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SOLAR ENERGY CONVERSION SYSTEMS
ENGINEERING AND ECONOMIC ANALYSIS
RADIATIVE ENERGY INPUT/THERMAL ELECTRIC OUTPUT
COMPUTATION

Volume III

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INTRODUCTION

The solar energy conversion system's transient operation mode requires the engineering and economic analysis of the systems to be performed on the basis of an energy input to the system--solar energy flux on the collector area--properly defined in relation to time constants of the components and of the system itself.

This situation becomes even more evident if it is considered that the value--maximum allowable cost--of the solar energy conversion system is also determined by the value of the substituted energy. The latter may depend, for instance, on how close the total utility load is to the peak value and this may depend, for some loads, e.g., air conditioning, on the atmospheric conditions at that time, and the latter will obviously also strongly influence the solar energy flux on the collector area. This synergy between solar energy flux, meteorological conditions and value of the energy substituted imposes not only a need for a non-steady state simulation, but also for a deterministic approach to the solar energy flux data bank construction. All these considerations, and more, are presented in the Introduction to the first volume of this series.

Due to the worldwide dearth of solar energy data records, a deterministic approach, on the basis of a few "generally available" meteorological parameters, for the computation of the solar data is performed in this work, and a technique of construction of a "typical year" is developed and applied.

In Volume I, the solar radiation characteristics and radiation laws are presented in Chapter 1 and Appendix A1; the computation of astronomical parameters is performed in Chapter 2; the interaction of the electromagnetic flux with the atmospheric components is discussed in Chapter 3; the solar energy flux depletion analytical model is presented in Chapter 4; and the correlation of the depletion to the meteorological parameters, as well as an analysis of the meteorological input data and presentation of alternative ways of computing some of the meteorological "state" parameters involved, are discussed in Chapter 5 and Appendices A2, A3, A4, A5, and A6.

In Volume II, model implementation criteria and the first version of the code CIRR2 for the computation of global energy flux on the collector area on the basis of geographic, geometrical and meteorological parameters are presented in Chapter 5; an extensive analysis of the possibilities of the code and a comparison between computed and experimental results is accomplished in Chapter 6, while Appendix A 7 is on CIRR2 program description.

The direct energy flux analytical model, an analysis of the results and a brief description of a non-steady state model of a thermal solar energy conversion system implemented on a code, SIRR2, as well as the coupling of the CIRR2 and SIRR2 are presented in this Volume III. In Volume III it is also shown how the CIRR2 and, mainly, the SIRR2 codes may be used for a proper design of a solar collector system.

Volume IV consists of a complete description of the CIRR2 interactive computer program with all its subroutines, data bases and their organization, as well as various sample computer sessions, i.e., Volume IV may be considered as a self-sufficient operation manual for the CIRR2 code in its last version.

CHAPTER 8

DIRECT COMPONENT OF THE SOLAR ENERGY RADIATIVE FLUX

This chapter will develop the concepts and techniques needed to adapt eq. 4.35 to the computation of the direct (or beam) component of the solar energy radiative flux and for the computation of all those coefficients of the developed equations that are dependent on meteorological conditions. The main criteria used to perform this task are the same used for the global solar energy flux computation and are stated in Chapter 5. The nomenclature is consistent with that used in the previous volumes and is recalled in the Nomenclature Section at the end of this volume. Eq. 4.35 follows:

$$E_0 = (1 - c_a) E_S \exp[-K_T A_0 A_1(h)] \quad [W \cdot m^{-2}] \quad (8.1)$$

It may be seen how the instantaneous global energy flux density on the ground, E_0 , is computed by multiplying the instantaneous global energy flux density outside the atmosphere (the solar "constant"), E_S , by an exponential attenuation factor, function of constant and variable components of the

atmosphere, (i.e., meteo-dependent) geographic location and time and by a term $(1 - c_a)$ that takes into account the presence of the clouds. The density integral of the atmosphere, A_0 , and the relative atmospheric mass, $A_1(h)$, are characteristic mainly of the energy depletion of the energy flux and therefore do not change for the direct component computation. The depletion "constant" of the atmosphere, K_T , will have to be reestablished for the present purposes, and so will be the $(1 - c_a)$ factor, as will be shown in the next section.

8.1 DEPLETION "CONSTANT" OF THE ATMOSPHERE

8.1.1 Macroclimatic approximation

It has been shown in subsection 5.1.1 how it would not make sense, under this approximation, to determine whether the K_T values obtained refer to the global or direct component being obtained, as they are, largely through averaged meteorological conditions. Furthermore, K_T is not the main source of differentiation between global and direct component computation and is therefore above the "noise level" introduced by the macroclimatic approximation. It should, however, be mentioned that some site-specific polluting agents such as dusts, haze, fog, smoke, etc. will have a particularly

strong impact on K_T , increasing it by more than double the amount obtained in the global component computation, i.e., by 1.2×10^{-5} in particularly critical conditions. Therefore in this case the range of variation of K_T is from 2.3×10^{-5} to $4.7 \times 10^{-5} \text{ m}^2 \text{ kg}^{-1}$.

