DRAFT

Oklahoma Medical Research Foundation (OMRF)

Wind and Solar PV Design and Engineering

Phase II

Submitted by Synergy California L.P. to Perkins+Will

1.0 Program Update:

Synergy California has been consulting for Perkins + Will Architects, to study and derive the wind and solar resource potential of the proposed Oklahoma Medical Research Foundation (OMRF) building located in Oklahoma City, Oklahoma with the objective of powering a portion of the building's load from these renewable forms of energy.

The Phase I report states the result of the wind and solar site surveys and provides recommendations for a suitable wind turbine capable of surviving gale force winds and an appropriate photovoltaic panel capable of surviving the downpour of 1.5" diameter hailstones. The Phase I report, delivered June 1. 2008, also provided a preliminary layout of the solar and wind energy assets of the roof.

The findings of the report showed that:

- the top of the new OMRF research tower could only provide a fraction of the total energy required by the building. The exact amount was equal to 2.5% of the future building's electrical load. Site visits in July to the OMRF revealed that many other roof-top opportunities exist on adjacent buildings to power the facility with photovoltaic (PV) panels.

- An analysis of wind and solar PV, comparing cost of equipment and delivery of energy, showed that PV was slightly more cost effective on a $ per watt basis.

- On July 2008 projections from the Phoenix Design Group, the electrical engineers of record, indicated that the proposed OMRF Research tower would consume **4,911,317 Kwhrs** of electricity in one year. It was decided that for the building to achieve Platinum LEED rating, the building would have to produce 12.5 % or 613,915 kWhrs/year of its electrical energy from solar and wind energy.

On September 2008, P+W finalized the roof plan which is now the basis of this Phase II report.

- The current designed output from solar and wind of the OMRF research tower is 157,936 kWhr/year. What is required is the additional production of 455,979 kWhr/year.

- In order to produce 12.5% of the buildings electrical energy we will need an additional 350 kW of photovoltaic panels to the surrounding buildings.

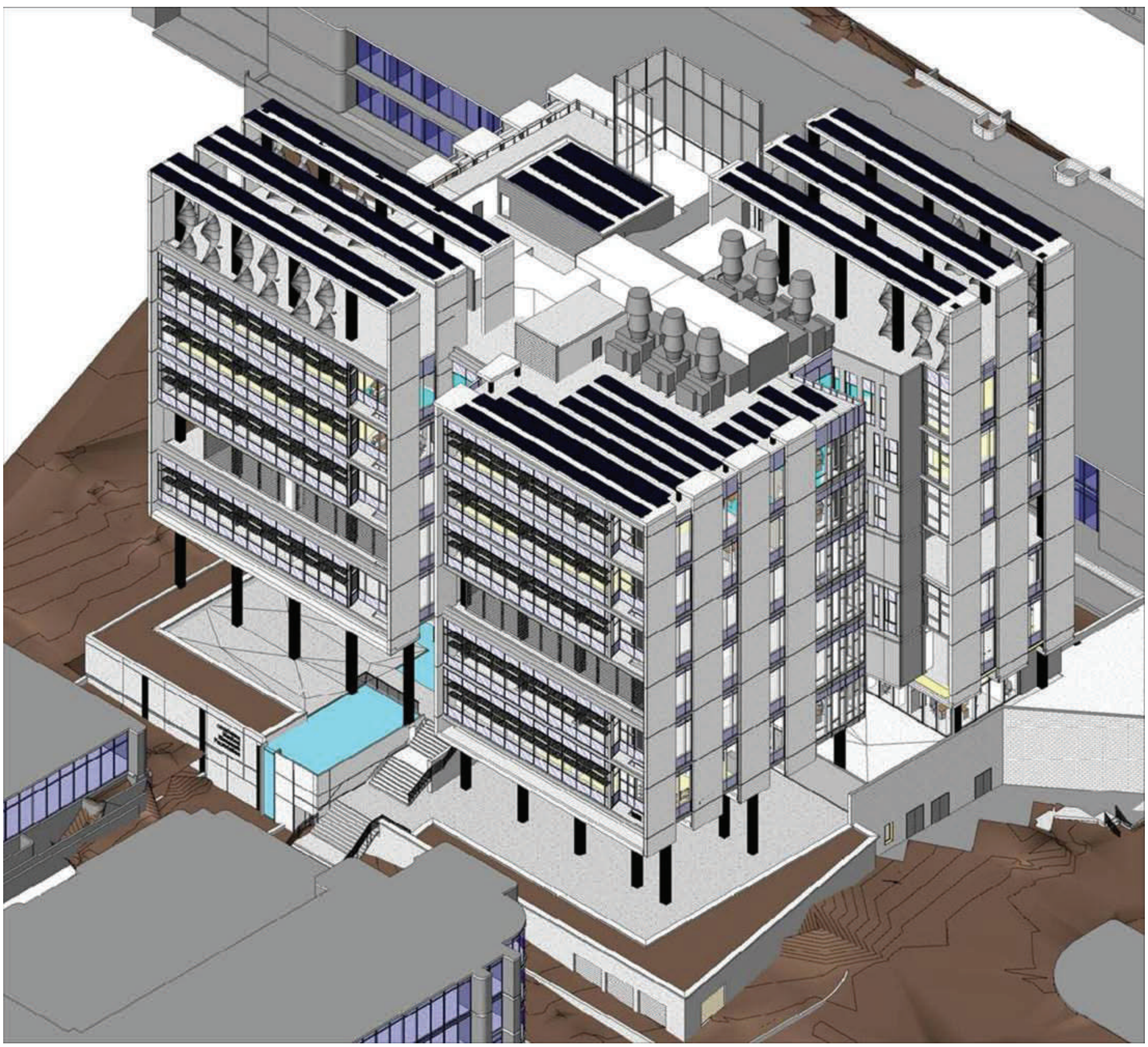
- Finally, extensive financial modeling has started to attract an investor and partner to finance the renewable energy components of the building. This is tricky because the cost of electricity in Oklahoma, made from coal, is relatively inexpensive.

1.1 The OMRF tower and the renewable energy systems.

The roof of the tower creates opportunities for the placement of 24 wind-turbines. These are located within trellises which act to accelerate the speed of the wind.

Photovoltaic panels are placed above the trellises and are facing south at a 20 degree angle. PV panels are also mounted on the penthouse and on the roof areas.

Buildings in front and the rear will also be utilized as PV collector mounts. Together these will contribute to providing 12.5% of the building's energy from renewable energy.

