Solar Thermal Generator

SunQuest Energy
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Structural Engineer
Jason M. Burby, P.E.

Surveyor
ServTech

Civil Engineer
Andrew Carnegie

EPC
Sopogy

Mechanical Engineer
Herb Newman, P.E. CPMP
LEED AP Building Design and Construction
ASHRAE Certified Building Commissioning Professional

Project Information

Latitude: 28.05° N
Longitude: 82.41° W

Record Cold Temperature: 18°F (1962)
Record High Temperature: 99°F (1985)

Type: Ground Mounted Concentrating Parabolic Trough

Load: Green Machine Waste Heat Generator

Solar Panels: 196 Sopogy SopoNova Parabolic Collectors

Project Summary

The project consists of installation of 196 Sopogy solar thermal collectors. The collectors will be installed on concrete piers in 14 rows with 14 collectors per row.

Each row of collectors will have a single, continuous absorption tube in the focal point of a parabolic reflecting mirror. Sopogy's proprietary control system will move the mirrors throughout the day, tracking the sun to maintain the focal point on the absorption tube.

A mixture of 70% water and 30% propylene glycol will be pumped from a 3800 gallon storage tank through the absorption tubes of the collectors. As the fluid circulates it will gain thermal energy from the solar collectors. The propylene glycol serves to protect the fluid from freezing temperatures.

Each row of collectors will be piped in parallel configuration to one another and be circulated by a single pump.

The thermal energy gained by the system will be used to drive a Green Machine brand waste heat generator. The generator will produce electrical power to feed into the campus grid.

Design Critera

Wind

V = 120 mph

Effective pressure is determined from wind tunnel study and ASCE 7-05.

Durability and product integrity determined by Sopogy.

Soil

Soil Data provided by BTL Engineering in report dated 9-1-2011

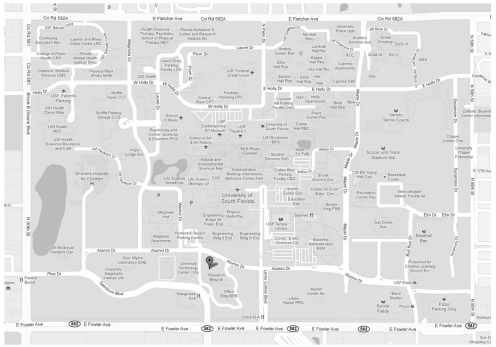
Applicable Codes

2007 Florida Building Code

Tampa Building Code

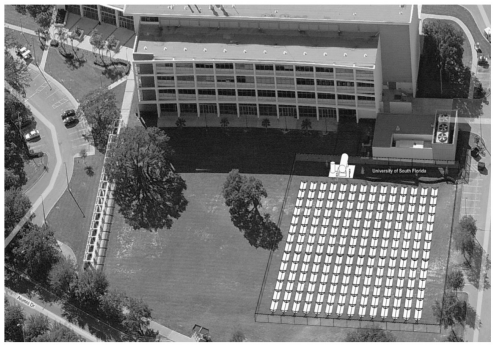
Sheet Index

General Notes



N

Location Map
NTS



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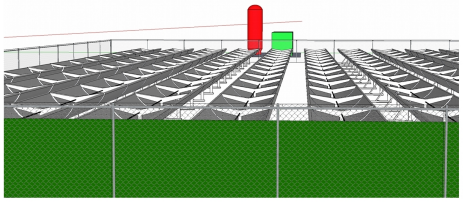
Conceptual Layout
NTS

Wind Screen



N

Conceptual Layout
NTS

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I certify that to the best of my knowledge and belief, the foundations to support the solar system, the on grade slab and the foundations to support piping and conduit have been designed to be in compliance with the 2007 Florida Building Code (Including the 2009 supplements). All other elements, systems and assemlies are the total responsibility of the builder, contractor, and/or others.

Engineer's Seal
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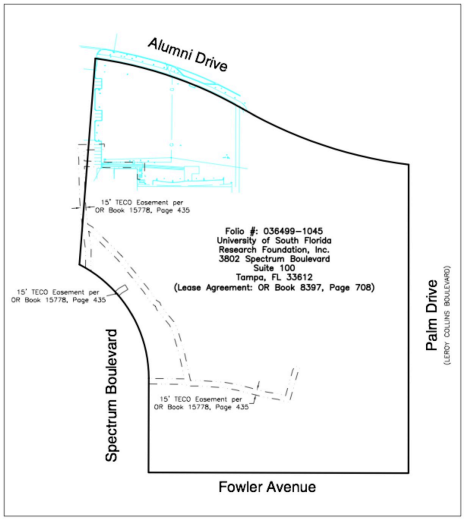
Solar Thermal Generator

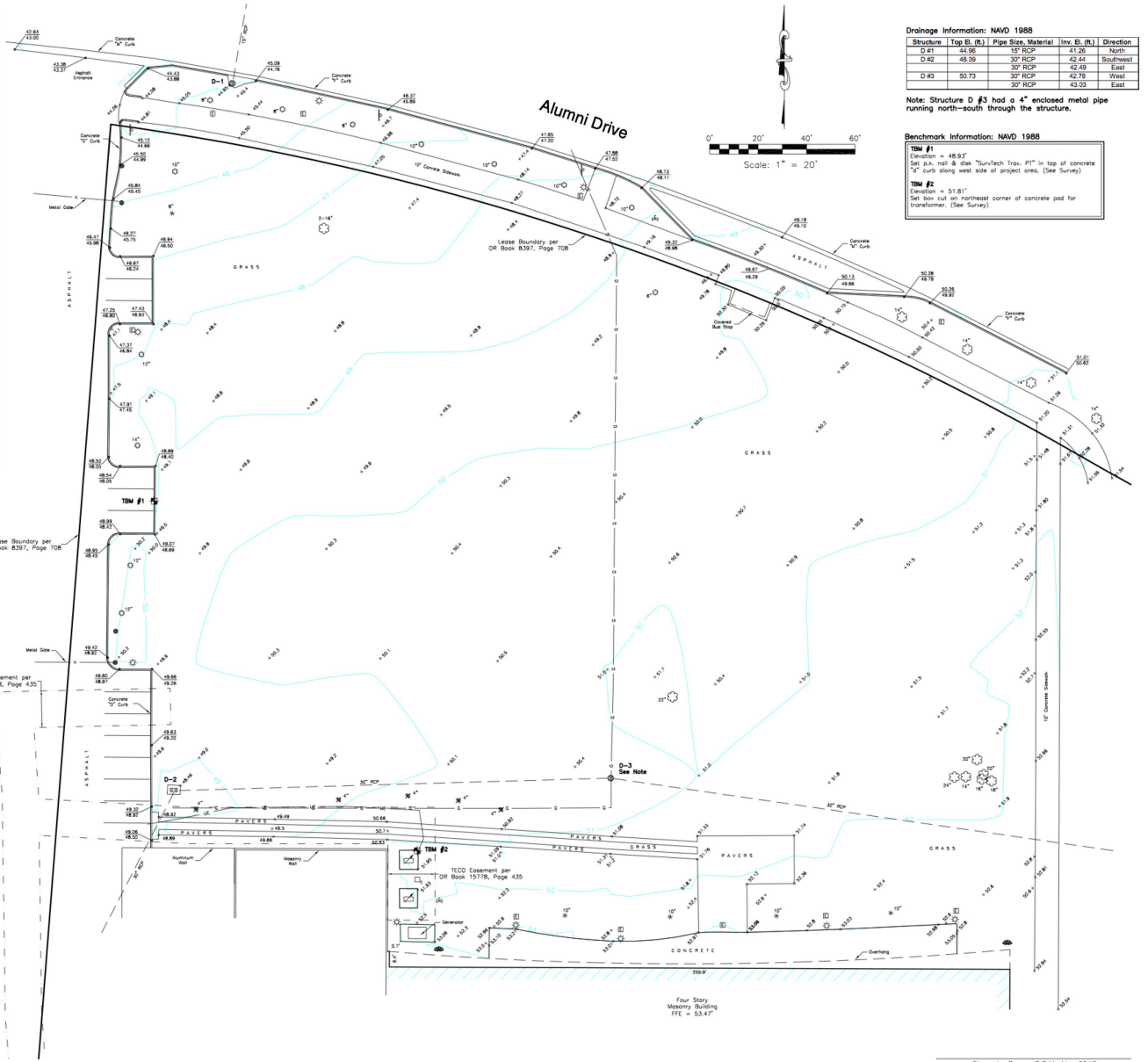
Project Information

Sheet Number
G-0
Sheet 1 of 1

Lease Parcel Detail

Scale: 1" = 150'





