Appendix A—Wire Loss Tables

12 Volt 2% Wire Loss Table

AMPS	Wattage	14ga	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	3/0
		Distance in Feet									
1	12	45	70	115	180	290	456	720	-	-	-
2	24	22	35	57	90	145	228	360	580	720	912
4	48	10	17	27	45	72	114	180	290	360	456
6	72	7	12	17	30	47	75	120	193	243	305
8	96	5	8	14	22	35	57	90	145	180	228
10	120	4	7	11	18	28	45	72	115	145	183
15	180	3	4	7	12	19	30	48	76	96	122
20	240	-	3	5	9	14	22	36	57	72	91
25	300	-	-	4	7	11	18	29	46	58	73
30	360	-	-	3	6	9	15	24	38	48	61
40	480	-	-	-	4	7	11	18	29	36	45
50	600	-	-	-	-	5	9	14	23	29	36

24 Volt 2% Wire Loss Table

AMPS	Wattage	14ga	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	3/0
		Distance in Feet									
1	24	90	140	230	360	580	912	-	-	-	-
2	48	45	70	115	180	290	456	720	-	-	-
4	96	20	35	55	90	145	228	360	580	720	912
6	144	15	24	35	60	95	150	240	386	486	610
8	192	11	17	29	45	71	114	180	290	360	456
10	240	9	14	23	36	57	91	145	230	290	366
15	360	6	9	14	24	38	60	96	153	192	244
20	480	-	7	11	18	29	45	72	115	145	183
25	600	-	-	9	14	23	36	58	92	116	146
30	720	-	-	7	12	19	30	48	77	97	122
40	960	-	-	-	9	14	23	36	58	72	91
50	1200	-	-	-	-	11	18	29	46	58	73

