agrees to perform or cause to be performed by qualified contractors the Work described in and in accordance with the Contract Documents (the "Work") for the Price (as hereafter defined). ASE will furnish or cause to be furnished all of the labor and materials, along with competent supervision, shop drawings and samples, tools, equipment, scaffolding, and permits which are necessary for such performance.

1.2 The Contract Documents are (and are deemed incorporated herein by this reference):

1. The Master Agreement between ASE and Customer dated \_\_\_\_\_.
2. This Schedule.
3. Specifications (as defined in the Master Agreement) dated \_\_\_\_\_, attached hereto as Exhibit A.
4. Equipment, as described on Exhibit B attached hereto.
5. Work timeline and completion schedule, attached hereto as Exhibit C.
6. Product Warranty attached hereto as Exhibit D.
7. Customer Materials, attached hereto as Exhibit E.
8. Customer Work, attached hereto as Exhibit F.
9. Staging Area, attached hereto as Exhibit G.
10. Customer Training, attached hereto as Exhibit H.

Article 2

PAYMENTS

2.1 PAYMENT TERMS - The total price for Project (excluding Project Price Additions as hereafter defined) is Two Hundred Forty Thousand Dollars (\$280,000) ("Total Project Price"), which shall be paid as follows:

- Upon execution of this Agreement, Fifty percent (50%) of the Total Project Price.
- Upon Delivery of the Solar Manifolds and array frames, Twenty percent (20%) of the Total Project Price.
- Upon installation of the solar collector array frames, Twenty percent (20%) of the Total Project Price.
- On the Installation Date, hereafter defined, Ten percent (10%) of the Total Project Price.

However, if on the Installation Date, past amounts are due, then Customer shall pay all amounts due, including Late Charges as defined herein as a condition to the installation of the System.

The following constitutes Project Price Additions which Purchaser shall pay with the last payment provided above:

- Sales and use taxes (estimated to be \$0.00)
- Freight and shipping charges (based on actual invoices for local delivery to the job site)
- Costs and expenses resulting from Approved Change Orders (as defined in the Master Agreement)

### Article 3

#### MISCELLANEOUS

3.1 Customer's Authorized Representative for all matters relative to the Project described by this Schedule is \_\_\_\_\_.

3.2 ASE's obligations to commence and proceed with the Project are contingent upon the following:

1. ASE has obtained all necessary building and other permits and other governmental and subdivision approvals relative to installation of the System.
2. ASE confirming that there are no prohibitions against installation of the System under applicable ordinances and covenants, conditions and restrictions.
3. Customer having delivered the Customer Materials to the Premises by the date(s) indicated on Exhibit E.
4. Customer shall have performed or caused to have been performed the Customer Work and ASE shall have approved same in its discretion.

3.3 Customer's obligations:

1. Customer shall permit ASE and its contractors to access the Premises on the following days and times:  
Monday through Friday, 7:00 AM – 5:00 PM. Weekends and holidays as required and agreed upon by Customer.
2. Customer shall supply at the Premises, at Customer's sole cost and expense, the materials indicated on Exhibit E attached hereto and incorporated herein by this reference by the date indicated on such Exhibit E (the "Customer Materials").
3. Customer shall perform or have performed, at Customer's sole cost and expense, the work indicated on Exhibit E attached hereto and incorporated herein by this reference by the date indicated on such Exhibit F ("Customer Work").
4. Customer shall have provided, at Customer's sole cost and expense, an equipment staging area on the Premises as shown on Exhibit G ("Staging Area").

[SIGNATURES APPEAR ON NEXT PAGE]

Contract No. \_\_\_\_\_

IN WITNESS WHEREOF the parties hereto have executed this Schedule the day and year first above written.

City of Chesterfield, Missouri  
Customer

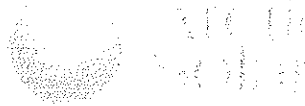
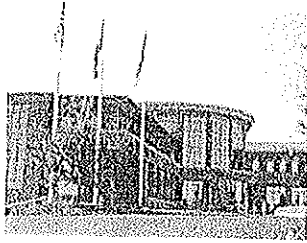
By \_\_\_\_\_