From the experimental values of the energy flux on the ground, E_{od} --or the experimental values of the attenuation factors--on clear days, in different "Standard Climatic Areas," and computing A_0 and $A_1(h)$ as indicated in Vol. I., from eq. 5.1 it is possible to determine the K_T values under a macro-climatic approximation:

$$K_T = 2.5 \times 10^{-5} \quad [\text{m}^2 \text{ kg}^{-1}]$$

for temperate winter, continental climatic conditions or desert climates (particularly clear atmosphere and low level of humidity);

$$K_T = 3.0 \times 10^{-5} \quad [\text{m}^2 \text{ kg}^{-1}]$$

for temperate summer, continental climatic conditions (clear atmosphere and medium level of humidity);

$$K_T = 3.5 \times 10^{-5} \quad [\text{m}^2 \text{ kg}^{-1}]$$

for humid (tropical) climatic conditions (clear atmosphere and high level of humidity).

As expected, the computed K_T values appear to have a very low sensitivity with respect to the solar altitude: this confirms once more the methodology adopted for the relative atmospheric mass computation and the value determined to be the height of the atmosphere for the purposes of this computation (see Fig. 12, Vol. I).

Also as expected, K_T does have a stronger dependency with respect to the clouds' presence, independent of the clouds' absorbance, i.e., even when the clouds do not directly interfere with the beam's path.

Recalling the discussion presented in Chapters 2 and 3 and making use of equations 5.1 and 8.1, a better approximation is obtained if the K_T values previously defined are correlated to the clouds' presence (and not cloud beam's interception) through the following empirical relation, which takes into account mainly the "instantaneous" increase in water vapor in specific locations in the atmosphere due to the clouds' presence:

$$K_T' = K_T (1 + .5 \eta) \quad (8.2)$$

Equation 8.2 implies that the dependence of the attenuation "constant" with respect to the total sky cover in periods in which $S/D = 1$ is more important for the direct than for the global component computation. The trend of the attenuation ratio with respect to the time of day for various K_T and n values is still substantially the one presented in the sensitivity analysis of subsection 5.1.1.

8.1.2 Microclimatic approximation

For a meso--or microclimatic approximation, the K_T computation should be strictly related, in an explicit, analytic and physical form, to the meteorological parameters.

Following the same criteria and using the same methodology adopted in subsection 5.1.2, K_T will be expressed as a function of the standard components of the atmosphere, i.e., permanent gases, amount of precipitable water and amount of polluting agents and dispersers, such as haze, fog, dust, etc. Thus,

$$K_T = K_T (\text{standard components, water vapor, local factors})$$

The following form will be used:

$$K_T = p_1 + p_2 w^{p_3} + p_4 p \quad (8.3)$$

where:

- p_1 = depletion due to permanent components of the atmospheric gas (N_2 , O_2 , Ar, O_3 , etc.)
- p_2 = intensive factor of depletion due to precipitable water
- w = amount of precipitable water
- p_3 = intensive factor of depletion due to precipitable water
- p_4 = intensive factor of depletion due to "local" factors
- p = extensive factor representing depletion due to "local" factors.

Both the form and the parameters (see discussion in Chapters 2 and 3 and Chapter 4) considered in eq. 8.3 permit the obtaining of a satisfactory relation between K_T and the atmospheric parameters. This relation shows again to be the most precise and realistic obtainable, considering the meteorological data records "generally" available.

Furthermore, it appears to be, for the direct as much as for the global component, quite independent from the geographic location to which it is applied, thus showing a physical content and a non (totally) empirical formulation.

Recalling the definition of the integral transparency coefficient from eqs. 4.25 and 4.29, and setting w and p equal to zero in eq. 8.3, the factor p_1 may be immediately computed and verified comparing it with the values quoted in ref. [51,52,53].

Once p_1 has been obtained, considering a real atmosphere on a particular clear day with no clouds or polluting agents, recalling eq. 4.29, assuming p equals zero, the factors p_2 and p_3 are obtained, using a best fitting procedure (least-square regression technique).

Unlike the global component computation, in the direct component computation the factor p_4 has a heavier impact in as much as even if some "local" factors might only marginally deplete by absorption and/or scattering the energy flux, they generally have a much stronger effect in interfering with the direct component, "obscuring" the beam's path. The computation of both the extensive and intensive parameters that take into account the effect of the "local" agents on the K_T expression has therefore been performed, choosing "clear" days with large amounts of haze or fog.