0' 20' 40' 60'

Scale: 1" = 20'

Drainage Information: NAVD 1988

Structure	Top El. (ft.)	Pipe Size, Material	Inv. El. (ft.)	Direction
D #1	44.96	15" RCP	41.26	North
D #2	48.39	30" RCP	42.44	Southwest
		30" RCP	42.49	East
D #3	50.73	30" RCP	42.78	West
		30" RCP	43.03	East

Note: Structure D #3 had a 4" enclosed metal pipe running north-south through the structure.

Benchmark Information: NAVD 1988

TBM #1
Elevation = 48.93'
Set p.k. nail & disk "SurvTech Trav. PT" in top of concrete "a" curb along west side of project area. (See Survey)

TBM #2
Elevation = 51.81'
Set box cut on northeast corner of concrete pad for transformer. (See Survey)

Legend & Abbreviations

P.S.M.	Professional Surveyor and Mapper	x—x—x	Fence
TBM	Temporary Benchmark	G—G—G	Gas Line
	Electric Meter	UE—UE—UE	Underground Electric Line
	Electric Vault	+x.x	Spot Elevation
	Telephone Vault	x.x+	Spot Elevation on Hard Surface
	Irrigation Control Valve	39.42	Back of Curb Elevation
	Light Pole	38.92	Edge of Pavement Elevation
	Transformer		Palm
	Sign		Oak
	Round Post		Cypress
	Catch Basin	RCP	Reinforced Concrete Pipe
	Storm Manhole	FFE	Finished Floor Elevation
	Electric Pull Box		Flood Light

Surveyor's Notes

1.) Not valid without the signature and original raised seal of a Florida Licensed Surveyor and Mapper.
2.) All utilities depicted hereon are from visible evidence as well as mark outs provided present at time of field survey.
3.) No underground foundations or footers were excavated or located for this survey.
4.) The horizontal datum utilized for this project is NAD 1983 (2007) Florida West Zone, U.S. Survey Feet.
5.) The vertical datum utilized for this project is NAVD 1988, U.S. Survey Feet. The benchmark utilized was Hillsborough County 3rd-Order Benchmark "VA-933" with an elevation of 45.58 feet.
6.) Surveyor makes no guarantees as to the species of trees or to the health of each tree depicted hereon. If this information is necessary, a certified arborist should be contacted.
7.) Survey has been performed without benefit of title policy or abstract. Therefore surveyor can make no guarantees to ownership or encumbrances.
8.) **THIS IS NOT A BOUNDARY SURVEY.**

Certifications:
SunQuestEnergy, LLC

Stacy L. Brown P.S.M. No. 6516
SurvTech Solutions, Inc. L.B. No. 7340

****Not Valid Without The Signature And The Original Raised Seal Of A Florida Licensed Surveyor And Mapper****

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Solar Generator

Topographic Survey

Sheet Number
C-1
Sheet 1 of 1

Notes

General

• It is the contractors sole responsibility to verify the presence of all utilities that may interfere with construction of this project and to protect said utilities whether or not they are shown on these construction plans.

• Installation of collectors and control system shall comply with Sopogy installation guide.

Site Preparation

• Any unsuitable material found during construction should be excavated and replaced with compacted inorganic granular backfill as specified by BTL Engineering soil report dated 9-1-2011

• Prior to construction, vegetation shall be removed and proof rolling of the soil shall be carried out a minimum of 10' in all directions from the edge of any pier or foundation.

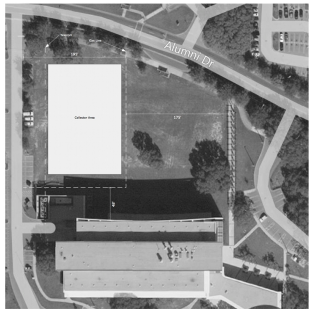
• Proof rolling shall be a minimum of 3 passes of either a 10-ton roller or a fully loaded tandem axle truck. The proof rolling shall be inspected by a geotechnical engineer for areas of yielding or soft soil. Any soft or deflecting area of subgrade shall be excavated and replaced with compacted granular material as specified. Following replacement of subgrade the area shall be proof rolled a second time to assure all unsuitable subgrade has been removed.

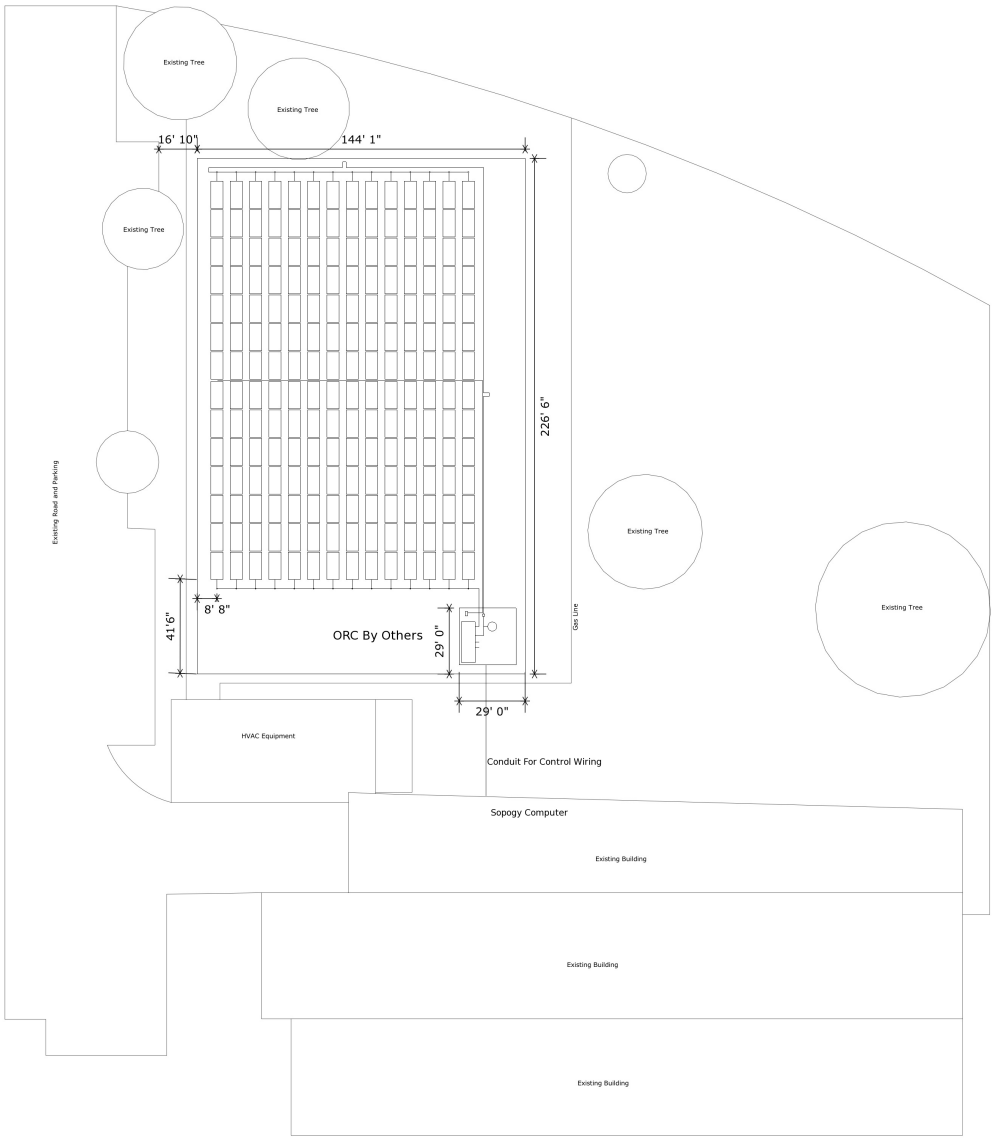
• All backfill and fill shall meet requirements specified in BTL Engineering Report section 7.3