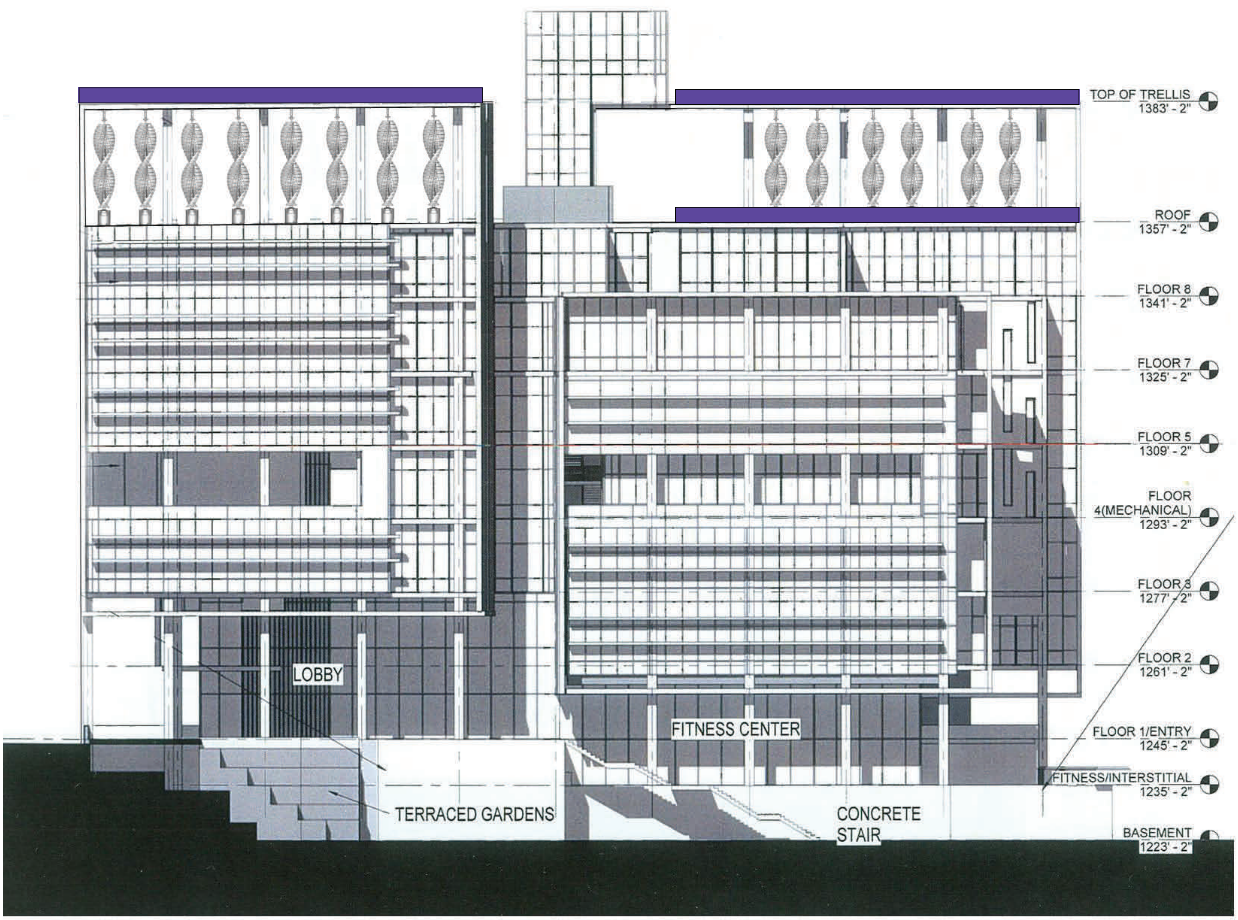


2.0 Building Integrated Wind Energy System. (BIWE)

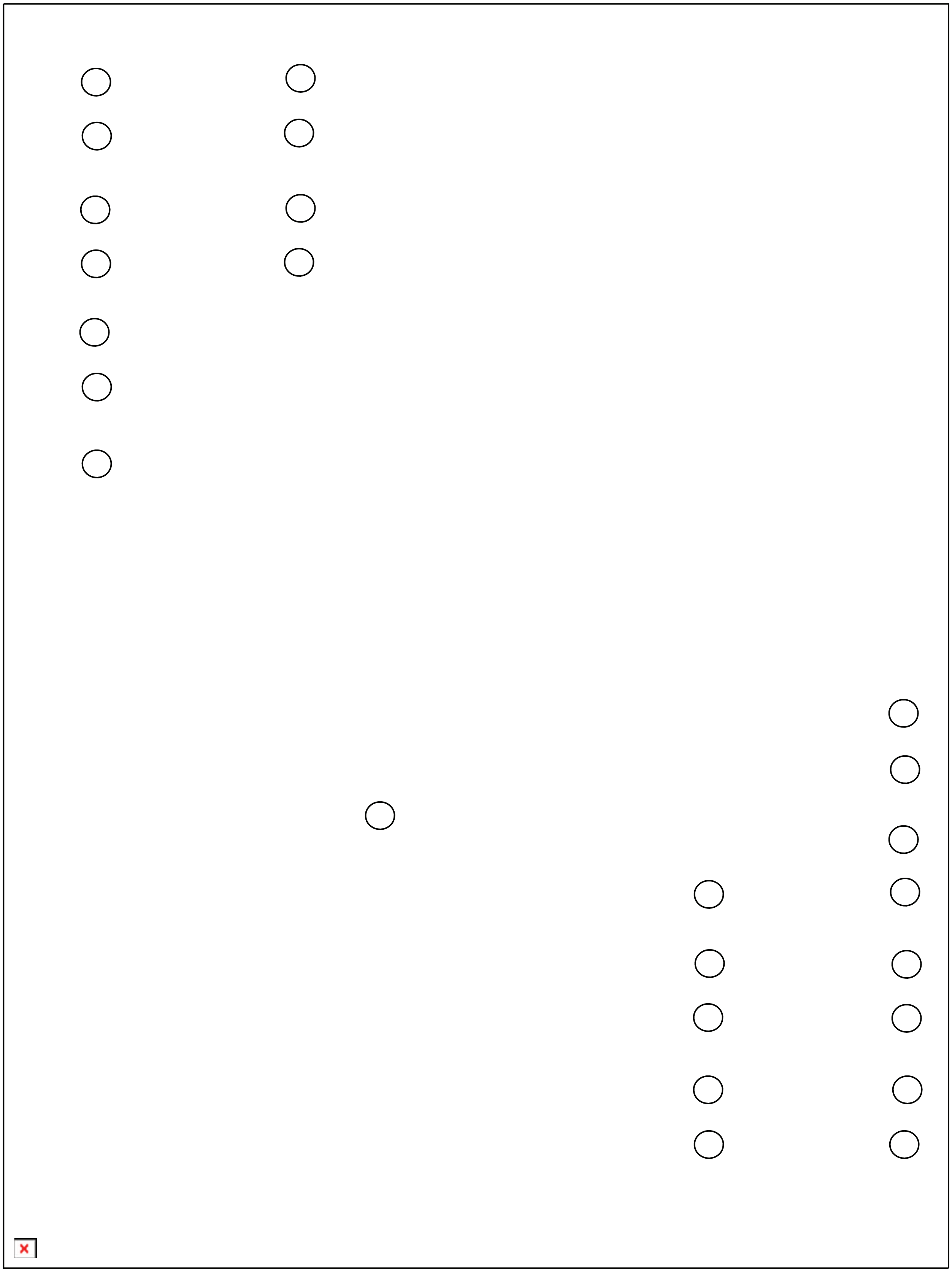
The wind turbines are spaced 1.5 rotor diameters apart within the trellises. This makes it unlikely that the turbulence of one will overshadow the other. The rotors are also spaced 6 rotors apart, downwind.

The elevation drawing shows the orientation facing south. This is also the direction of the prevailing winds from the south and north.