Arctic Solar Engineering, LLC

By \_\_\_\_\_

Exhibit A

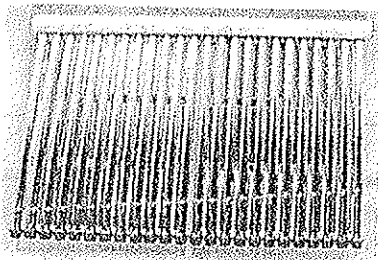
Specification (Design and Performance)



Chesterfield City Hall  
Solar System

Technical Parameters

Solar collector field



- Each collector 2.5 kW peak power
- Total output 322.5 kW max
- Yearly savings 658,800 kWh (incl. control savings)
- Equals 1,300,000 lbs of CO<sub>2</sub> savings/year
- 129 vacuum tube collectors with 25 tubes each
- (values may vary depending on weather conditions)

Functional description



- Collectors heat water up to 210 F
- 3000 gal/hour water heats 10,000 gal buffer tank (in Garage)
- Tank is made of stainless steel

Functional description – hot water

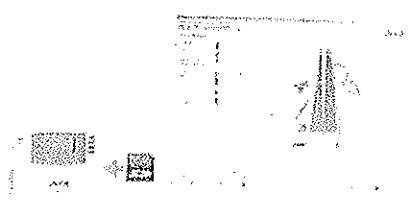
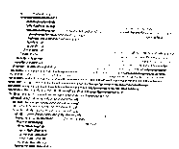
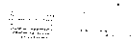


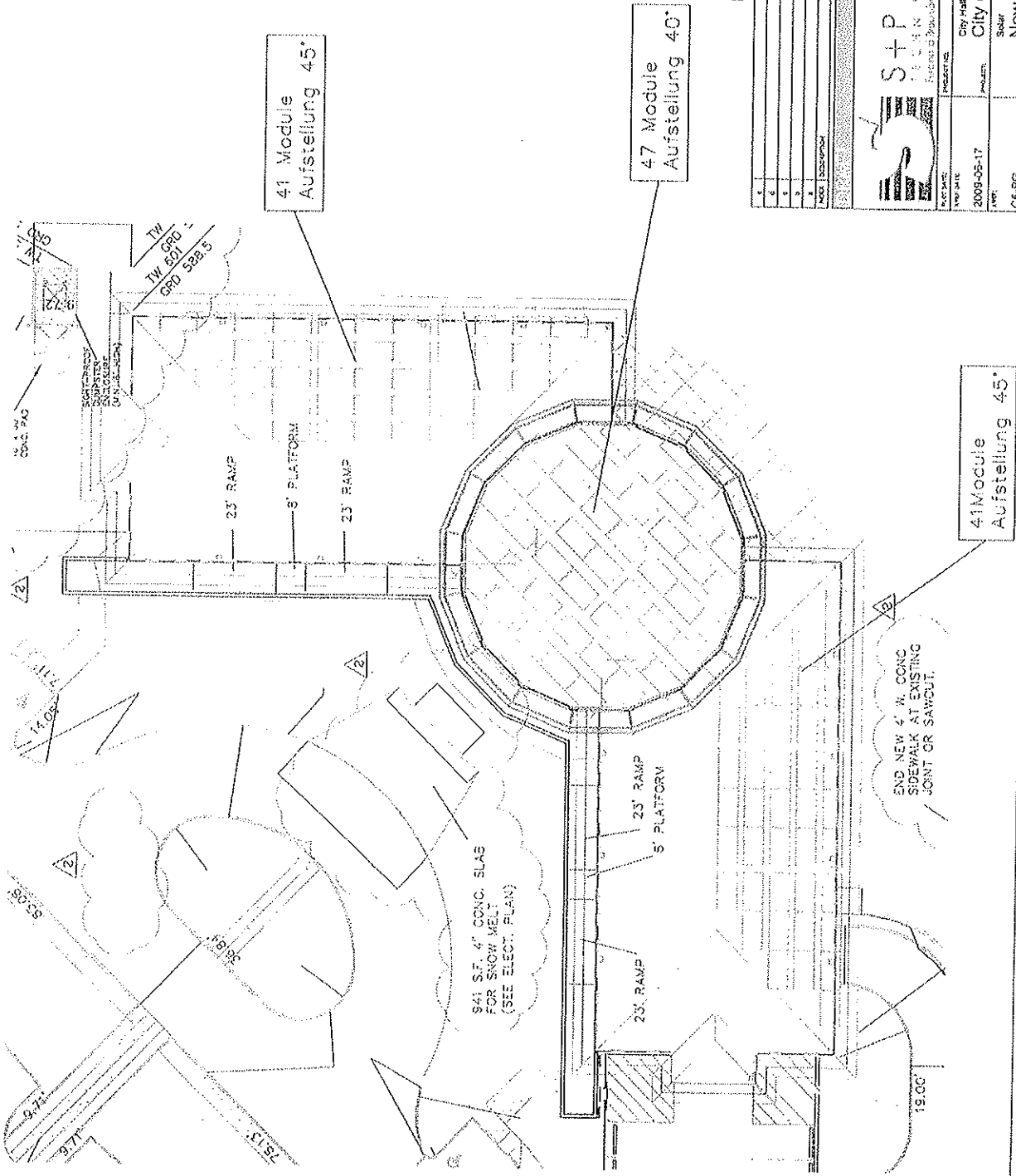
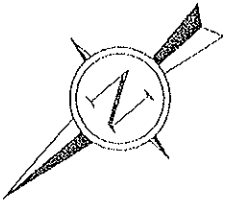
- Water from buffer tank is circulated through plate heat exchanger
- Heat exchanger heats existing hot water heating system
- Gas heating kicks only in when buffer tank is empty