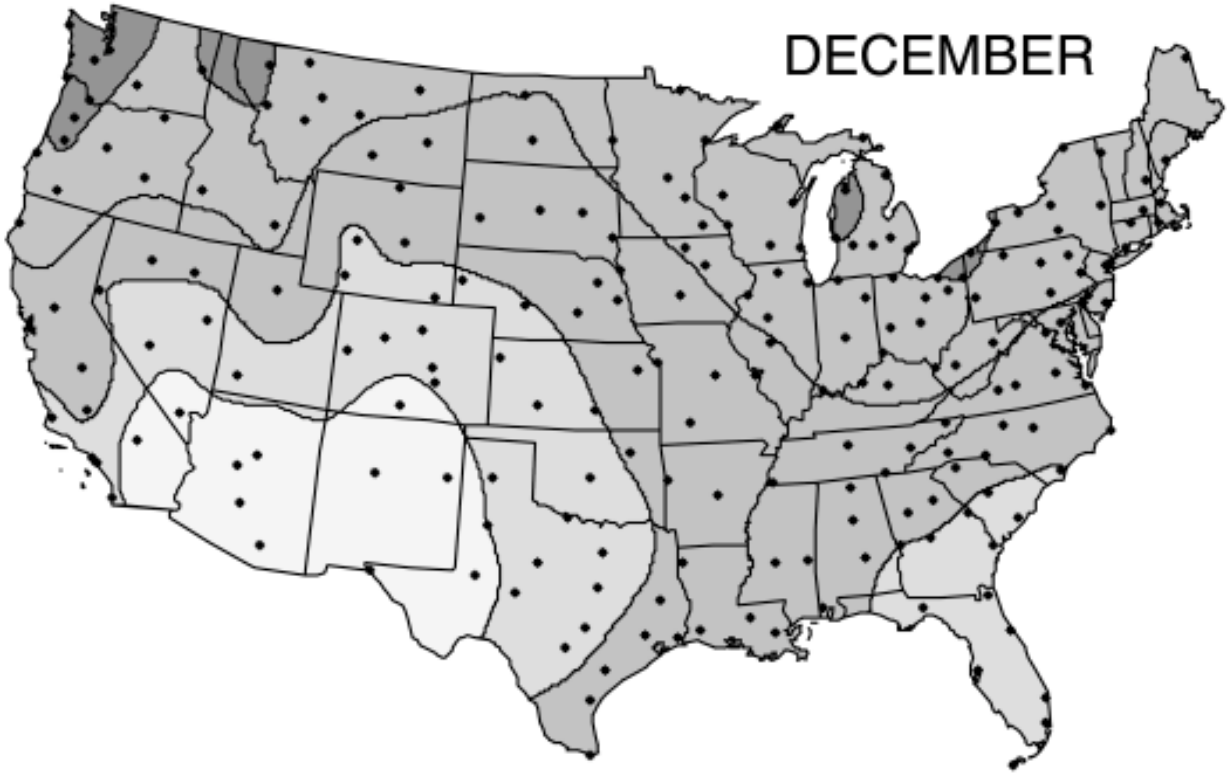
120 Volt 2% Wire Loss Table

AMPS	Wattage	14ga	12ga	10ga	8ga	6ga	4ga	2ga	1/0	2/0	3/0
		Distance in Feet									
1	120	450	700	-	-	-	-	-	-	-	-
2	240	225	350	575	900	-	-	-	-	-	-
4	480	100	175	275	450	725	-	-	-	-	-
6	720	75	120	175	275	450	725	-	-	-	-
8	960	55	85	145	225	355	570	-	-	-	-
10	1200	45	70	120	190	300	480	765	960	-	-
15	1800	30	45	70	120	190	300	480	765	960	-
20	2400	-	35	55	90	145	225	360	575	725	915
25	3000	-	-	45	70	115	180	290	460	580	730
30	3600	-	-	-	60	95	150	240	385	485	610
40	4800	-	-	-	45	70	115	180	290	360	455
50	6000	-	-	-	-	55	90	145	230	290	365

Appendix B—Average Daily Solar Radiation

From: *Atlas for the Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors*, National Renewable Energy Laboratory (http://rredc.nrel.gov/solar/old_data/nsrdb/atlas/redbook)

Average Daily Solar Radiation Per Month



Flat Plate Tilted South at Latitude + 15 Degrees

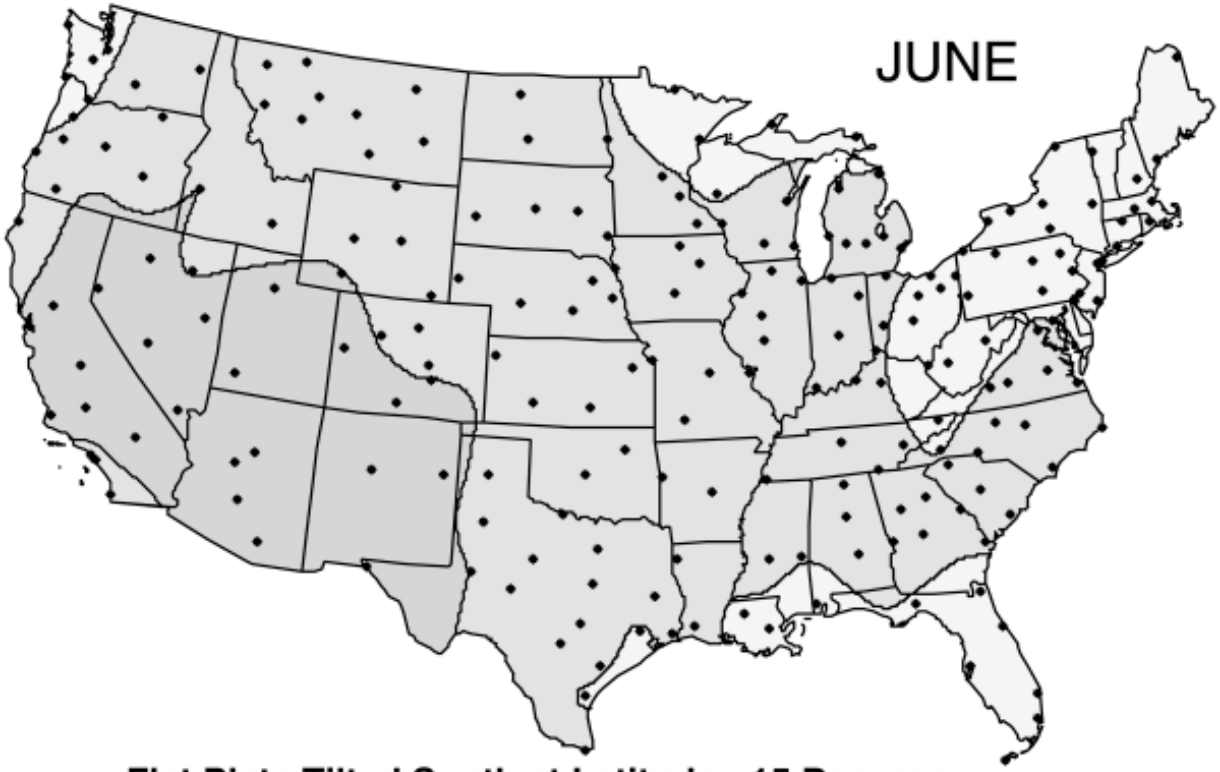
This map shows the general trends in the amount of solar radiation received in the United States and its territories. It is a spatial interpolation of solar radiation values derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The dots on the map represent the 239 sites of the NSRDB.