On top of the trellises are positioned the photovoltaic panels facing south at a 20 degree angle. (indicated in purple below



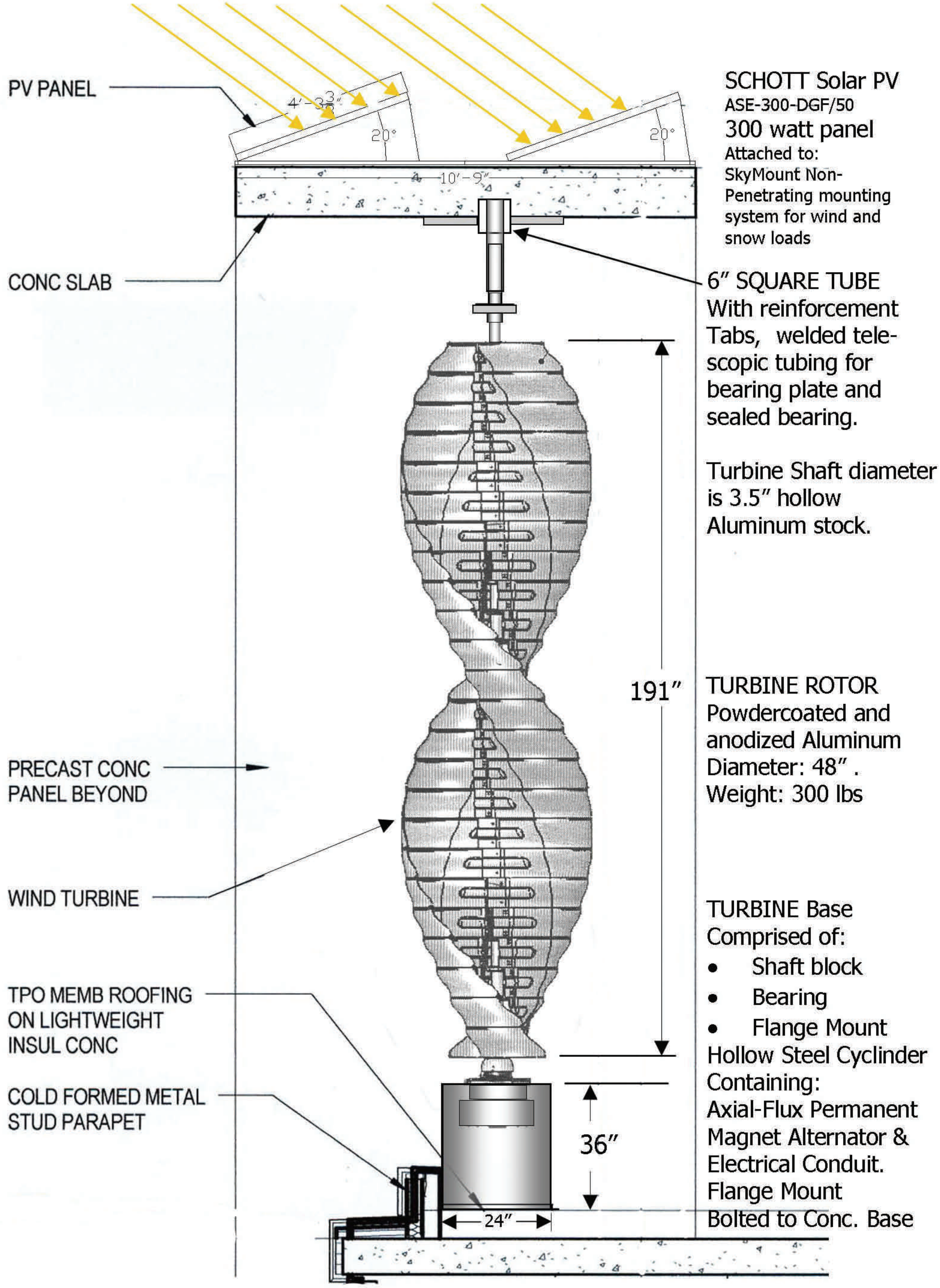
2.1 Placement of 24 wind-turbines on the OMRF Roof.



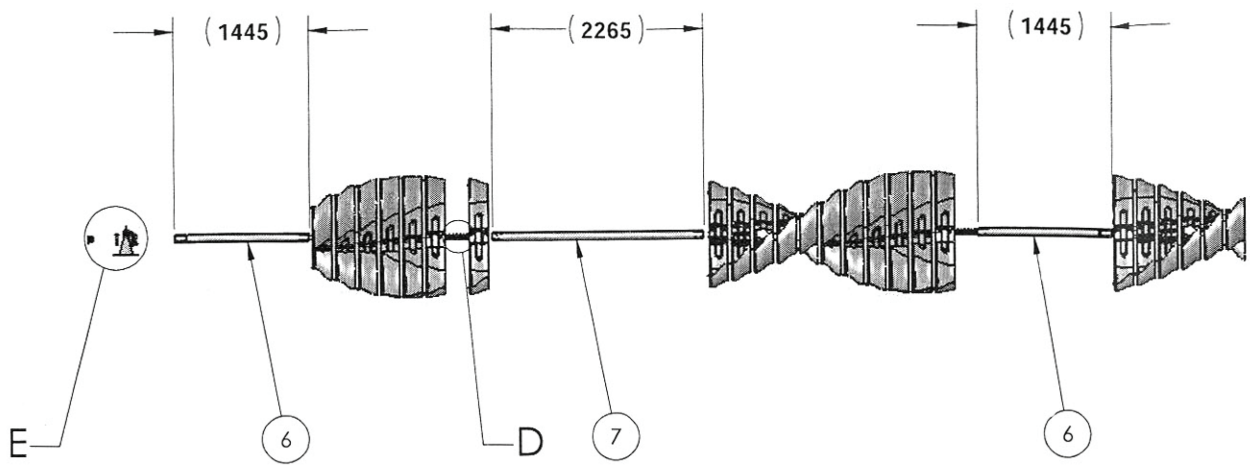
2.2 The Helix-Wind turbine.

2.3 The Helix-Wind turbine.

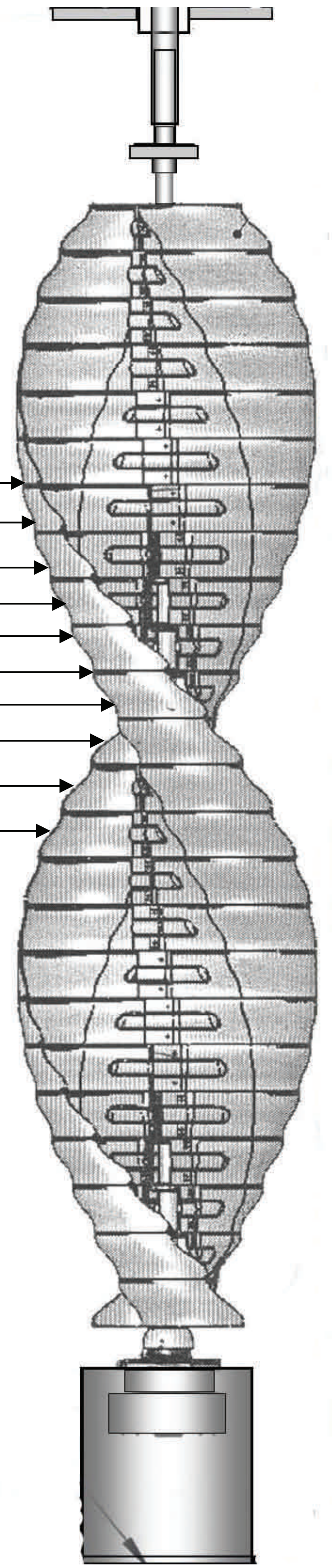
2.4 Helix-Wind Building Mounting Details.