Exhibit A - Continued

Functional description – computer control

- 2 computer systems:
  - Solar field controller controls water flow
  - Accounting computer calculates energy savings and displays them in lobby





REVISIONS

NO.	DATE	DESCRIPTION	BY
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

**S+P INGENIEURE AG**  
 TECHN. SCHIENENBAU  
 FRIEDRICH-SCHUBERT-STR. 12 74624 HESSELN 07141 78525-0  
 FAX 07141 78525-25

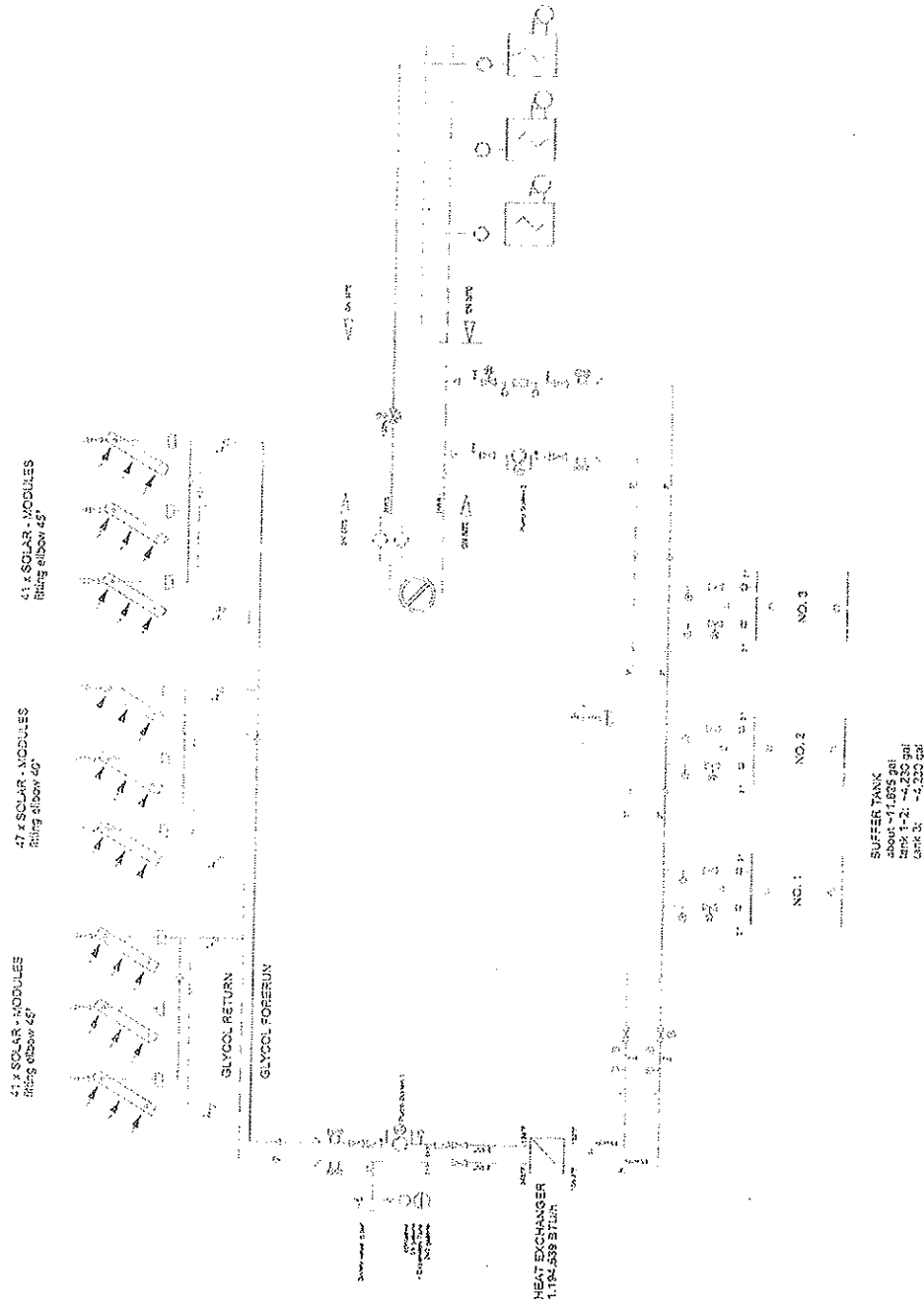
PROJECT NO. AG-012

CITY/HALB: City of Chesterfield  
 PROJECT: Solar  
 DRAWING: New Government Center

DATE: 2009-05-17  
 SCALE: 1" = 200'-0"

PROJECT MANAGER: [Name]  
 ARCHITECT: [Name]  
 ENGINEER: [Name]

Exhibit A - Thermal System Diagram



- 1. SOLAR MODULE
- 2. GLYCOL RETURN
- 3. GLYCOL FORWARD
- 4. HEAT EXCHANGER
- 5. SUPER TANK
- 6. PUMP
- 7. VALVE
- 8. METER
- 9. AIR/FLUID CONTROL VALVE
- 10. CONTROL VALVE
- 11. THERMISTOR
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PRELIMINARY DRAFT

STP ENGINEERING & ARCHITECTURE

ARCHITECTURAL DIVISION

ARCHITECT: Arctic Solar

CHILLING SCHEMA - SKETCH



**Exhibit B  
Equipment**

Description		Amount	
1.	Solar-Modules		
1. 1.	solar-Modules		
1. 1. 10.	tube Collector	129	pcs
1. 1. 20.	support brackets for existing modules	129	pcs
1. 1. 30.	pump solar	1	pcs
1. 1. 40.	pump heat	1	pcs
1. 1. 50.	saftey device solars thermal system	1	lst
1. 1. 60.	regulsting valve 3/4"	18	pcs
1. 1. 70.	valve DN65	10	pcs
1. 1. 80.	valve DN50	6	pcs
1. 1. 90.	valve DN25	18	pcs
1. 1. 100.	dirt trap DN 65	2	pcs
1. 1. 110.	purging valve DN15	5	pcs
1. 1. 120.	air beld valve DN15	56	pcs