Site Work:

Grade and apply gravel to array field

Apply constant slope of 1/4" per 3 ft.
Extend Ground Cover 2' past fence line





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Solar Generator

Layout

Sheet Number
C-2
Sheet 1 of 1

Notes

General

• Top Elevation of solar collector foundations to be 96'. All foundations must be equal elevation.

• Above grade formwork to be removed after concrete has fully cured.

Concrete

• Concrete form work shall be in accordance with the latest edition of the ACI "Manual of Concrete Practice."

• Reinforcing steel shall be placed in accordance with the latest edition of the ACI "Manual of Concrete Practice."

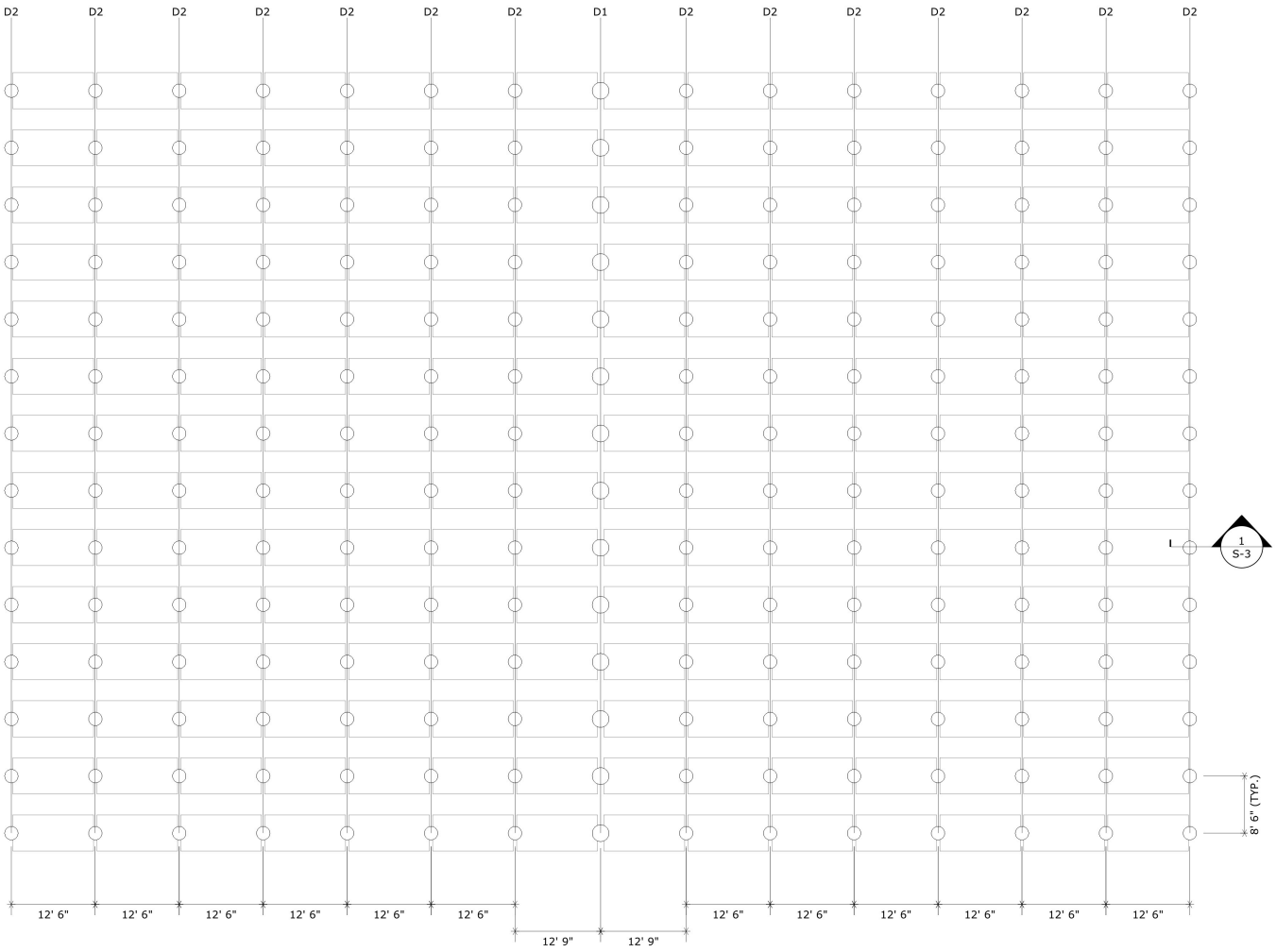
• Protection for reinforcing steel shall be in accordance with the latest edition of the ACI "Manual of Concrete Practice."

• Minimum 28 day concrete cylinder strength to be:

Footings and Piers: 3000 psi
Slabs on Grade: 3000 psi

• Reinforcing Steel Shall conform to ASTM A615 Grade 60

• Soil bearing capacity for piers and slabs is 2000 psf based upon soil report issued by BTL Engineering and dated 9-1-2011.



1 **Solar Collector Foundation Plan**
Scale: 1/8" = 1'

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Solar Generator

Solar Collector Foundation Plan

Sheet Number
S-1
Sheet 1 of 1

Notes

General

- Top Elevation of pipe support foundations to be 96'.
- Top Elevation of anchor foundations to be 97' 4.75".
- Top Elevation of equipment pad to be 96'.
- Above grade formwork to be removed after concrete has fully cured.

Concrete

- Concrete form work shall be in accordance with the latest edition of the ACI "Manual of Concrete Practice."
- Reinforcing steel shall be placed in accordance with the latest edition of the ACI "Manual of Concrete Practice."
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Slabs on Grade: 3000 psi