2.5 Custom Mounting Details continued.



2.6 Thrust Load and Drag calculations.



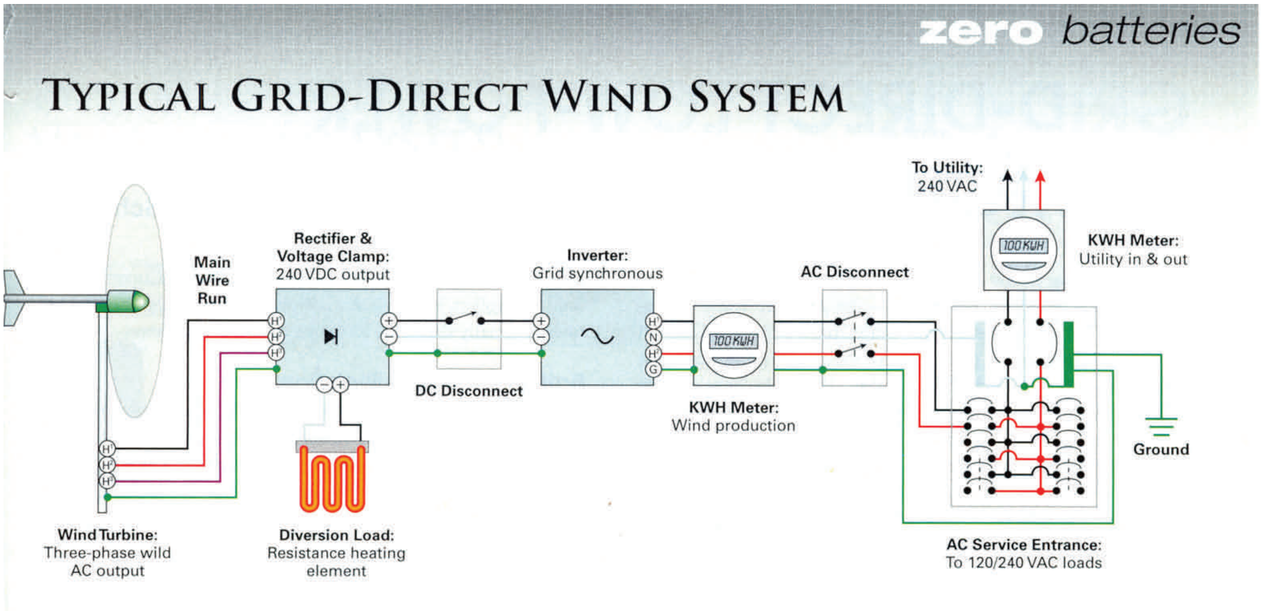
$$D = C_D pV \times VS/2$$

D = drag force (newtons)
C_D = coefficient of Drag = (1.18)
P = density of the air = 1.2 kg/m3
V = velocity of the wind = m/sec
S = swept rotor area = 5.9 m2

1 newton = 0.224808943 pounds force

Wind Velocity		Drag Force	Pounds
m/s	Miles/hour	newtons	of force
5	11	104.4	23.4
7	15.4	204.7	46.01
10	22	417.7	93.9
15	33	939.9	211.3
20	44	1670.9	375.6
25	55	2610.8	586.9
30	66	3759.5	845,1

2.7 Utility-Intertie Inverters.



2.8 Helix-Wind: Performance at various wind-speeds on the OMRF Tower.

Wind Speed Bin (m/s)	Gross Wind Power (kW)	Turbine Power Curve (kW)	Efficiency (Cp)	Turbine Corrected Power (kW)	Weibull Freq. Dist.	Turbine Avg. Power (kW)	(h/yr)	Gross Wind Energy (kWh/yr)	Turbine Avg. Energy (kWh/yr)
1	0.003639	0	0	0	0.009433	0	82.63	0.30	0.00
2	0.029111	0	0	0	0.031109	0	272.51	7.93	0.00
3	0.098249	0	0	0	0.060316	0	528.37	51.91	0.00
4	0.232886	0.034927	0.149976	0.0349272	0.091642	0.003201	802.78	186.96	28.04
5	0.454856	0.068217	0.149976	0.06821719	0.11868	0.008096	1039.64	472.88	70.92
6	0.78599	0.117879	0.149976	0.1178793	0.135394	0.01596	1186.05	932.22	139.81
7	1.248123	0.187188	0.149976	0.18718796	0.137988	0.02583	1208.78	1508.70	226.27
8	1.863088	0.279418	0.149976	0.2794176	0.126318	0.035296	1106.55	2061.60	309.19
9	2.652717	0.397843	0.149976	0.39784264	0.10397	0.041364	910.78	2416.05	362.35
10	3.638844	0.545738	0.149976	0.5457375	0.076832	0.04193	673.04	2449.10	367.31
11	4.843301	0.726377	0.149976	0.72637661	0.050826	0.036919	445.23	2156.40	323.41
12	6.287922	0.943034	0.149976	0.9430344	0.029983	0.028275	262.65	1651.53	247.69
13	7.99454	1.198985	0.149976	1.19898529	0.015703	0.018828	137.56	1099.74	164.93
14	9.984988	1.497504	0.149976	1.4975037	0.007267	0.010882	63.66	635.63	95.33
15	12.2811	1.841864	0.149976	1.84186406	0.002956	0.005445	25.90	318.06	47.70
16	14.90471	2.235341	0.149976	2.2353408	0.001052	0.002351	9.21	137.34	20.60
17	17.87764	2.681208	0.149976	2.68120834	0.000326	0.000873	2.85	50.99	7.65
18	21.22174	3.182741	0.149976	3.1827411	8.72E-05	0.000278	0.76	16.21	2.43
19	24.95883	3.743214	0.149976	3.74321351	2.01E-05	7.52E-05	0.18	4.39	0.66
20	29.11075	4.3659	0.149976	4.3659	3.96E-06	1.73E-05	0.03	1.01	0.15
21	33.69933	5.054075	0.149976	5.05407499	6.66E-07	3.36E-06	0.01	0.20	0.03
22	38.74641	5.811013	0.149976	5.8110129	9.46E-08	5.5E-07	0.00	0.03	0.00
23	44.27381	6.639988	0.149976	6.63998816	1.13E-08	7.52E-08	0.00	0.00	0.00
24	50.30338	7.5	0.149095	7.5	1.14E-09	8.52E-09	0.00	0.00	0.00
								Total per Year	**2414.46**

2.9 Helix-Wind: Yearly Performance.

Estimated Annual Energy Output for HELIX WIND Turbines

Updated by Reinhold Ziegler, Synergy California L.P. 4-21-2008 for Wind Spectrum of OMRF Oklahoma City

	Swept Area (m^2)	Rated Power (kW)	Peak Power	
MOD R-1	3.22	1.25	1.87	
MOD R-2	3.22	2.5	3.75	
MOD C-2	5.94	2.5	5	***C***
MOD C-5	5.94	5	7.5	***Model C-5***

Inputs		**Output**	
Rated Power (kW)	5.0	Hub Height Avg. Wind Speed (m/s)	**7**
CP-Efficiency (%)	15%	Altitude Correction	1.00
Swept Area (m^2)	5.94	Temperature Correction	1.00
Avg. Wind Speed (m/s)	7	Annual Energy Output (kWh/year)	**2414.46**
Weibull K Factor	2.75	Avg. Daily Energy (kWh)	6.61
Altitude (m)	50	Avg. Monthly Energy (kWh)	201.21
Avg. Temp. (C)	20	Avg. Power (kW)	0.28
Anemometer Height (m)	50	Avg. Conversion Efficiency	0.15
Tower Height (m)	50	Capacity Factor	0.04
Wind Shear Exponent	0.24	Annual Specific Yield ($kWh/m^2/yr$)	406.48
Availability	100%		
Turbulence Intensity	0		
Safety Margin	0		