1. 1. 130.	deerator Solar	2	pcs
1. 1. 140.	analog thermometer incl. fitting	16	pcs
1. 1. 150.	pressure meter	8	pcs
1. 1. 160.	reguation an control system	1	lst
1. 1. 170.	water glycol mixture	700	ltr
1. 1. 180.	heat exchanger solar / heating 350 kW	1	pcs
1. 1. 190.	hot water puffer tank include 44 m <sup>3</sup>	1	pcs
1. 1. 200.	3-way-valve DN 80	1	pcs
1. 1. 210.	regulsting valve DN 50 incl. actuator	6	pcs
1. 2.	Pipes		
1. 2. 10.	steel pipe DN65	500	ft
1. 2. 20.	steel pipe DN50	270	ft
1. 2. 30.	steel pipe DN40	60	ft
1. 2. 40.	steel pipe DN32	380	ft
1. 2. 50.	steel pipe DN20	270	ft
1. 2. 60.	steel pipe DN15	1400	ft
1. 2. 70.	addition for fittings steel	1	lst
1. 3.	Insulation		
1. 3. 10.	insulation solar steel pipe DN65	430	ft
1. 3. 20.	insulation solar steel pipe DN50	270	ft
1. 3. 30.	insulation solar steel pipe DN40	60	ft
1. 3. 40.	insulation solar steel pipe DN32	380	ft
1. 3. 50.	insulation solar steel pipe DN20	270	ft
1. 3. 60.	insulation solar steel pipe DN15	1320	ft
1. 3. 70.	insultion for fittings	1	lst
1. 3. 80.	insulation for pumps	2	pcs
1. 3. 90.	insulation for valves DN 65	12	pcs
1. 3. 100.	insulation for valves DN 50	12	pcs
1. 4.	other services		
1. 4. 10.	sectional Steel Construction	300	kg
1. 4. 20.	description sign	15	pcs
1. 4. 30.	pipe marker	33	ft
1. 4. 40.	flush, venting solar system	1	lst
1. 4. 50.	pressure test	1	lst
1. 4. 60.	hydraulic control, regulation equipment	1	lst
1. 4. 70.	core hole D=200mm	10	pcs
1. 4. 80.	core hole D=300mm	2	pcs
1. 4. 90.	job site equipment	1	lst
1. 5.	humidity control system		
1. 5. 10.	humidity control system	1	lst