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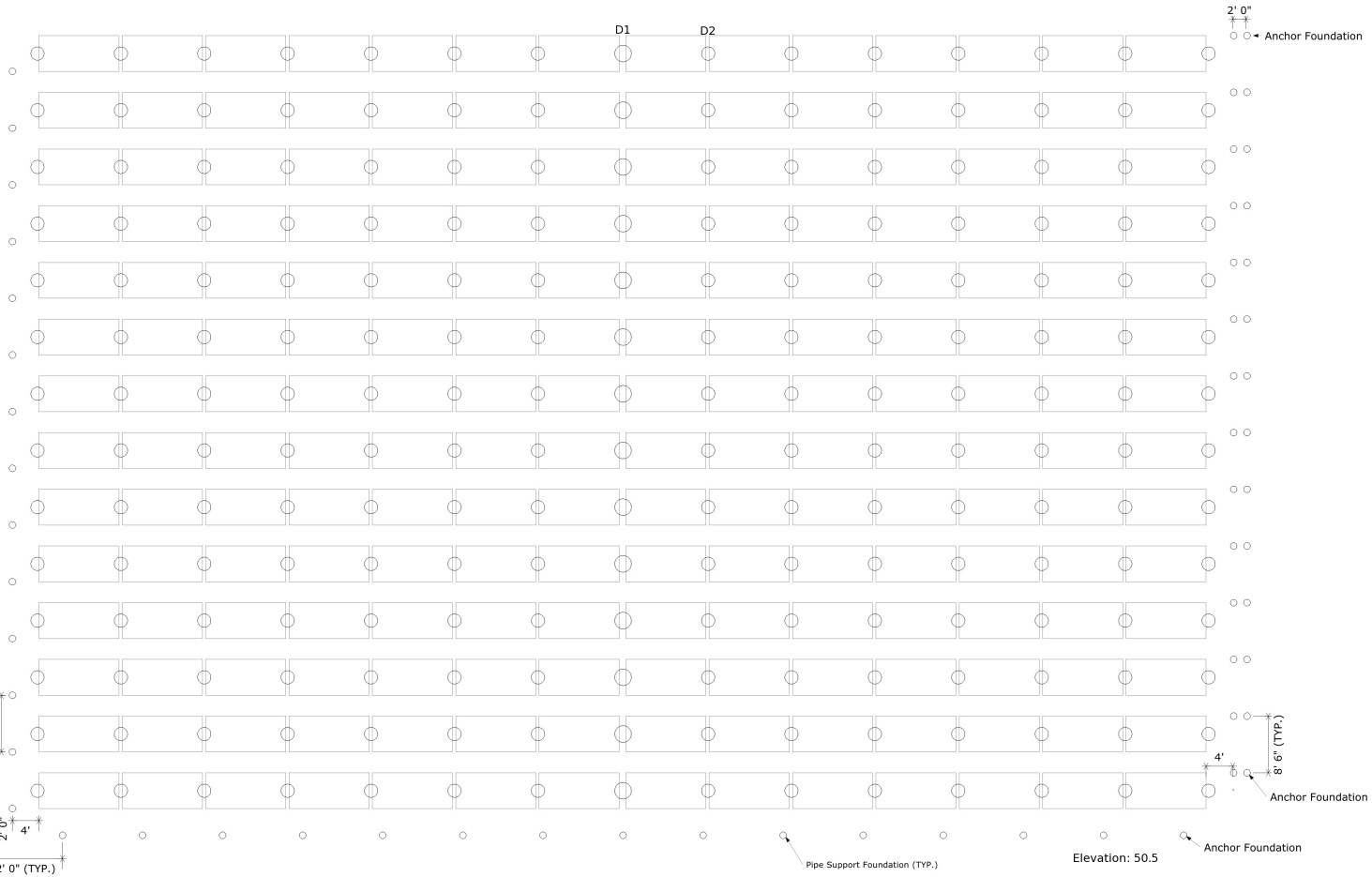

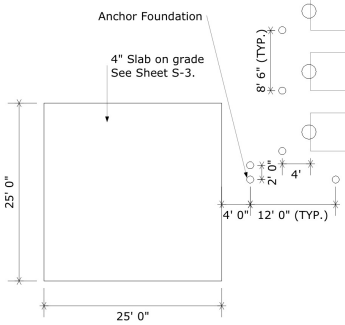

Equipment Pad, Storage Tank, and ORC By Others

1 **Pipe Support and Equipment Foundation**
Scale: 1/8" = 1'

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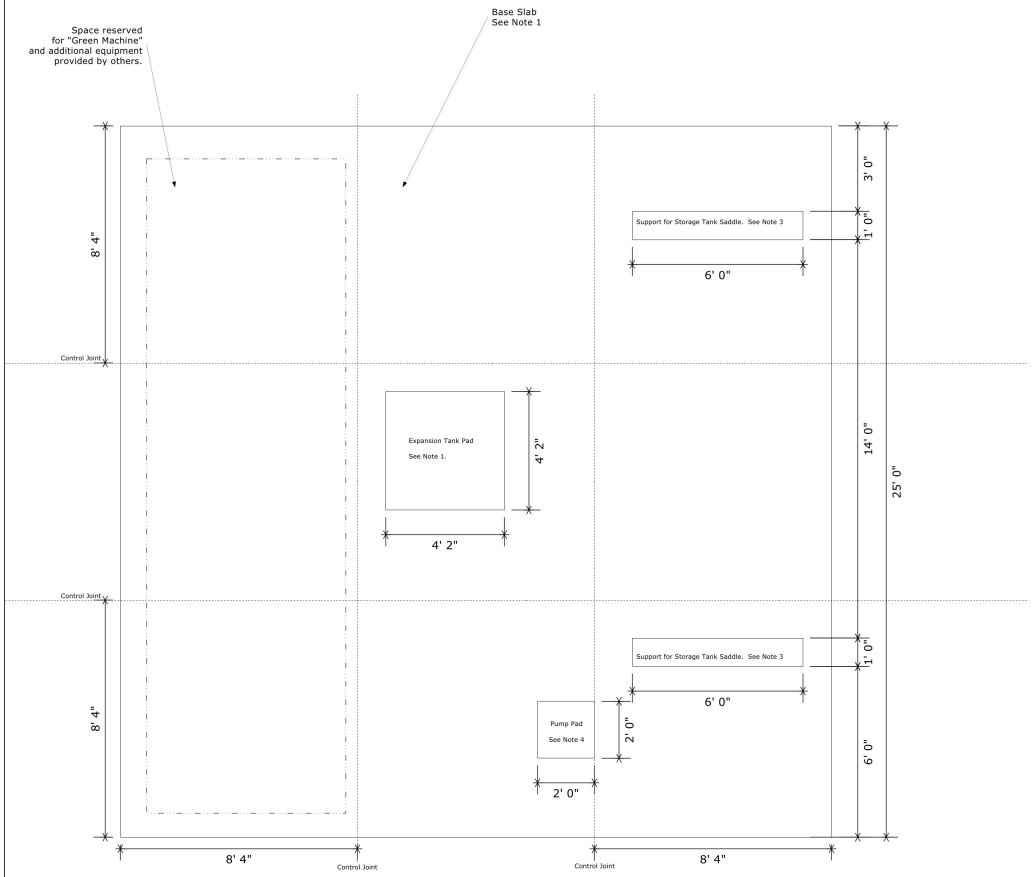
Solar Generator

Equipment and Support Foundations

Sheet Number
S-2
Sheet 1 of 1



1 **Equipment Pad Layout**
NTS

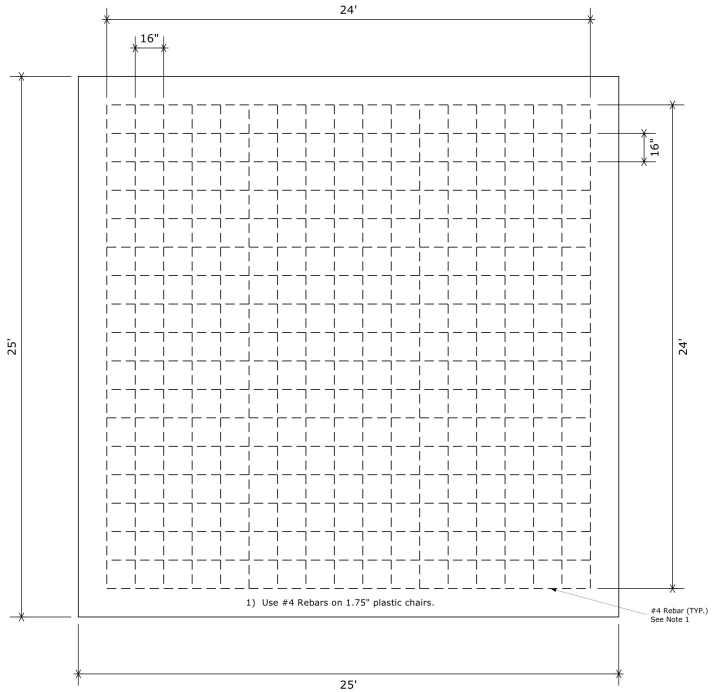
1) 4" Base Slab on Grade. Tool control joints to 1" depth at specified dimensions. See detail 2, Sheet S-4 for reinforcing layout.