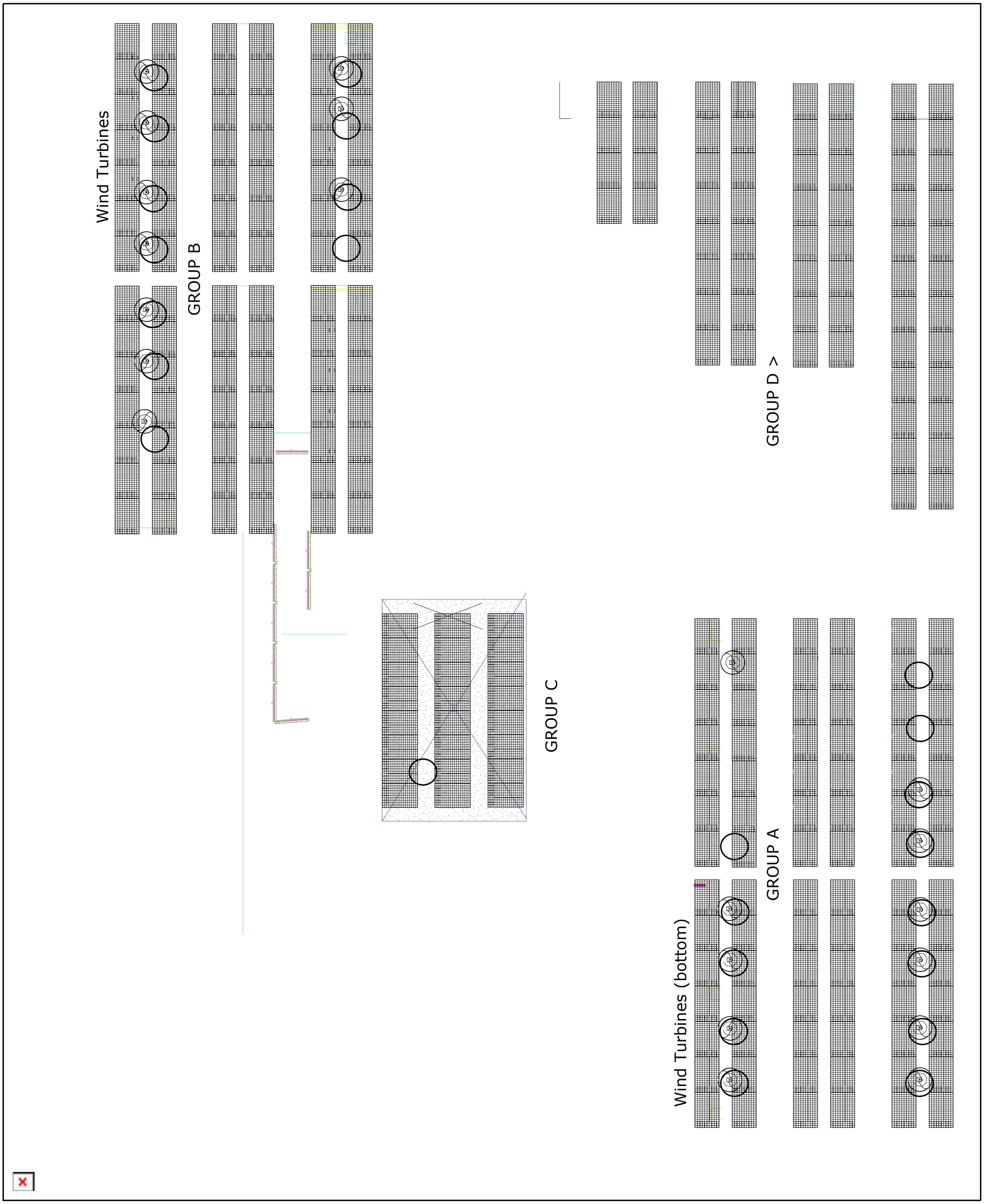
We will be utilizing (24) MOD C-5 HELIX-WIND turbines rated at 5 KW

These 24 turbines will generate conservatively 159 KWhrs per day,

or, 57,142 KWh per year.

3.0 Building Integrated Photovoltaic System. (BIPV) OMRF Isometric

3.1 BIPV Layout of PV panels on the OMRF plan.

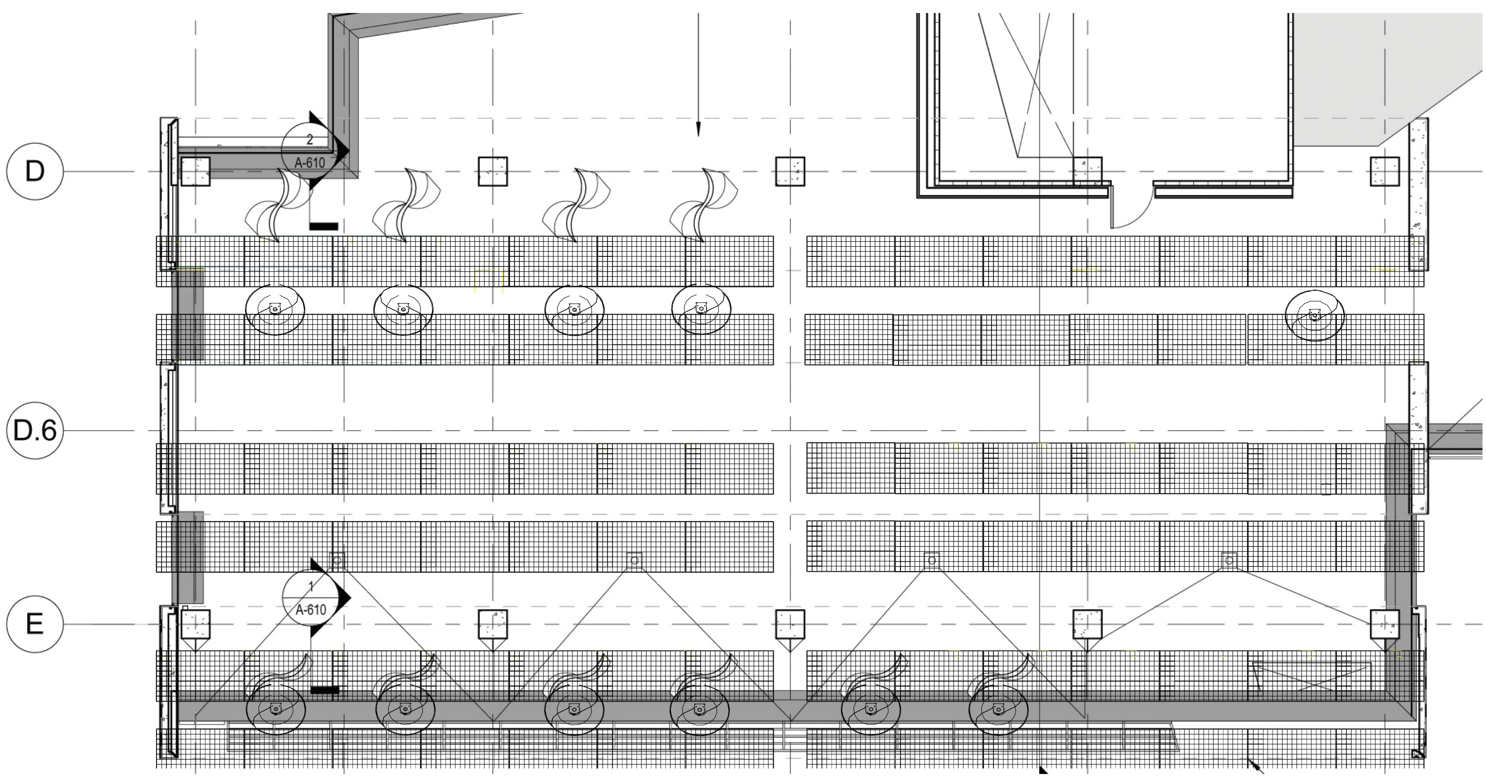


3.2 BIPV String Listing, Output and Calculations for the OMRF Tower only:

Group A:
12 Strings of 7 = 84 panels @ 300 watts/panel = 25,200 watts
Group B:
12 Strings of 7 = 84 panels @ 300 watts/panel = 25,200 watts
Group C:
4 Strings of 8 = 32 panels @ 300 watts/panel = 9,600 watts
Group D:
8 Strings of 8 = 64 panels @ 300 watts/panel = 19,200 watts
Total Capacity **79,200 watts**