All these computations are performed using the Southern European data available and as extensively indicated in

Volume II: eq. 8.3 may be rewritten as:

$$K_T = 10^{-5} (1.20 + 0.60 w^{0.40} + .8) \quad [m^2 \text{ Kg}^{-1}] \quad (8.4)$$

where the amount of precipitable water is expressed in millimeters, and p_2 , p_3 and p_4 correspond to a smooth best-fitting, accomplished with Southern European data.

The sensitivity analysis of K_T with respect to the three parameters p_1 , p_2 , and p_3 , using the "spider" graph technique follows for different values of w.

Taking into consideration the explicit form of K_T (given in eq. 8.4) eq. 8.1 may be rewritten (for non-cloudy days, i.e., $S/D = 1$; $\eta = 0$) as:

$$E_{od} = E_S \exp[-(10^{-5}(1.2 + .6 w \cdot^4 + .8) A_0 A_1(h))] \quad (8.5)$$

The "spider" technique sensitivity analysis is now applied to eq. 8.5 and the E_{od} sensitivity is analyzed with respect to the parameters p_1 , p_2 and p_3 , for different values of the amount of precipitable water.

8.2 QUANTITATIVE ASPECTS OF THE CLOUD'S PRESENCE

The dynamics of the interaction between the electromagnetic radiation and the clouds have been described in Chapter 3. There it was stressed that, as large particles are strong light scatterers, the clouds strongly deplete the radiation beam through diffusion (and absorption). It has also been pointed out how a "differential" (punctual) approach to this interaction, in order to construct a physical model of the interaction itself was almost impossible to accomplish, because of lack of knowledge of the interaction between the energy flux and the constituents of the clouds and, mainly, because of the lack of sufficient and sufficiently precise data "generally" available on the cloud cover and clouds' constitution. Therefore, an "integral" approach, through an intensive factor (albedo) and an extensive factor (hours of sunshine per hour), as deep as the available data allowed, has been performed for the global solar energy radiative flux computation.

In the case of the direct component of the solar energy flux density computation no major problem should be expected: eq. 8.5 furnishes the depletion of the beam due to all the components of the atmosphere, all but clouds directly on the beam's path. Values of the hours of sunshine per hour, i.e., S/D, are generally available (for the U.S., see Section 5.3).

Therefore, beside a transcendental term to take into account the surface inclination, the direct component of the solar energy flux should be perfectly determined by simple manipulation of eq. 8.5. Furthermore this approach fully eliminates the problem encountered for the global component computation, i.e., the computation of the albedo of each cloud type, performed in subsection 5.2.1, and therefore eliminates, as it has been shown in Vol. I, one of the main sources of imprecision in the energy flux computation.

Unfortunately, and in spite of the accuracy, as it will be shown in the next chapter, with which eq. 8.5 computes the direct component of the energy in the absence of clouds on the beam's path, the S/D factor does not manage, as it should, to properly take into account the cloud's interception of the beam. This is due to the way S/D is generally measured (a convex lens that focuses substantially direct radiation on a strip of paper on its focal plane, therefore literally "burning" the paper if there is any beam radiation) that does not allow for any precise computation of the minutes of sunshine per hour; does not allow to properly take into account cirrus clouds that would let some direct radiation filtrate and does not allow either for the consideration of heavy cumulus-type clouds that would only briefly intercept the beam.

Another approach has then to be found, making use of all the information generally available on meteorological data bases and generating a more complex function of the latter in order to properly take into account the cloud's presence on the beam's path. This function is here called τ' and eq. 8.1 may then be rewritten, in its more general form:

$$E_{od} = \tau' E_S \exp[-K_T' A_0 A_1(h)] \quad (8.6)$$

It has been found that the best way to eliminate the intrinsic imprecision on the evaluation of S/D (that otherwise should be perfectly adapt to our requirement!) is to express τ' as a function of the total sky cover, η_1 , of the total opaque sky cover, η_2 , and of the total cirrus sky cover, η_{ci} , all expressed in percent of sky dome covered by clouds, normalized to one. Thus

$$\tau' = \tau'(S/D, \eta_1, \eta_2, \eta_{ci}) \quad (8.7)$$

It has also been found that a main differentiation in the computation of τ' has to be done for predominantly sunny as opposed to predominantly cloudy days.

The τ' dependence on total sky cover and on S/D is

plotted on the next four graphs, for both sunny and cloudy days
and treating the remaining variables in eq. 8.7 as parameters.