2) 4" Pad over Base Slab. Reinforce with 6"x6" WWF @ 2" depth. See detail 4, Sheet S-4.

3) 3' Wall over Base Slab. See detail 5, Sheet S-4.

4) 4" Pad over Base Slab. Reinforce with 6"x6" WWF @ 2" depth. See detail 3, sheet S-4.

Concrete Work Done By Others



2 **Base Slab Rebar Layout**
NTS

Concrete Work Done By Others

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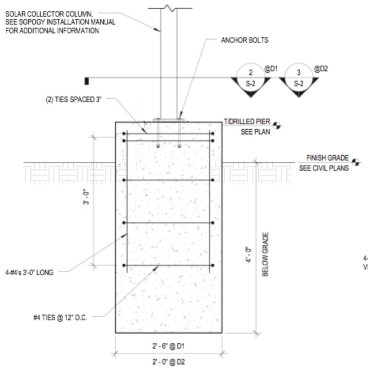
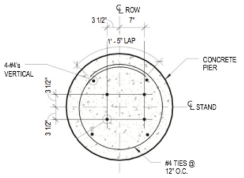
Solar Generator

Equipment Slab

Sheet Number
S-3
Sheet 1 of 1



1 SECTION
3/4" = 1'-0"



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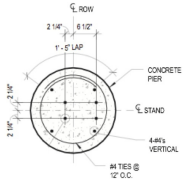
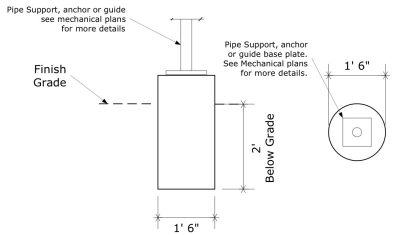
3/4" = 1'-0"



3 SECTION
3/4" = 1'-0"

Solar Collector Foundation Details and Sections



2 **Pipe Support and Anchor Foundation**
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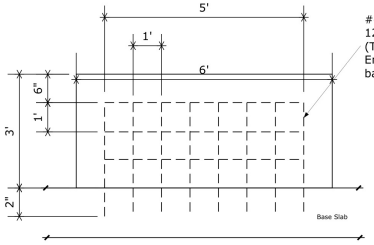
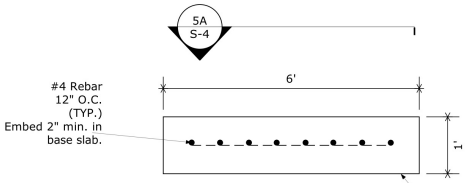


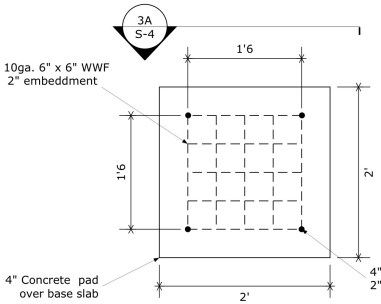
5A **Storage Tank Stand**
No Scale

Equipment Pad By Others

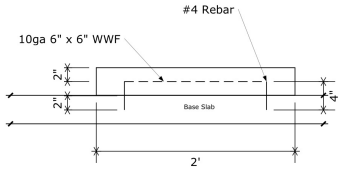


5 **Storage Tank Stand**
No Scale

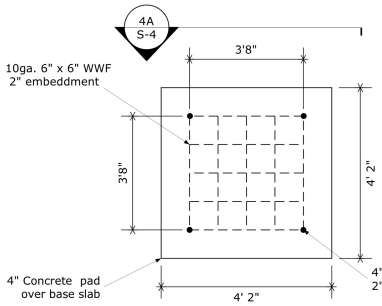
Equipment Pad By Others



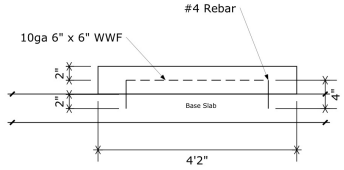
3 **Pump Pad**
No Scale



3A **Pump Pad**
No Scale



4 **Expansion Tank Pad**
No Scale



4A **Pump Pad**
No Scale

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Solar Generator

Foundation Details and Sections

Sheet Number
S-4
Sheet 1 of 1

Notes

General

• Contractor shall coordinate locations of new equipment with work from all trades.

• Contractor shall verify layout and installation requirements for actual equipment provided.

• Sopogy Collectors to be installed according to Sopogy Installation Guide.

•Collector design and arrangement provided to engineer by Sopogy.

Piping

• Piping to conform to ASTM A53 standards.

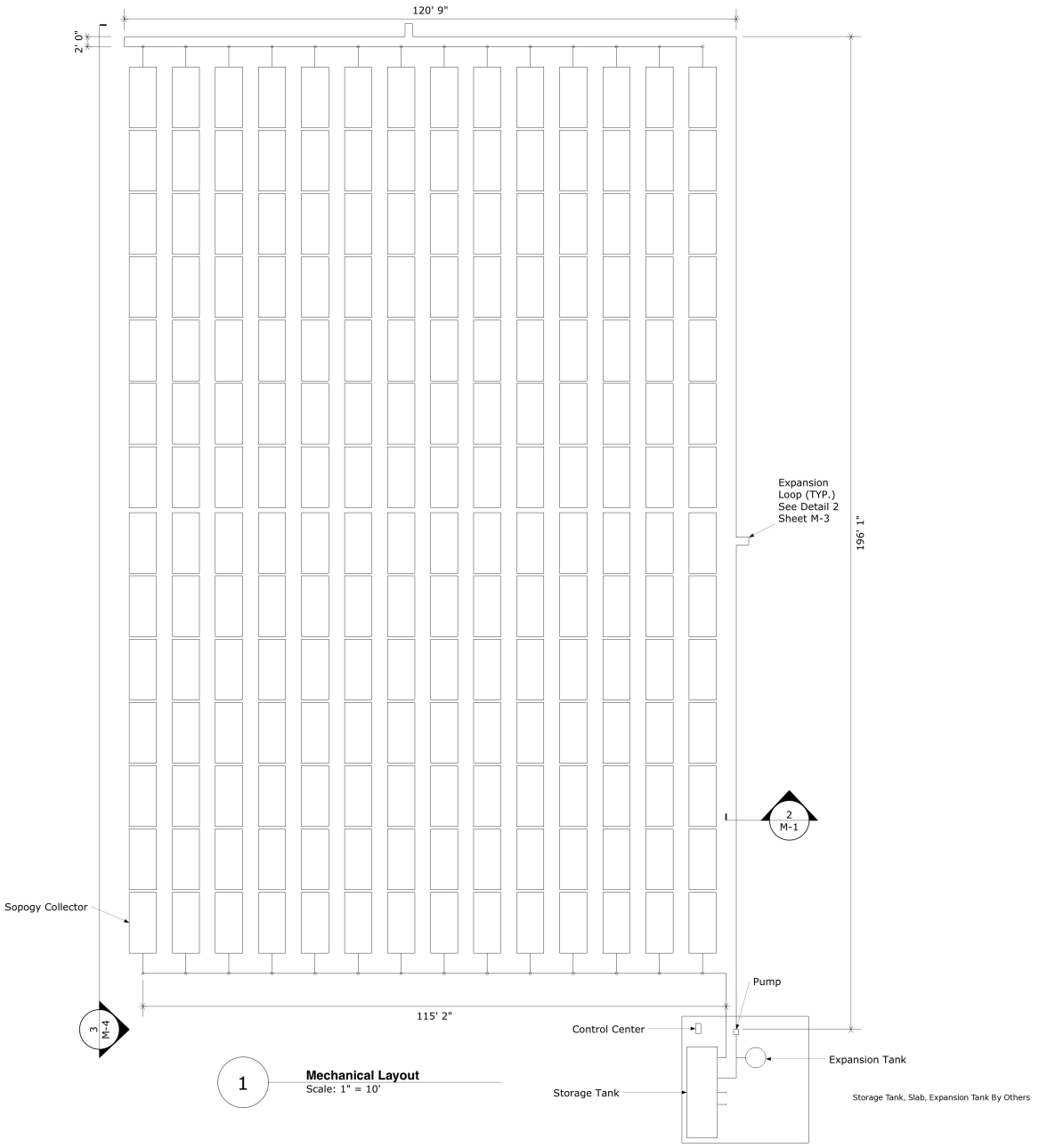
• Piping to be field insulated with 1" KFlex pipe insulation or approved equivalent.