Exhibit C

Work Timeline and Completion Schedule

1. Delivery of components 90 days after down payment
2. Installation of collectors on roof 2 – 3 weeks
3. Installation of tank, piping between tank and solar system 2 – 3 weeks
4. Hydraulic integration between existing heating system and solar system 1 - 2 weeks. For the integration of the plate exchanger into the heating system of the building we should have a weekend between Friday night and Sunday night, as we will need to turn off the heat for this process. (Most likely estimate of time for this is 4 – 6 hours, but if issues occur, more time may be required.)
5. Startup and software modification 1 week
6. Installation of energy metering system and display in lobby 1 week.

Certain schedule components may not be started until specific Customer Work has been completed. A full project schedule will be developed upon order. Customer must complete Customer Work in accordance with the schedule in order for the overall project schedule to be maintained.

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# ARCTIC SOLAR ENGINEERING, LLC

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## Evacuated Tube Solar Collector Warranty

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Effective Date: October 2009

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**Warranty and Maintenance Policy  
Evacuated Tube Solar Collector**

**1.) General**

This Warranty and Maintenance Policy (the "Policy") is issued by Arctic Solar Engineering, LLC ("ASE") and applies only to a new thermal solar collector purchased by the end user ("Customer") from an authorized ASE distributor or dealer (collectively, the "System" with such ASE distributor or dealer being the "ASE Dealer"). Except to the extent excluded from coverage under this Policy, this Policy covers the solar thermal collector as a whole including all of its components and parts (the "System) on and subject to the terms and conditions provided herein.

**2.) Policy Effectiveness**

This Policy shall be effective upon completion of the installation of the System and acceptance thereof by Customer as evidenced by a completed installation form executed by the certified ASE Installer (the "Installer") and Customer (such completion and acceptance being "Installation" and such Installation form being an "Installation Form"), one original copy of which shall be left with the Customer and another original copy to be retained by the Installer. This Warranty is only applicable for Systems installed and completed by an installer certified by ASE.

**3.) The Warranties under this Policy are as follows:**

- (a) ASE warrants its manifold copper pipe to be free from defects resulting in leakage of heat transfer liquid when operating within specified allowable pressure limits, flow rates and using approved liquids in both material and workmanship for a total period of five (5) years from date of Installation. If a failure, except for exclusions specified herein, does occur during the warranty period, ASE will provide a new part, or at ASE's option, repair any part of the collector. A new warranty shall apply to any replacement part, but shall be limited in time to the remainder of the original warranty period. The customer must provide a dated photograph of the solar collector (including the serial number) showing a water trail from the solar collector. A copy of the Installation Form must also accompany the claim. Any labor required under this Paragraph 3(a) shall extend for one (1) year from date of Installation.
- (b) ASE warrants its solar evacuated tubes to be free from defects resulting in loss of vacuum for five (5) years from date of Installation. This warranty excludes loss of vacuum due to breakage during transport, or handling during installation. Gradual reduction in vacuum levels over time are normal and accordingly are not defects in violation of this warranty. If a failure does occur during the warranty period, ASE will provide a new part, or at ASE's option, repair any part of the collector. A new warranty shall apply to any replacement part, but shall be limited in time to the remainder of the original warranty period. The customer must provide a dated photograph of the evacuated tube (including the serial number if available) showing no structural tube damage and a white bottom end. A copy of the Installation Form must also accompany the claim. Any labor required under this Paragraph 3(b) shall extend for one (1) year from date of Installation.
- (c) ASE warrants the heat transfer liquid storage tanks to be free from defects resulting in leakage of the heat transfer fluid for one (1) year from Installation. Any labor required under this Paragraph 3(c) shall extend for one (1) year from the date of Installation.
- (d) ASE warrants the water heater to be free from defects resulting in the malfunction of or leakage from such water heater for one (1) year from Installation. Any labor required under this Paragraph 3(d) shall extend for one (1) year from the date of Installation.
- (e) ASE warrants all parts and components identified on Schedule 1 resulting in the malfunction of the System for one (1) year from Installation. Any labor required under this Paragraph 3(e) shall extend for one (1) year from the date of Installation.