8.3 TRACKING COLLECTORS

The experimental values of the direct component of the energy flux are generally available on a horizontal surface, as opposed to global component whose experimental values are furnished perpendicularly to the beam. For this reason and because we want to be able to compute both components of integrated solar energy flux on any type of fixed or sun-tracking collector (two axes or one axis tracking), the instantaneous angle between the energy beam and the normal to the collector, θ , has to be determined as a function of location, day of year, time of day, collector's geometry and sun-tracking system. Eq. 8.6 then becomes:

$$E_{od} = \tau' E_S \exp[-K_T' A_0 A_1(h)] \cos(\theta) \quad (8.8)$$

The θ angle expression for various collectors' sun tracking systems may be immediately obtained by simple manipulations of the relations derived in Chapter 2. The final expressions obtained for the $\cos(\theta)$ term follow.

8.3.1 Horizontal collector

$$\cos(\theta) = \sin(h) \quad (8.9)$$

where h is the sun's altitude (see subsection 2.3.1)

8.3.2 Sun-tracking collector, both axes tracking

$$\cos (\theta) = 1 \quad (8.10)$$

8.3.3 Sun-tracking collector, one-axis tracking, fixed horizontal East-West axis

$$\cos (\theta) = (1 - \cos^2 (h) \sin^2 (\psi))^{1/2} \quad (8.11)$$

where ψ is the sun's azimuth (see subsection 2.3.2).

8.3.4 Sun-tracking collector, one-axis tracking, fixed horizontal North-South axis

$$\cos (\theta) = (1 - \cos^2 (h) \cos^2 (\psi))^{1/2} \quad (8.12)$$

8.4 ADDITIONS TO THE GLOBAL ENERGY FLUX DENSITY COMPUTATION

In light of the problems encountered on the direct component of the energy flux computation (mainly due to lack of precision of the meteorological data "generally" available), some minor changes have been made on the global energy flux

model

8.4.1 K_T^i global energy flux computation

The uncertainty associated with the S/D measurement induced us to review the K_T^i and K_T parameters that have been refined as follows

$$K_T^i(\text{global}) = K_T(1 + \alpha \eta_1) \quad (8.13)$$

where: $\alpha = 1.3$ if S/D = 0 for the entire day

$\alpha = .4$ otherwise

η_1 = normalized total sky cover.

$$K_T(\text{global}) = 10^{-5} (p_1 + p_2 w^{p_3} + p_4 p) \quad (8.14)$$

where:

$p_1 = 0.95$

$p_2 = 0.38$

$p_3 = 0.54$

$p_4 p = 0.3$ if there is fog
0.6 if there is haze
0.0 otherwise

8.4.2 Albedo values

There is no change in the albedo computation itself, that is performed as indicated in Section 4.4. However, the average hourly albedo is now arbitrarily assigned as an average between two adjacent hours' average albedos, i.e., for hour i the albedo $a(i)$ is:

$$a(i) = (a(i) + a(i - 1))/2 \quad (8.15)$$

The cloud attenuation factor plotted as a function of S/D for 3 values of albedo computed with the cloud optical depth approach (eq. 5.8) developed in subsection 5.2.2 follows.

8.5 SUMMARY AND MODEL INPUT DATA

Since the availability of input data has been one of the main concepts discussed throughout this work, a few words will now be devoted to the qualitative analysis of the data needed, under different operation options of the model, both for a clear atmosphere and for an atmosphere with clouds. The sensitivity analysis of all parameters involved in the computation has been performed in the previous chapters.

8.5.1 Energy flux density in a clear atmosphere (no clouds)

Equation 8.6 computes the energy flux density as a function of E_0 , K_T , A_0 , and $A_1(h)$.

E_S : Daily values of E_S are computed through equations 1.6, 2.1, and 2.2, assuming the solar "constant" to be 1377 W m^{-2} * and the W.M.O. values of the geometric parameters of the Earth's orbit.

*Computed from the recommended values in reference [66] adjusted upwards 1.8 percent [67] to provide a value on absolute scale.

K_T : For a macroclimatic approximation, the K_T values furnished in Subsection 8.1.1 may be used. Equation 8.4 may also be considered, inserting quarterly values for the amount of precipitable water and local factor.

For a microclimatic approximation, eq. 8.4 must be used and, again, K_T is expressed as a function of precipitable water, w , and "local" factor p . In this approximation, at least daily values of precipitable water should be known (it has been already pointed out that two daily readings are generally available--see Subsection 5.1.2--for a large amount of locations in the United States and throughout the world).

As an alternative, the amount of precipitable water may be computed, as reported in Appendix A3, from hourly (or daily) values of the atmospheric pressure, and from consistent dry-bulb and dew-point temperatures. Measurements of these three "state" parameters of the atmospheric conditions are available on both SOLMET tapes and analogic sheets provided by the National Weather Service.