• Insulation under pipe stands to be calcium silicate to support piping.

• Piping to be field clad with aluminum cladding and stainless steel banding over insulation.

• Piping and fittings to be welded in compliance with AWS D10.12, latest edition unless otherwise noted.

• Piping greater than 2.5" shall be butt welded. Piping smaller than 2.5" shall be socket welded.



1 **Mechanical Layout**
Scale: 1" = 10'

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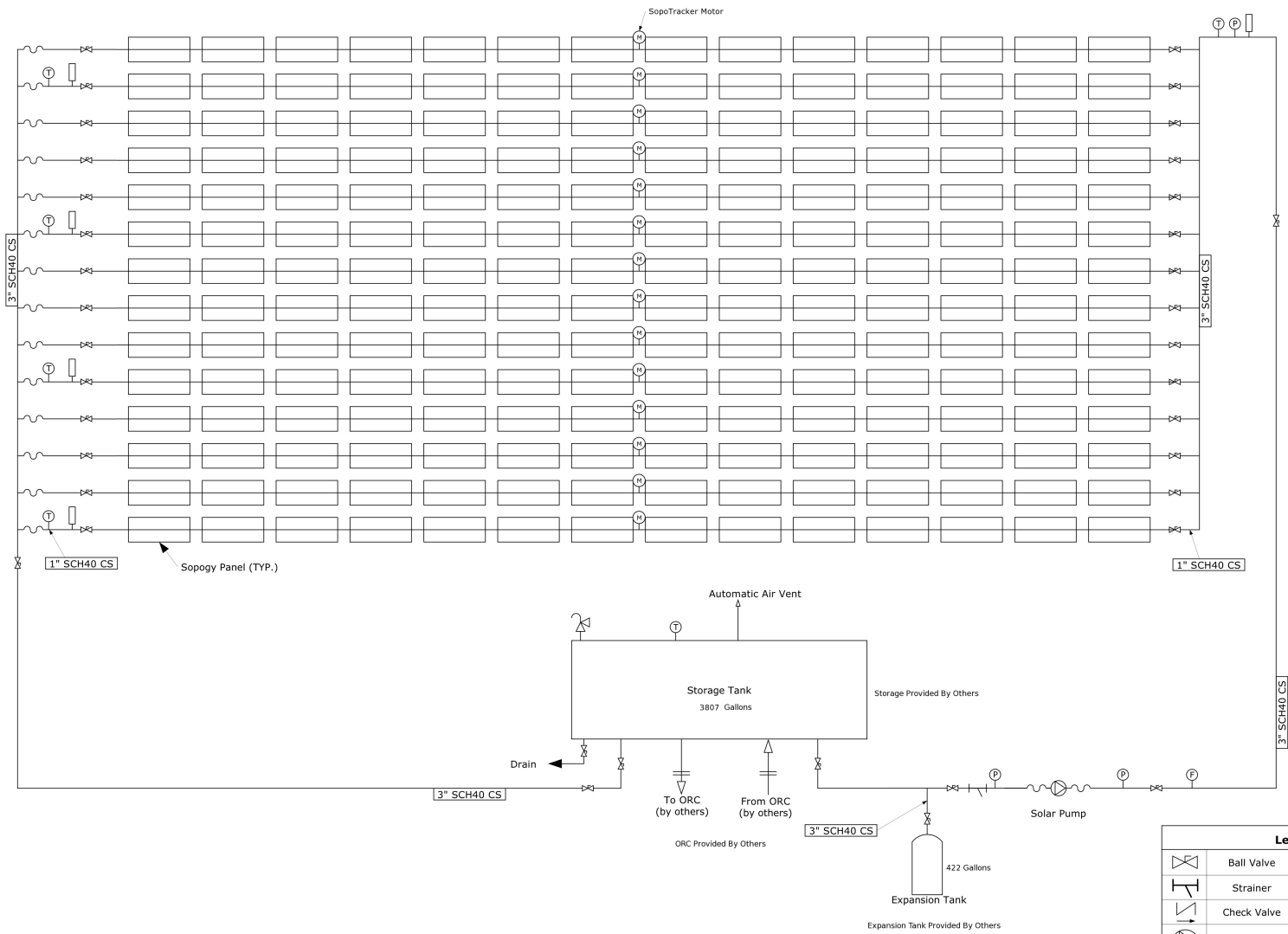
Solar Generator

Mechanical Layout

Sheet Number
M-1
Sheet 1 of 1



Equipment Schedule

Storage Tank	Lochinvar TGV 3807 Horizontal with Factory Saddles
Expanion Tank	Westank TXA 1600
Solar Pump	Grundfos CR32-2-2 with Cool Top

Legend

	Ball Valve		Existing Valve
	Strainer		Balance Valve
	Check Valve		Relief Valve
	Pump		Union
	Thermometer		Vacuum Breaker
T	Temperature Sensor		New Line
			Sensor Cable
F	Flow Meter		Existing Line
			Flexible Connection
P	Pressure Sensor		Flange

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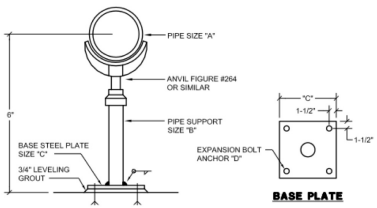
Solar Generator

Process and Instrumentation Diagram

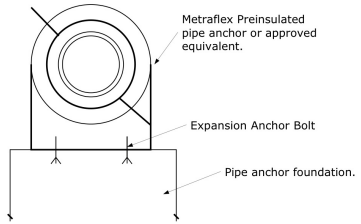
Sheet Number
M-2
Sheet 1 of 1



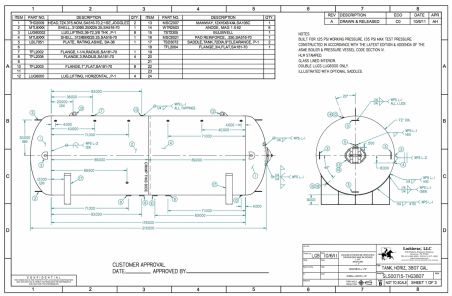
"A"	"B"	"C"	"D"
2-1/2	2	1/2 X 9 X 9	3/8
3	2-1/2	1/2 X 9 X 9	3/8
4	3	1/2 X 9 X 9	3/8