Angle of Slope south: 20 degrees
Derating of output: 15 % Actual Capacity **66,528 watts**
At 5 full sunhours/day, Daily power from the system **333 kWhr/day**
At 365 days of full sunshine: (theoretical) 121,545 kWhr/year
Actual output from the PV: Approximate **100,000 kWhr/year**

The Output from the 24 Helix Wind-turbines total: **159 kWhr/day**
Yearly Output from the 24 Helix Wind-turbines total: **57,936 kWhr/year**
Total Power Produced from the OMRF tower: **157,936 kWhr/year**
Total Power consumed by the OMRF tower: **4,911,317 kWhr/year**
12.5% of total power (LEED 3 points) 613,915 kWhr/year
Percentage provided by wind and solar on the tower: 3.2%



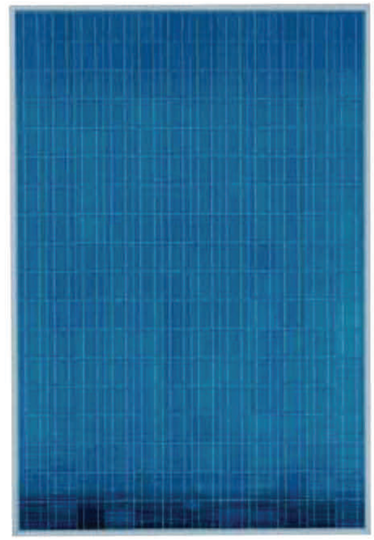
3.3 Final Illustration of the OMRF tower showing placement of PV panels.

3.4 Solar PV potential for the entire OMRF campus.

3.5 The SCHOTT 300 watt PV panel. (Specification-sheet A)

SOLAR | PHOTOVOLTAIC | ASE-300-DGF/50

The World's Single Most Powerful Photovoltaic Module



Utilized in a wide range of applications, the ASE-300-DGF/50 is an industrial-grade solar power module built to the highest standards. Extremely powerful and reliable, the module delivers maximum performance in large systems that require higher voltages, including the most challenging conditions of military, utility and commercial installations. For superior performance, quality and peace of mind, the ASE-300-DGF/50 is renowned as the first choice among those who recognize that not all solar modules are created equal.

Faster Installation

- Large surface area requires fewer interconnects and structural members
- All module-to-module wiring is built right into the module
- Multi-Contact Plug-n-Play connectors mean source-circuit wiring takes just minutes
- Unique mounting systems available for commercial roofs eliminate need for traditional mounting rails, heavy ballast, and roof penetrations

More Reliability

- Bypass diode protection for every 18 solar cells in series, thus minimizing power loss, and mitigating overheating/safety problems
- Advanced encapsulation system ensures steady long-term module performance by eliminating degradation associated with traditional EVA-encapsulated modules
- Moisture impermeable glass on *both* sides of the module protects against tears, perforations, fire, electrical conductivity, delamination and moisture
- Patented no-lead, high-reliability soldering system guarantees long life and ensures against environmental harm should the module break or be discarded

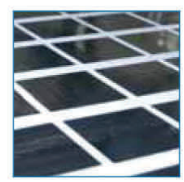
Higher Quality

- Each of the module's 216 individual semi-crystalline silicon cells is inspected and power matched to ensure consistent performance between modules
- Every module is tested utilizing a calibrated solar simulator to ensure that the electrical ratings are within the specified tolerance for power, voltage, and current
- Module-to-module wiring loss is factored into the module's labeled electrical ratings by testing through the module's cable/connector assemblies

Independently Certified

- The ASE-300-DGF/50 is independently certified to meet IEEE 1262, IEC 61215, and UL 1703 Standards
- It is also the *only* module in the industry to receive a UL (Underwriters Laboratories) Class A fire rating

ASE-300-DGF/50 diode housing with bypass diodes, UV resistant cables with MC®-connectors.



Full square semi-crystalline EFG cells ensure maximum energy yield.

Designation:
DG = Double Glass
F = Frame
/50 = Nominal Voltage at STC

SCHOTT solar

3.6 The SCHOTT 300 watt PV panel. (Specification-sheet B)

Current/voltage characteristics with dependence on irradiance and module-temperature.

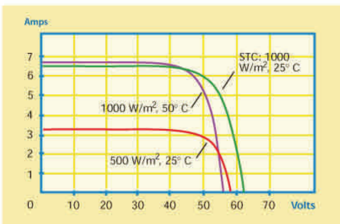
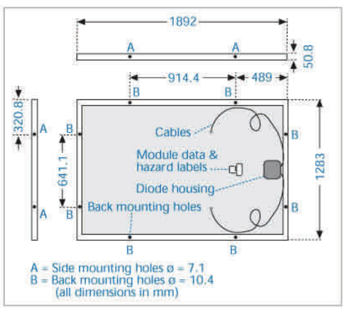


Chart applies to ASE 300 W module only.



Electrical data

The electrical data applies to standard test conditions (STC):
Irradiance at the module level of 1,000 W/m^2 with spectrum AM 1.5
and a cell temperature of 25° C.

Power (max.)	P_P (watts)	280 W	290 W	300 W	310 W	320 W
Voltage at maximum-power point	V_P (volts)	49.6 V	50.1 V	50.6 V	51.1 V	51.6 V
Current at maximum-power point	I_P (amps)	5.7 A	5.8 A	5.9 A	6.1 A	6.2 A
Open-circuit voltage	V_{OC} (volts)	61.9 V	62.5 V	63.2 V	63.8 V	64.4 V
Short-circuit current	I_{SC} (amps)	6.2 A	6.4 A	6.5 A	6.5 A	6.8 A

The rated power may only vary by ± 4% and all other electrical parameters by ±10%.
NOCT-value (800 W/m^2, 20° C, 1m/sec.) = 45° C.

Dimensions and weights

Length mm (in)	1,892.3 (74.5")
Width mm (in)	1,282.7 (50.5")
Weight kg (lbs)	46.6 ± 2 kg (107 ± 5lbs)
Area	2.43 sq meters (26.13 ft sq)

Characteristic data

Solar cells per module	216
Type of solar cell	Semi-crystalline solar cells (EFG process), 10x10 cm^2
Connections	10 AWG single conductor, stranded copper with Multi-Contact connector. Junction box comes with 10 built-in bypass diodes.

Cell temperature coefficients

Power	T_K (P_P)	- 0.47 % / °C
Open-circuit voltage	T_K (V_{OC})	- 0.38 % / °C
Short-circuit current	T_K (I_{SC})	+ 0.10 % / °C

Limits

Maximum system voltage	600 VDC U.S.
Operating module temperature	-40 to +90° C
UL certified design load	50 PSF
Equivalent wind resistance	Wind speed of 192 km/h (120 mph)