A_0 : For a macroclimatic approximation, the density integral value for the Standard Atmosphere, given in Section 4.1, may be used.

For a microclimatic approximation, A_0 may be computed from eq. 4.8, as a function of the atmospheric pressure (for a zero station elevation). If the equivalent height of the atmosphere is known (and if the station is at an altitude superior to a few hundred meters), the density integral may be computed again from eq. 4.8 (or from eq. 4.11, as a function of the zero elevation atmospheric pressure and temperatures and the station elevation). For this approximation, the A_0 computation should be performed on an hourly basis.

$A_1(h)$: The relative atmospheric mass, as defined in Section 4.2, is a strictly "astronomical" parameter. It may be computed for every instant from eq. 4.18, as a function of the Sun's altitude, h . The Sun's altitude is expressed in eq. 2.10 as a function of the latitude, of the declination (computed daily from eq. 2.3), and of the pole angle (computed as a time function from eq. 2.11).

8.5.2 Energy flux density for an atmosphere with clouds

Equation 8.6 computes the energy flux density as a function of E_S , K_T , A_0 , $A_1(h)$, and τ' .

The first four parameters are computed as previously indicated.

' values are picked up from the graphs developed in Section 8.2 (or computed as indicated in Volume IV).

8.5.3 Energy Flux

The energy flux (KJ m^{-2}) computation is performed by numerical integration of eq 8.8.

The optimal integration interval will depend on the climatic option adopted (macro or micro) and on the frequency and quality of the meteorological data available. However, it should be between a minimum of one interval per hour (macroclimatic approximation, low quality, or "low frequency" meteorological data available) and six intervals per hour (microclimatic approximation, acceptable quality, and "frequency" of meteorological data).

The intervals of integration, for computing the energy flux on the horizontal, will be the instants of geometrical sunrise and sunset, computed, from eq. 2.17, as follows:

$$\text{sunrise} = t_i = 12 - D/2 \quad [\text{hours}] \quad (8.16)$$

$$\text{sunset} = t_f = 12 + D/2 \quad [\text{hours}] \quad (8.17)$$

where:

D = geometrical day length [hours].

For an arbitrary slant fixed surface, the computation of the astronomical parameters should be made starting from t_i , but the start of the computation of the meteorological correlation functions (and energy density flux) should coincide with the first value of the zenith angle, θ , which is equal or inferior to 90° . The computation will end for the next value of θ superior to 90° . The zenith angle is computed from eqs. 2.18 and 2.19 as a function of the Sun's altitude (computed from eq. 2.11 as a function of the time, declination-day, and latitude), the Sun's azimuth (computed from eqs. 2.12, 2.13, and 2.14 as a function of the Sun's altitude), the surface inclination and orientation angles (as defined in Section 2.5). θ is computed from eqs. 8.9, 8.10, 8.11, and 8.12, depending on the type of collector.

8.6 RANDOMIZATION ROUTINES IN CIRR2

In certain parts of the CIRR2 code, it is necessary to "compute" experimental values of random variables, e.g., cloud data for the macro-climatic option and all of the data for the typical year option. Further, different random variables within the program have different Probability Distribution Functions (PDF's). Some are uniform, i.e., the probability of all possible experimental values is the same. Others have a

"Gaussian" or "normal" PDF. One illustration of a normal PDF might be to graph the scores of students in histogram form. One would observe relatively many occurrences of the mean score and relatively fewer occurrences as one deviated from the mean. Just so, a variable with a normal distribution has a proportionally large number of occurrences of the mean, and proportionally fewer occurrences of values as one deviates from the mean.

A true random variable would be one whose values are not dependent on outside factors, i.e., one whose next value at any given time cannot be computed. Unfortunately, an apparatus of this type--one which would generate values of a true random variable with a specified PDF--does not exist on most computers (if, indeed, it exists at all). However, an algorithm does exist for generating pseudo-random numbers. Pseudo-random numbers are not true random numbers, because they are computed. By definition, the nth value of a pseudo-random number can be computed, hence it is not truly random. Pseudo-random number algorithms are useful, however, because the sequences of numbers they produce very closely resemble the results of observing a true random variable. Pseudo-random number algorithms are also useful because one can, on similar runs, arrange for the same sequence of values of the random variable in question to be generated, by starting from the same "seed."

For computer applications, pseudo-random number generation is accomplished by doing some clever processing on a "seed" number, using knowledge of the way that numbers are stored within the computer. The result is a new seed value (to be used in the next call to the generator) and a uniformly distributed pseudo-random variable on the interval $[0,1]$.