1 **Pipe Support**
No Scale

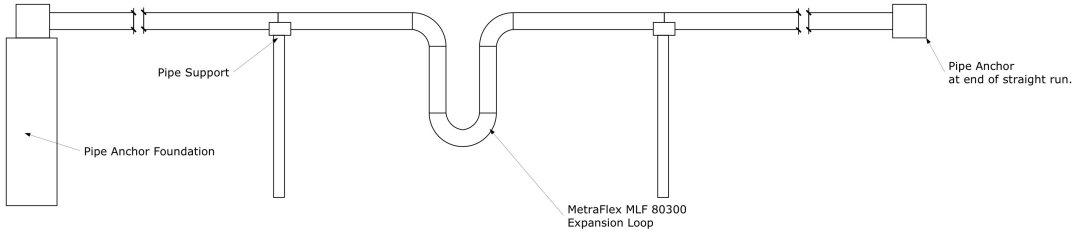
• Replace Anvil Figure #264 with B-Line #3094 or similar at flange supports



5 **Pipe Anchor**
No Scale



Storage Tank Provided By Others



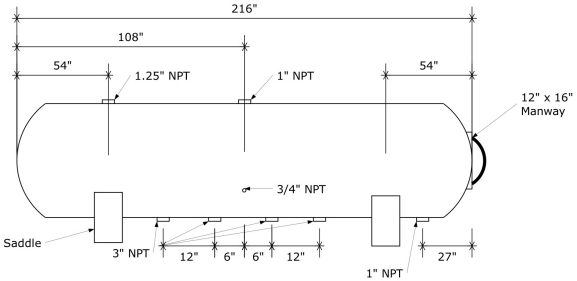
2 **Expansion Loop**
No Scale

• Use Lochinvar Model TGV 3807 ASME 125 psi rated or approved equivalent.

• Tank to be provided from factory with tappings as shown.

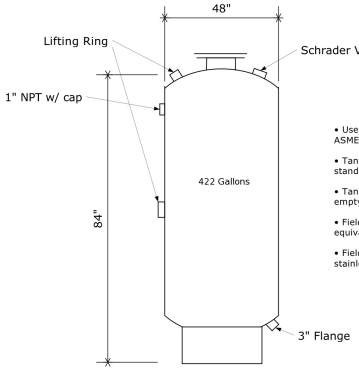
• Field insulate with 2" K-Flex or approved equivalent insulation.

• Field clad tank with aluminum jacket and stainless steel banding.



3 **Storage Tank**
No Scale

Storage Tank Provided By Others



• Use Westank TXA 1600 Expansion Tank with ASME 125 psi rating.

• Tank to be provided from factory with standard tappings as shown.

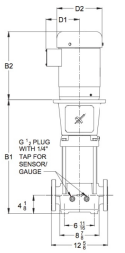
• Tank air charge to be 12 psig when bladder is empty.

• Field insulate with 2" K-Flex or approved equivalent insulation.

• Field clad tank with aluminum jacket and stainless steel banding.

Expansion Tank Provided By Others

4 **Expansion Tank**
No Scale



B1	22 3/4"
B2	15 3/8"
D1	10 1/4"
D2	8 1/2"

5 **Solar Pump**
No Scale

• Use Grundfos model CR32 - 2 - 2 with cooltop option.

• Anchor pump to pump pad with expansion bolt anchors.

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Engineer's Seal
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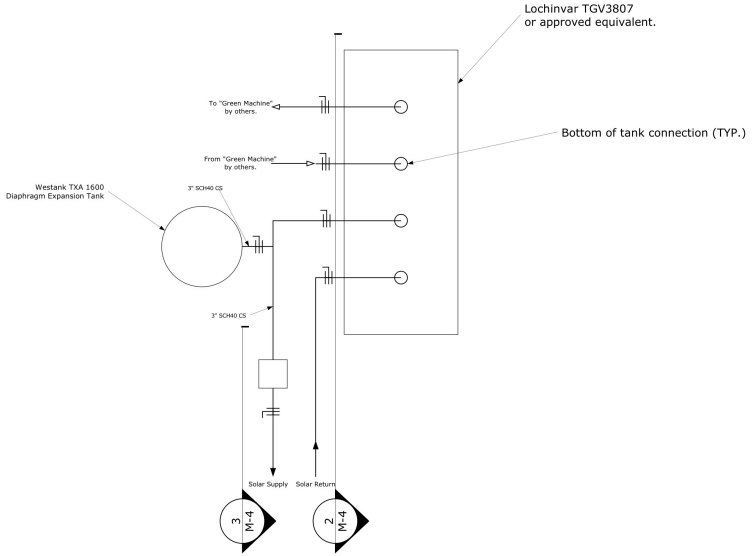
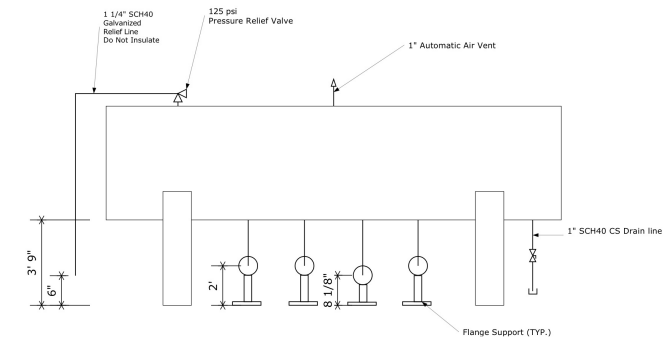
Solar Generator

Mechanical Details

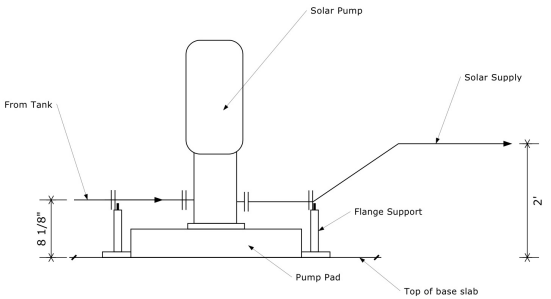
Sheet Number
M-3
Sheet 1 of 1



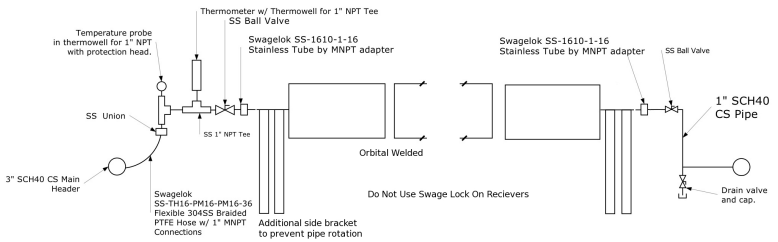
1 **Storage Tank Plumbing**
No Scale



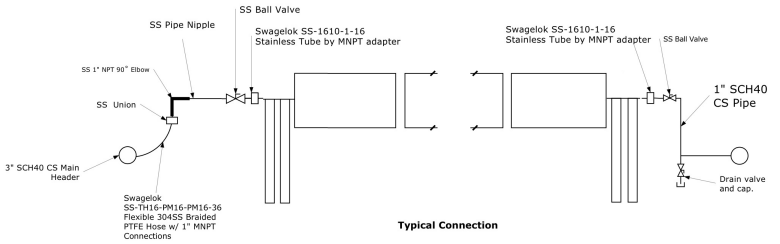
2 **Storage Tank Plumbing**
No Scale



3 **Pump Plumbing**
No Scale



Typical Connection with thermometer and temperature snesor



Typical Connection

4 **Connection to Collector**
No Scale

Legend

	Ball Valve		Existing Valve
	Strainer		Balance Valve
	Check Valve		Relief Valve
	Pump		Union
	Thermometer		Vacuum Breaker
T	Temperature Sensor		New Line
			Butterfly Valve
F	Flow Meter		Flexible Connection
P	Pressure Sensor		Flange