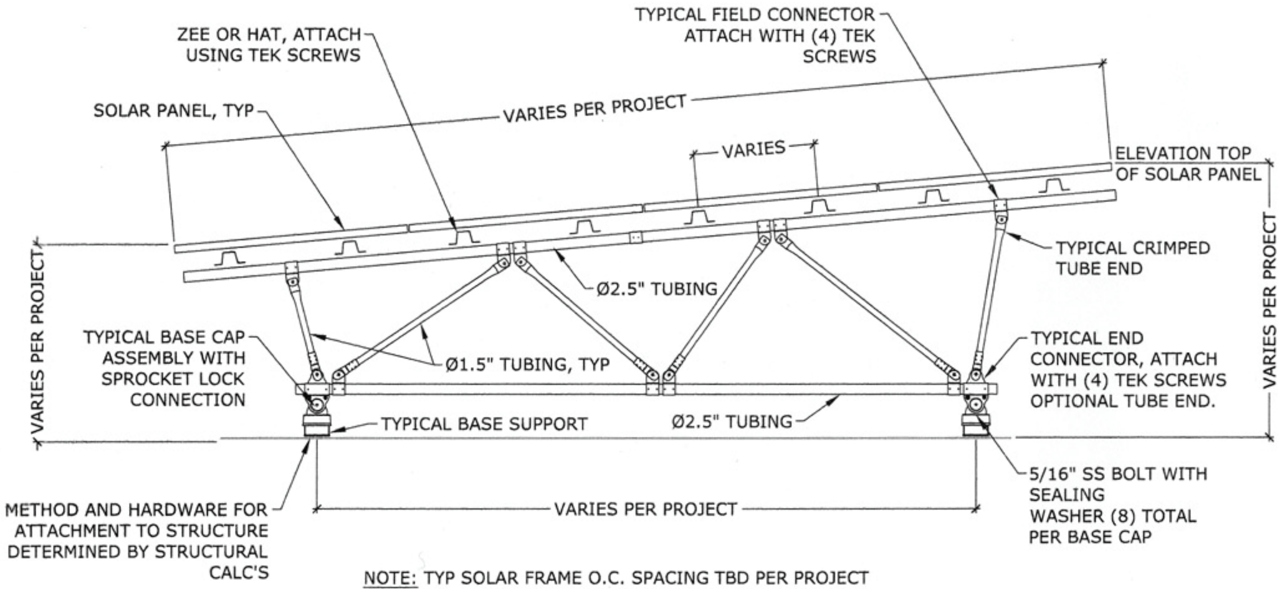
The right is reserved to make technical modifications. For detailed product drawings and specifications please contact SCHOTT Solar or an authorized reseller.

Certifications and Warranty

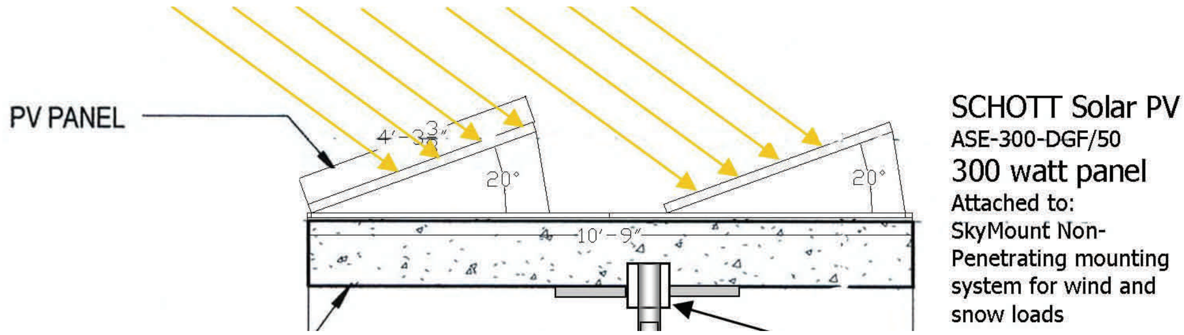
The ASE-300-DGF/50 has been independently certified to IEC 61215, IEEE 1262, and UL 1703 (Class A Fire rating). The ASE-300-DGF/50 comes with a 20 year power warranty (see terms and conditions for details).

3.7 PV Mounting System.

3.7.1 Space-frame details.



3.7.2 Flush mount details.



The SkyMount™ solar array mounting system provides an easy-to-install, non-penetrating platform for the installation of commercial solar systems to a broad range of roof types.

Features	Benefits
Quick and easy installation	• With a limited number of parts, this system provides a simple snap-in-place feature for the module, as well as quick attachment of assemblies, with no loose screws or bolts.
Layout flexibility	• Optimized performance through a creative design layout of single module placement.
Fire code friendly	• Allows for quick and easy removal of modules.
All aluminum and stainless steel construction	• Engineered with extreme durability to provide extended longevity and increased weather resistance.*
Increased roof integrity	• Due to minimal penetration and a quick installation process, this ultimately provides less wear and tear on various roof types.
Minimal penetration	• Provides reduced system cost due to a significantly streamlined installation process.
Removable	• Quick removal capabilities allow for system relocation if needed.
Elevated design	• Better airflow to lower module temperature and increase module performance
Aesthetically appealing	• A sleek, low-profile design that blends with roof lines and architecture.

** 10 year warranty*

Quick and Easy Installation

- Pre-assemblies—four per module. Including module/excludes penetration or ballast
- Module snaps in place
- Quick attachment of penetration, if required
- No loose screws or bolts

Specifications for 20° Tilt Angle—CA

Row Pitch (in/mm)	63.83/1621
Column Pitch (in/mm)	58.43/1484
Height (in/mm)	19.17/487
Weight (lbs/ft²/kg/m²)	2.2/10.5
Weight (no deflectors) (lbs/ft²/kg/m²)*	1.9/9.1