From this variable (call it x_0), one can easily get a uniformly distributed pseudo-random variable, y_0 , on the interval $[a,b]$ using the formula

$$y_0 = a + x_0(b - a)$$

If a pseudo-random variable with a normal distribution is desired, slightly more information is needed, specifically the mean and standard deviation for y_0 , the resultant pseudo-random variable.

The standard deviation of a variable is a measure of how widely distributed about the mean the experimental values of a random variable are observed to be.

If one has observed a random variable for a period of time, the standard deviation of the variable can be computed using the formula

$$\sigma_x = \left(\sum_{i=1}^n (x_i - \bar{x})^2 / n \right)^{1/2}$$

where x_i are the individual observations of the variable, $\bar{x}$ is the mean of the observations, n is the number of observations, and σ_x is the standard deviation of x .

To generate the values of a pseudo-random variable with a normal distribution, an algorithm known as the "direct method" may be employed. If the resultant pseudo-random variable is called y_0 , then

$$y_0 = \sigma_y x + \bar{y}$$

$$x = (-2(\ln(v_1)))^{1/2} \cos(2\pi v_2)$$

where σ_y = desired standard deviation of y

$\bar{y}$ = desired mean of y

v_1, v_2 = uniformly distr. pseudo-random vars of $[0,1]$

(the argument to cos is in radians)

Thus, using these two algorithms, pseudo-random number generation is accomplished in CIR2.

One would observe relatively many occurrences of the mean score and relatively fewer occurrences as one deviated from the mean.

8.6.1 Meso-climatic approximation

To retain as much accuracy as possible a stochastic process for all data items based on historical information is used. It is hypothesized that if the yearly mean and standard deviation of a particular parameter are known for a particular location then, in the long run, the parameter can be modeled as a random variable with a Gaussian ("normal") PDF with the given mean and standard deviation. To this end, the program "computes" dry bulb and dewpoint temperature, and station pressure on a daily basis using a pseudo-random generator which produces numbers with a Gaussian PDF with mean and standard deviation as input. In all cases, values of specified parameters ($\bar{x}_0$) are restricted to the range $(x - 2\sigma_x) \leq x_0 \leq (x + 2\sigma_x)$. From dry bulb and dewpoint temperatures and station pressure (all generated by the stochastic process) a daily value of the amount of precipitable water is computed (eq. A3-21, with the caveats discussed in Appendix A3).

If this same algorithm were to be applied to generate cloud data, the results would be unrealistic: clouds simply do not remain at the same density, optical depth and type all day, every day. So as to obtain more "realistic" results a slightly different approach is used to generate the cloud data, i.e., η_1 , η_2 (and albedo when needed) are determined using the Gaussian randomization routine with the yearly average and standard deviation as inputs. Then a random choice of a daily standard deviation is made, therefore "constructing" day's data fairly uniform, mildly variable or highly variable. Finally, for each hour of the day the Gaussian randomization routine is used to generate hourly values of η_1 , η_2 and albedo letting S/D for that hour to equal $1 - \eta_1$. A final consistency check is then made by comparing the η_1 and η_2 values. If the latter happens to be larger than the former, then η_1 is set to equal η_2 .

It has been found that over many days of computations, the "weather pattern" generated is nearly the same as that observed.

8.6.2 Macroclimatic approximation

For the macroclimatic option, CIRR2 uses monthly default values of station pressure and amount of precipitable water, either user input or world average. However, cloud data are

generated using a stochastic process: the pseudo-random number generator is used to provide a sequence of random numbers; based on this sequence and historical data (either user input or "default") of percentage of sunny, light cloudy, heavy cloudy and overcast days for the over under consideration, six basic types of closed patterns are generated:

- i. sunny day with no clouds
- ii. clear day with few light (transparent) clouds with low frequency
- iii. day with few heavy (opaque) clouds with variable frequency
- iv. day with many heavy clouds with high frequency
- v. day with many heavy clouds with no breaks
- vi. overcast day

8.6.3 Typical year option

Finally, a typical year option has also been created. Historical data were not collected with the same accuracy used for the collection of meteorological and insolation measurements used for the CIRR2 model verification, i.e., by actually inspecting the measurement sites and disregarding those that did not meet all the needed requirements. Historical data were collected mainly through SOLMET data bank,

available for 10 cities in the U.S. and from other, less reliable, data banks. Monthly averages of each parameter and its standard deviation have been computed for each city. Finally regions were mapped around the cities on the basis of similarity in insolation and/or meteorological parameter values (or data availability!). The 10 regions that it was possible to define for the continental U.S. are presented in Fig. 1.

Figure 1

CHAPTER 9

CIRR2 OUTPUT ANALYSIS: DIRECT (BEAM) ENERGY FLUX

The availability of solar energy flux experimental data has been extensively discussed in Chapter 5; the insolation data furnished on SOLMET format using criteria presented in references [64] and [65] are reported in Appendix A4.