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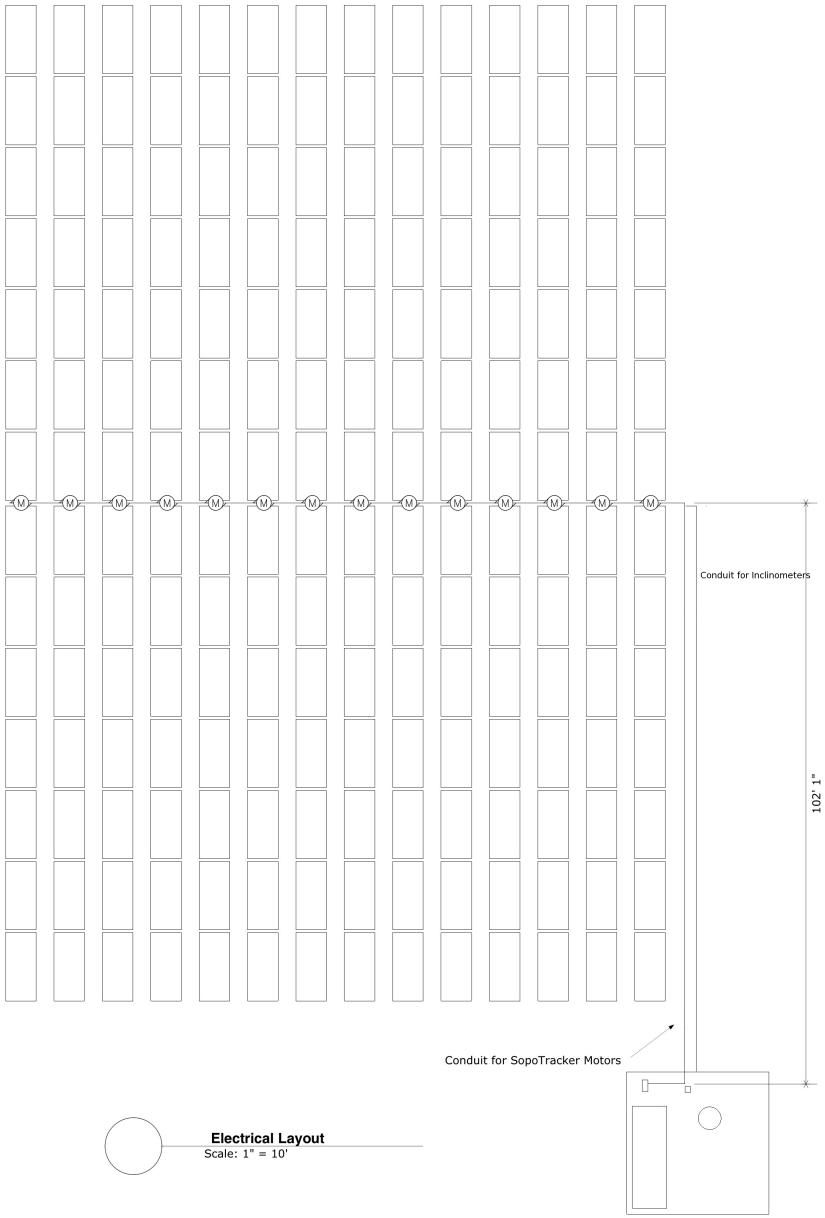
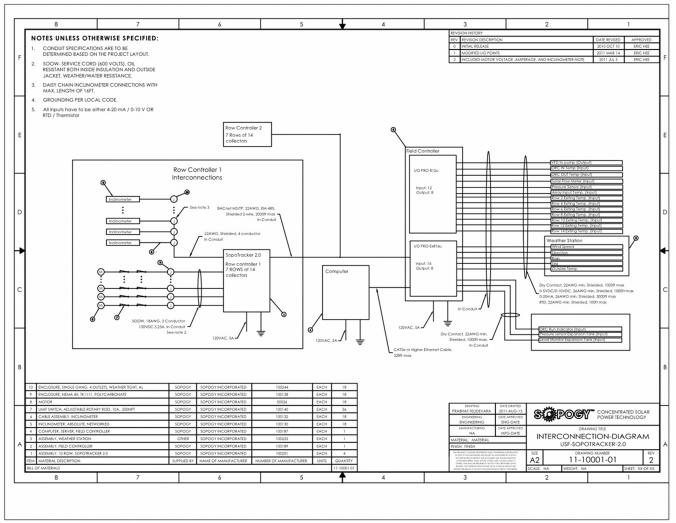
Solar Generator

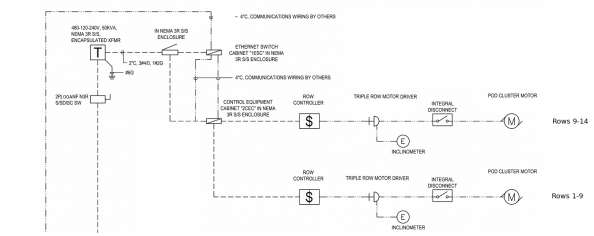
Plumbing Plan

Sheet Number
M-4
Sheet 1 of 1



Electrical Layout
Scale: 1" = 10'





Power and Data From Research Center

One Line Diagram

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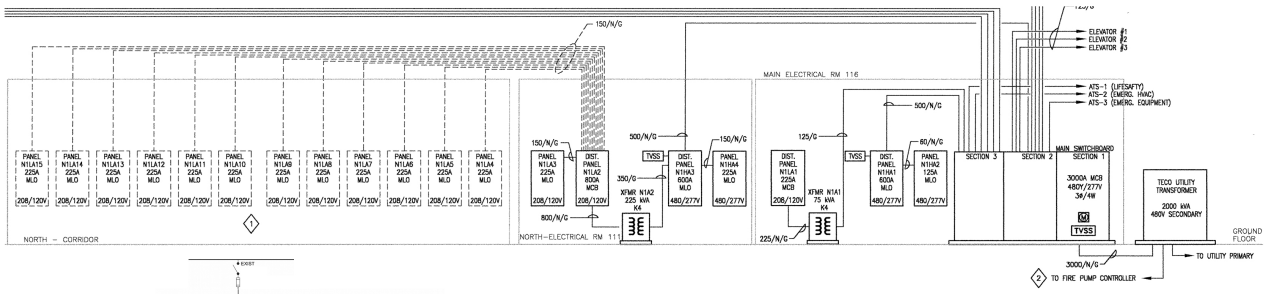
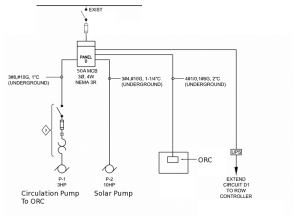
Solar Generator

Electrical Layout

Sheet Number
E-1
Sheet 1 of 1





Field Verify Spare Breakers for Sub Panel

Required Amperage: 30A

Existing and New Riser

No Scale

PANEL Panel1			VOLTAGE: 120/240V			1 PHASE 3 WIRE		MOUNTING: SURFACE MIN. A.I.C.			
			BKR TYPE: BOLT-ON					CABINET WIDTH			20"
CKT NO.	DESCRIPTION	KVA A	KVA B	CKT BKR	WIRE SIZE	CKT NO.	DESCRIPTION	KVA A	KVA B	CKT BKR	WIRE SIZE
1	RON CONTROLLER	0.9		20/2	12	2	RON CONTROLLER	0.9	0.9	20/2	12
3			0.9			4					

CONNECTED KVA:	20	KVA
DEMAND FACTOR:	10	%
DEMAND KVA:	10	KVA
DEMAND AMPS:	50	AMPS

NOTE:

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Solar Generator

Electrical Layout

Sheet Number

E- 2

Sheet 1 of 1