4.) The components and parts listed on Schedule 1, are not covered by any warranty hereunder but rather by, to the extent of and subject to all terms and conditions of (including all limitations thereon and thereof), the applicable manufacturer's warranty, copies of which Customer shall receive with the Installation Form, which ASE shall either, in ASE's discretion, (i) make commercially reasonable efforts to seek to enforce on Customer's behalf if allowed to do so under such manufacturer's warranty or (ii) shall assign such manufacturer's warranty to Customer if necessary for the processing of a claim under any such manufacturer's warranty.

#### 5.) Exclusions From Warranties

The Warranties granted under this Policy will not apply to, or in the event of, any of the following:

- a. Any use of all or any part of the System for any purpose other than its ordinary purpose, as well as damage from abuse, customer neglect or acts of omissions, vandalism, accident, fire, flood, hail, wind or acts of God or other event beyond the reasonable control of ASE;
- b. Malfunctioning of System due to internal freezing of pipes;
- c. Malfunctioning of System due to failure of mounting brackets, fasteners or, nails, straps or other components for solar collector mounting that are either not supplied by ASE or not fastened to structurally sound material according to the installation instructions supplied by ASE;
- d. Malfunctioning of System resulting from environmental conditions (including hurricane wind load) or mechanical forces that exceed the levels that component materials can be reasonably expected to withstand;
- e. Any portion of the System is opened or altered in any way by any person or entity other than an ASE certified representative;
- f. Malfunctioning of the System resulting from failure by Customer to maintain the equipment in accordance with the required equipment maintenance requirements and specifications;
- g. Malfunctioning of System due to maintenance, modification, replacement, relocation, repair or other manipulation of or on the Product by persons not certified to do so by ASE;
- h. When installed in a system using a glycol based heat transfer liquid and the solar collector is left exposed to daily sunlight without hot water usage or effective heat dissipation;
- i. The solar collector is left dry (no liquid circulation) and exposed to daily sunlight (not covered) for a period of time exceeding ten (10) consecutive days; or
- j. Faulty installation of all or any part of the System.
- k. Any parts or components of the System provided by Customer.

#### 6.) WARRANTY VOIDABILITY

- A. The applicable warranties otherwise provided under this Policy hereunder as to the parts and components described in Paragraph 3 shall be void and of no force and effect in the event of:
- (i) Any work on any part of the System is supplied by or performed by Customer, its agents, employees or contractors (other than ASE, its employees, authorized agents and authorized contractors; or
  - (ii) Any maintenance, modification, replacement, relocation or repair or other manipulation of or on the System by persons not certified to do so by ASE;
  - (iii) The serial tag initially attached to the System is removed or defaced.

#### 7.) Maintenance

ASE shall provide the following System maintenance services for the one (1) year period from Installation:

- a. Biannual System evaluation;
- b. Biannual air bleeding; and
- c. Biannual cleaning

#### 8.) Customer Claim

A Customer must notify ASE in writing by certified mail return receipt requested postage prepaid at P.O. Box 4391, Chesterfield, MO 63006-4391 (with such notice being effective upon such delivery in the mail as aforesaid describing any defect in the System that Customer believes is covered by a