For the purposes of this analysis, the values of the direct (beam) solar energy flux have been furnished by the Solar Energy Meteorological Research and Training Site of the Atmospheric Research Center, State University of New York at Albany. For consistency with the global energy flux analysis, the months of February and June 1979 are used as the initial basis of the discussion. A statistical analysis of CIRR2 performance will be presented later in the chapter. Albany climate and the months taken into consideration do ensure, however, plenty of meaning already to the present analysis.

The atmospheric density integral is performed on the basis of the station pressure experimental values, recorded every three hours. These values are linearly interpolated. The

integral of the global energy flux, computed both using the station pressure and using "Standard Atmosphere" pressure values for an artificial day with maximum difference between those two pressures is reported below along with the corresponding tabulation of energy flux values for the two different hypotheses.

TABLE OF VALUES

SOLAR TIME	EO (1)	EO (2)	SOLAR TIME	EO (1)	EO (2)
7.33	4.95	4.85	7.50	20.36	19.98
7.67	37.95	37.30	7.83	57.50	56.58
8.00	78.72	77.56	8.17	101.32	99.92
8.33	125.94	123.35	8.50	150.46	147.55
8.67	175.42	172.23	8.83	200.56	197.11
9.00	225.63	221.94	9.17	250.42	246.52
9.33	274.72	270.63	9.50	298.37	294.10
9.67	321.20	316.79	9.83	343.09	338.54
10.00	363.92	359.24	10.17	383.57	378.79
10.33	401.97	397.08	10.50	419.01	414.04
10.67	434.63	429.59	10.83	448.77	443.66
11.00	461.36	456.20	11.17	472.37	467.16
11.33	482.32	476.51	11.50	490.04	484.20
11.67	496.08	490.21	11.83	500.41	494.51
12.00	503.01	497.10	12.17	503.88	497.97
12.33	503.01	497.10	12.50	500.41	494.51
12.67	496.08	490.21	12.83	490.04	484.20
13.00	482.32	476.51	13.17	472.93	467.16
13.33	461.92	456.20	13.50	449.31	443.66
13.67	435.17	429.59	13.83	419.54	414.04
14.00	402.49	397.08	14.17	384.09	378.79
14.33	365.30	359.24	14.50	344.44	338.54
14.67	322.50	316.79	14.83	299.62	294.10
15.00	275.93	270.63	15.17	251.57	246.52
15.33	226.72	221.95	15.50	201.50	197.11
15.67	176.37	172.23	15.83	151.32	147.55
16.00	126.71	123.35	16.17	102.83	99.92
16.33	79.99	77.56	16.50	58.49	56.58
16.67	38.66	37.30	16.83	20.78	19.99
17.00	5.06	4.85			

EO (1) = INSTANTANEOUS VALUES OF EO COMPUTED USING
'STANDARD' ATMOSPHERE (PO = 101325. (N/SQ. M))

EO (2) = INSTANTANEOUS VALUES OF EO COMPUTED USING
'REAL' ATMOSPHERE (PO = P (STATION))

STATION ELEVATION APPROX. ZERO

The direct component of the global energy flux is computed as indicated in Section 8.5. The surface meteorological data (described in Appendix A5) have been furnished by the Weather Service Forecast Office, N.O.A.A., Albany, N.Y. The site of those measurements is only a few miles from the site of the solar energy flux measurements, at the Atmospheric Sciences Research Center at the State University of New York at Albany.

The meridian (local) time is computed through the following algorithm.*

$$T_{\text{meridian}} = T_{\text{solar}} + \Delta$$

where:

$$\begin{aligned} \Delta = & 0.123570 \sin(D) - 0.004289 \cos(D) + \\ & 0.153809 \sin(1D) + 0.060783 \cos(1D) - \\ & 4(\lambda_{\text{time zone}} - \lambda)160 \\ D = & (N - 1)360/365.242 \end{aligned}$$

In reference to the tabulations, it should be noted that for some hours, although S/D is reported equal to one, there is an indication of clouds. This means only that the clouds did

*H.M. Wolfe, "On the Computation of Solar Elevation Angles and the Determination of Sunrise and Sunset Times," National Meteorological Center, ESSA, Hillcrest Heights, Maryland, NASA TM-X-1645 (1968).

not intercept (or substantially intercept) the beam (which does not necessarily mean they do not have an influence on the beam's depletion as it has been shown and taken into account through K_T which is a function of K_T and the cloud cover).