Maps of average values are produced by averaging all 30 years of data for each site. Maps of maximum and minimum values are composites of specific months and years for which each site achieved its maximum or minimum amounts of solar radiation.

Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

Maps are not drawn to scale.

Average Daily Solar Radiation Per Month



Flat Plate Tilted South at Latitude - 15 Degrees

This map shows the general trends in the amount of solar radiation received in the United States and its territories. It is a spatial interpolation of solar radiation values derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The dots on the map represent the 239 sites of the NSRDB.

Maps of average values are produced by averaging all 30 years of data for each site. Maps of maximum and minimum values are composites of specific months and years for which each site achieved its maximum or minimum amounts of solar radiation.

Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

Maps are not drawn to scale.

Appendix C—Maintenance Checklist

From: *Maintenance and Operation of Stand-Alone Photovoltaic Systems.* 1991. Sandia National Laboratories: 187-188.

Maintenance Check List

Site/Location: _____ Date: _____

System Meters and Readouts

Battery Voltage: _____ Array Current: _____ Load Current:_____

Charging LED: ☐ On ☐ Off LVD LED: ☐ On ☐ Off
Other LED: _____ ☐ On ☐ Off
Other LED: _____ ☐ On ☐ Off

Portable Metering
Array Voltage (test points D+ and D-)
Battery Voltage (test points L+ and L-)
System Current (test point M, P, or S)

- ☐ Circuit breakers not tripped, fuses not blown

Charge Controller

- ☐ Normal operation
- ☐ Wiring connections secure
- ☐ Temperature compensation probe secure and properly located
- ☐ Charge controller properly located and clean

System Wiring

- ☐ Grounding system continuous
- ☐ Disconnect switches operate properly
- ☐ All wiring connections and conduit secure, clean, and uncorroded

Batteries

- ☐ Battery tops clean
- ☐ All cells filled to proper levels
- ☐ Terminal connections secure, clean, protected from corrosion
- ☐ Tie downs and enclosure secure
- ☐ Venting system operating properly
- ☐ Equalization charge performed, if needed
- ☐ Batteries' states of charge recorded on copy of Inspection Record Sheet

Arrays

- ☐ Covers, frames, and reflectors clean and undamaged
- ☐ Seasonal tilt adjustment made, if applicable
- ☐ Tracking checked, if applicable
- ☐ All wiring connections and conduit secure, clean, and uncorroded
- ☐ Open circuit voltage and short circuit current of array and modules measured and recorded on copy of Inspection Record Sheet

Loads

- ☐ All loads operating properly
- ☐ Necessary maintenance and repair operations performed on loads

Inverters

- ☐ Normal operation
- ☐ Wiring connections secure and uncorroded

Current draw in idling mode (test point P):

_____

Current draw in operating mode (test point P): _____

Current draw of load (test point Q): _____

Voltage to load (test points R+ and R-): _____

- ☐ Inverter properly located and clean

About the Author…

Robi Robichaud began studying renewable energy after teaching for 13 years in public and private schools. He received a bachelor's degree in accounting from the University of Massachusetts in Amherst during 1980. During the 1996-1997 academic year he attended the University of Massachusetts in Lowell, taking classes related to renewable energy. In 1998 he transferred to the University of Colorado to work on a master's degree in Building Systems. He has worked on renewable energy assessments and the design of solar photovoltaic systems.

Steve Oravetz graduated from the University of Washington in Civil Engineering and is a licensed Professional Civil Engineer. He began his career on the Wenatchee National Forest in 1980. He became Chief Engineer for the Northeastern Research Station in 1993. In 1996, he became Engineering Program Leader at MTDC. He has been the facilities engineer for the Northern Region in Missoula, MT, since 2001.

Library Card

Robichaud, Robi; Oravetz, Steve. 1999. Maintaining photovoltaic systems: tips from users in land management agencies. Tech. Rep. 9971-2805-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 23 p.

Describes techniques used by the USDA Forest Service and other land management agencies when maintaining photovoltaic systems. Most of the examples are from the Western United States.

Keywords: energy sources, facilities, maintenance, renewable energy, renewable resources

Additional single copies of this document may be ordered from:

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