warranty hereunder or a manufacturer's warranty). Any such notice must be delivered to ASE prior to the end of the applicable warranty period (including any applicable manufacturer's warranty period) and ASE shall have no obligation for addressing the defects identified in a notice delivered after the end of the applicable warranty period. The ASE will research the defect to determine if it is covered by this warranty or any manufacturers warranty. ASE will have the right in its sole and absolute discretion to determine whether or not the defect violates the applicable warranty hereunder. Customer's sole and exclusive remedy with respect to any breach of any warranty (as determined by ASE in its sole discretion) during the applicable warranty period will be the repair or replacement of the part or component by a designee of ASE or, in ASE's sole discretion a refund of the unamortized portion (amortized over ten (10) years from Installation discounted at nine percent (9%) per annum purchase price of the System to the Customer in which event this Policy shall terminate upon such refund. These remedies will be provided within a reasonable amount of time and without additional charge. ASE will not be responsible for any costs or expenses associated with the investigation or analysis of an alleged defect or any repair charges for service to the System that is not covered hereby. ASE's total liability to Customer with respect to any System shall be limited to Customer's unamortized portion of the purchase price for the System (amortized over ten (10) years from Installation discounted at nine percent (9%) per annum). The warranties granted under this Policy do not cover any labor costs for repairs or any shipping expenses for replacement of parts. ASE will not be liable to any party, including without limitation, the Customer, for any consequential, exemplary, incidental, indirect, liquidated, punitive and speculative or other similar damages, including, without limitation, any damages to property or cost of replacement goods, resulting from any breach of warranty by a product or any product defect. This paragraph sets forth a Customer's sole and exclusive remedy with respect to any System, and a Customer shall not have any other remedy or remedies at law, in equity, or otherwise. Except as expressly set fourth in this Policy, this Policy shall be binding upon and inure to the benefit of the respective successors, assigns, heirs, personal representatives and transferees of the respective parties hereto. The term "Customer" herein shall mean only the initial end user of the System and upon any transfer of the System, only the then current owner of such System; provided, however, the transferor shall have no claims against ASE except those that accrued prior to such transfer. This policy is only for the benefit of the then current Customer and there are no third party beneficiaries entitled to enforce any of the terms of this policy. ASE HEREBY EXPRESSLY DISCLAIMS AND EXCLUDES ANY AND ALL REPRESENTATIONS AND WARRANTIES, WHETHER WRITTEN OR ORAL, WHETHER EXPRESS OR IMPLIED, WHETHER ARISING BY CONTRACT, AT LAW, IN EQUITY, BY STRICT LIABILITY, OR OTHERWISE, WITH RESPECT TO THE PRODUCTS, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ANY WARRANTY ARISING OUT OF USAGE OR CUSTOM, ANY WARRANTY AGAINST DEFECTS, AND ANY WARRANTY AGAINST INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS UNDER THE LAWS OF ANY JURISDICTION, INCLUDING, WITHOUT LIMITATION, ANY PATENTS, TRADEMARKS, OR COPYRIGHTS.

Schedule 1

Miscellaneous Parts and Components (1 Year Parts and Labor)

- Pipes
- Fittings
- Water Tank Insulation

Schedule 2

Manufacturer's Warranty Items (As Applicable to the System)

- Pumps
- Control System
- Coils
- Chiller
- Cooling Tower
- Plate Heat Exchanger
- Indoor Radiators
- Water Based Evaporators



Exhibit E

Customer Materials

Electric power

Dumpster access for disposition of project trash and waste

Access to relevant building rooms, garage, roof and other areas as necessary for the installation

Water to fill the underground water storage tanks and entire solar system

Staging area

Provide space for installation of the heat exchanger and solar equipment

Provide space for water storage tanks in the parking garage

Access to restrooms for workers

Plans and functional schematics / cut sheets of mechanical and electrical building services

Electric power for the solar system controls, display and pumps

Exhibit F

Customer Work

Provide down time on the heating system as required

Open and close the dropped ceiling

Open and close the vertical space required for the piping

Changes to the existing technical installations in the roof areas, so that solar collectors can be mounted (e.g. antenna)

Provide access to building and parking lot for cranes and other deliveries

Parking for workers and delivery vehicles

Access to building operations staff as required (e.g. for building area access, temporarily disabling parts of the sprinkler system at certain times, etc.

Provide insurance coverage for the building during times when the security system is disabled

Roof penetrations for piping and sealing of those penetrations

Drilling holes through exterior and interior walls for piping in the lower level

Note: All customer work must be completed in a timely manner, consistent with the project schedule.

Exhibit G

Staging Area

Secure area in the underground parking lot where materials and supplies for the project may be stored for later installation.

Interior space for staging of weather sensitive materials.

Roof and equipment room.

Exhibit H

Customer Training

Train up to four (4) Chesterfield City employees in the maintenance, support and operation of the thermal solar system. Such training to be in one class session, conducted during normal business hours.