** Includes module/excludes any ballast*

3.8 Utility-intertie inverters

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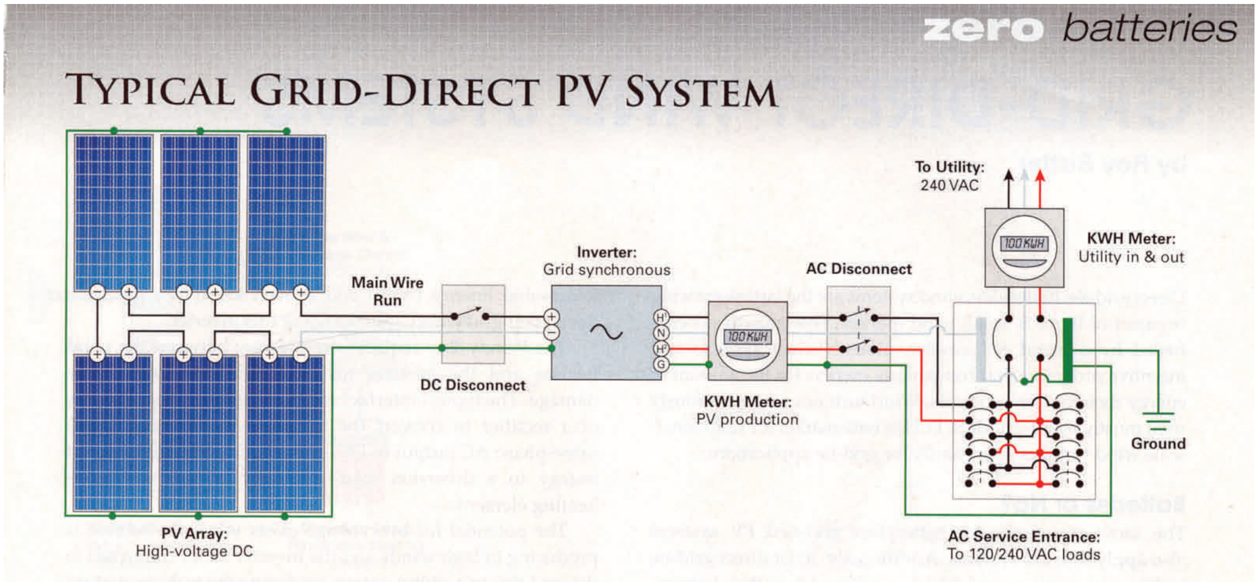
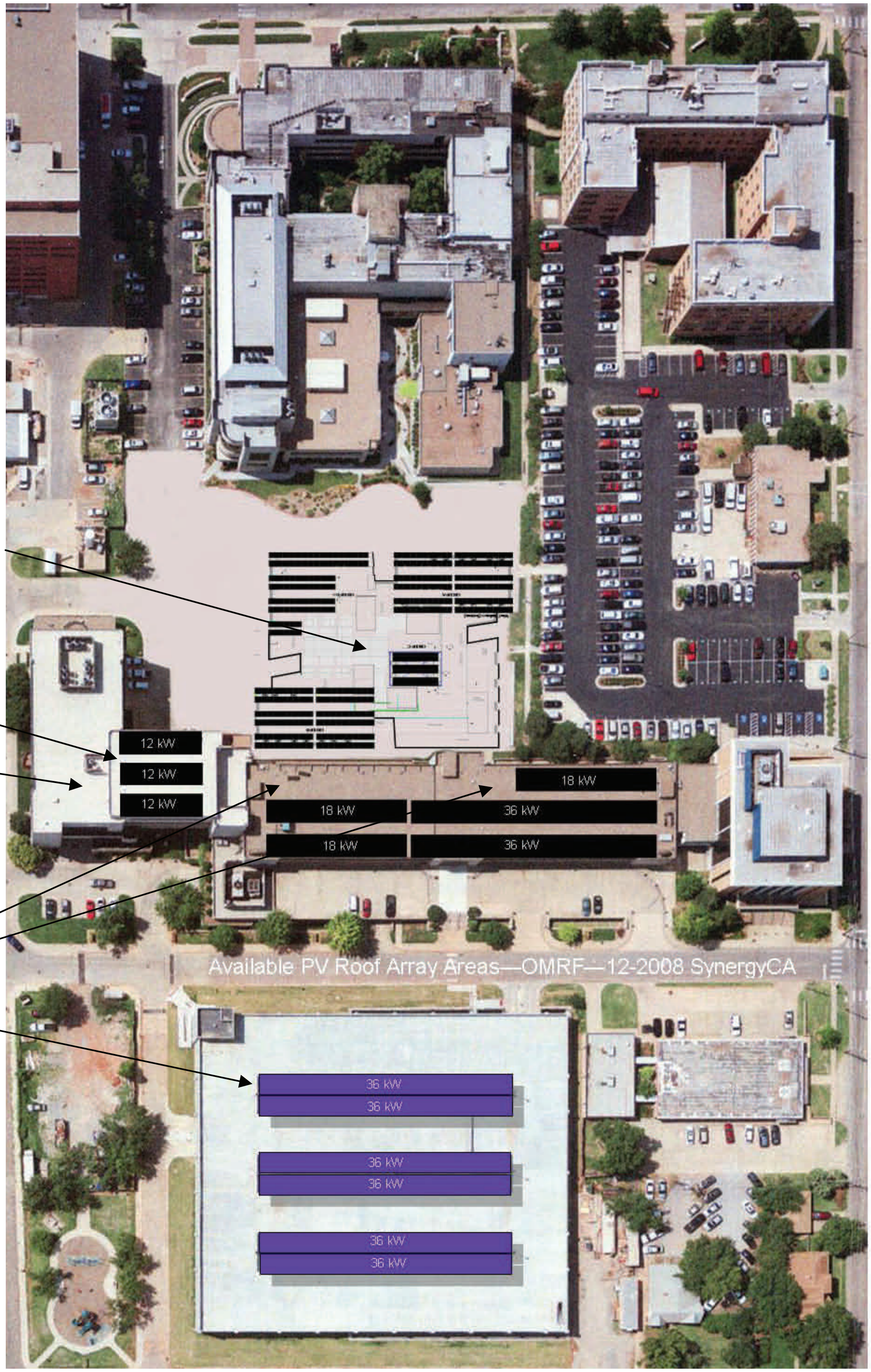


3.9 PV Layout of OMRF campus to achieve 12.5% of electrical load.



OMRF Research Tower:
77 kW of PV
48 kW of Wind

Bell Building:
36 kW of PV
31.2 kW of additional PV capacity (not shown)

Massman Building:
36 kW of PV
(front is shadowed by the new OMRF Tower.)

Acree-Woodworth:
90 kW of PV

Parking Structure:
(Future Capacity)

216 kW of PV
Operational as a shade structure for parking.

More capacity on the perimeter.

3.10 PV Array Inventory and de-rating factors.

OMRF Research Tower:

Group A:

12 Strings of 7 = 84 panels @ 300 watts/panel = 25,200 watts

Group B:

12 Strings of 7 = 84 panels @ 300 watts/panel = 25,200 watts

Group C:

4 Strings of 8 = 32 panels @ 300 watts/panel = 9,600 watts

Group D:

8 Strings of 8 = 64 panels @ 300 watts/panel = 19,200 watts

Total Capacity **79,200 watts**

Bell Building:

Group E:

15 Strings of 8 = 120 panels @ 300 watts/panel = 36,000 watts
13 Strings of 8 = 104 panels @ 300 watts/panel = 31,200 watts

Massman Building:

Group F:

15 Strings of 8 = 120 panels @ 300 watts/panel = 36,000 watts

Acree-Woodworth:

Group G:

38 Strings of 8 = 300 panels @ 300 watts/panel = 90,000 watts

Total Capacity 271,400 watts

Angle of Slope south: 20 degrees
Derating of output: 16 % Actual Capacity **234,400 watts**

Output from 24 windturbines @ 2 kW/machine = 48,000 watts

Total Renewable Energy Capacity of OMRF Campus = 282,400 watts

4.0 Costs and Performance.

Hardware and Installation Cost: The PV and Wind System:

Rating:

PV Capacity: 271,400 watts capacity
Wind: 48,000 watts capacity at 30 mph wind.

The PV Installation: complete with PV panels, rack mounting, array combiner boxes, utility intertie inverter(s) wire trays, wire to array disconnect, circuit breakers, monitoring software and labor.

Industry standard $8.00/watt, installed.
271,400 watts x $8.00 = **$2,171,200**

The Wind Installation: complete with wind rotors, alternator, built in inverters, systems combiner boxes, circuit breakers, utility disconnect interface, monitoring software, and labor to install.

Each machine is rated at 2KW at 30 mph winds. 24 machines.
48,000 watts x $9.00 = **$432,000**

Total Installed cost: $2,603,000

PERFORMANCE: The PV and Wind System:

PV (at 5 full sunhours/day—16% line and inclination loss)	Kwhrs Output/day:	**1,172**
	Kwhrs Output/year;	**427,780**
WIND (utilizing OMRF Windspectrum)	Kwhrs Output/day:	**160**
	Kwhrs Output/year	**58,400**

Total Kwhrs per day for PV and Wind:	**1160 Kwhrs**
Total Kwhrs per year for PV and Wind:	**486,180 Kwhrs**
Total Kwhrs per year required by the building**:**	**4,911,317 Kwhrs**

The PV and Wind turbines are providing **9.9%** of the building's energy.

Note:
There may be days where the wind turbines are working through the night because of storm conditions. This represents an energy bonus situation. Likewise there may be overcast days that limit the output of the PV system.

Net metering contracts with Oklahoma Gas and Electricity are over a period of one year. All systems are monitored to resolve the NET GAIN over the period of one year

4.1 Power Purchase agreements with OG&E.

The Proforma has been completed now that we have received all estimates of the rate structure from Oklahoma Gas and Electric.

We are receiving hard quotes from Solar PV and Wind turbine suppliers.

We are also determining precise Federal Tax Credits, Production Tax credits, Investment Tax credits, Renewable Energy Credits and Rapid Depreciation Allowances as they apply to Oklahoma.

The recent $700B Economic Bailout Bill provided provisions that extended the Federal Solar tax credit out to the year 2015. Likewise the production tax credit of 15% was reinstated for wind energy systems.

These final quotes can be shown to Energy Service companies who may finance the overall renewable energy development.

As a non-profit corporation OMRF can't take advantage of the solar and wind energy tax credits. We are having discussions with OG&E, the Oklahoma Gas & Electric company to partner and become an investor in the renewable energy assets of the building (s)

We expect to have a final Proforma completed by February 1, 2009

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