It also should be noted that sometimes, at sunrise or at sunset, the S/D factor appears superior to one. This is physically impossible, as is evident from the S/D definition. The reason for this is that the minutes of sunshine are an experimental datum, which is divided exactly by 60 minutes (in order to obtain S/D) for all periods of the day, except the sunrise and sunset hours. In those periods, the S factor has been divided by the appropriate computed fraction of the jour: this and the fact that the S measurement is rather imprecise have caused, for those sunrise and sunset times for which the fraction of the hour is particularly small, those "over-computations" which have been reported without correction.

Finally, it should also be noted that four different expressions for the tau prime function are reported on the tabulations. The one considered on the users' version of the CIRR2 code is TAUP4, defined as "selective algorithm" and plotted in Section 8.2.

The results of those computations, performed by the CIRR2 code on the basis of the analytical model described in this volume and in Volume I, are reported below for the month of February 1979, at Albany, N.Y.

The yearly and monthly values of the computation and relative errors, a synoptic table for the daily values, and a synoptic table for the error distribution follow.

Finally, the same computations are reported for the month of June 1979, always at Albany, N.Y.

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

ALBANY, NY

LATITUDE 42.70 DEG. LONGITUDE 73.83 DEG.

TIME = STANDARD TIME [HOURS]
S/D = HOURS OF DIRECT SUNSHINE PER HOUR [ADIM.]
TAUP1 = TAU-PRIME FOR NO CLOUDS (= 1.0)
TAUP2 = TAU-PRIME USING S/D ALGORITHM
TAUP3 = TAU-PRIME USING HYBRID ALGORITHM
TAUP4 = TAU-PRIME USING SELECTIVE ALGORITHM

SKY COVER:

T = TOTAL SKY COVER (IN TENTHS)
O = TOTAL OPAQUE SKY COVER (IN TENTHS)
C = TOTAL CIRRUS SKY COVER (IN TENTHS)
FH = 1 FOR FOG, 16 FOR HAZE, ELSE 0

ALBANY, NY
FEB 1979
DAY NUMBER 32

SUNRISE = 7.23 SUNSET = 17.06 (STD. TIME)
GEOMETRIC DAY LENGTH = 9.83 HOURS
COLL. RISE = 7.23 COLL. SET = 17.08 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
8.00	0.647	5	2	3	0	1.000	0.563	0.607	0.607	1109.	1109.	625.	672.	672.	32.	3364.4	1851.6	2001.2	2001.2
9.00	1.000	5	2	0	0	1.000	0.885	0.770	0.770	1948.	1948.	1724.	1500.	1500.	1176.	65.6	46.6	27.6	27.6
10.00	1.000	7	3	0	0	1.000	0.875	0.680	0.680	2357.	2357.	2062.	1603.	1603.	2193.	7.5	-6.0	-26.9	-26.9
11.00	0.733	7	5	0	0	1.000	0.587	0.465	0.465	2665.	2665.	1563.	1240.	1240.	1540.	73.0	1.5	-19.5	-19.5
12.00	0.300	8	7	0	0	1.000	0.210	0.248	0.248	2758.	2758.	579.	684.	684.	103.	2577.6	462.3	563.8	563.8
13.00	0.083	10	10	0	0	1.000	0.048	0.083	0.083	2658.	2658.	127.	221.	221.	346.	668.2	-63.2	-36.2	-36.2
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2520.	2520.	0.	2.	2.	18.	13901.9	-100.0	-90.2	-90.2
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2230.	2230.	0.	2.	2.	1.	*****	-100.0	56.1	56.1
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1733.	1733.	0.	1.	1.	1.	*****	-100.0	21.3	21.3
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1043.	1043.	0.	1.	1.	32.	3158.5	-100.0	-97.7	-97.7
18.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	0.	0.	0.	0.	0.	0.	*****			

DAILY TOTALS:

21020. 21020. 6681. 5925. 5925. 5442. 286.3 22.8 8.9 8.9

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAJP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					
8.00	0.647	5	2	3	0	1.000	0.563	0.607	0.607	90.		90.	51.	55.	55.
9.00	1.000	5	2	0	0	1.000	0.885	0.770	0.770	415.		415.	368.	320.	320.
10.00	1.000	7	3	0	0	1.000	0.875	0.680	0.680	812.		812.	710.	552.	552.
11.00	0.733	7	5	0	0	1.000	0.587	0.465	0.465	1175.		1175.	690.	547.	547.
12.00	0.300	8	7	0	0	1.000	0.210	0.248	0.248	1364.		1364.	286.	338.	338.
13.00	0.083	10	10	0	0	1.000	0.048	0.083	0.083	1333.		1333.	64.	111.	111.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1163.		1163.	0.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	841.		841.	0.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	443.		443.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	111.		111.	0.	0.	0.
18.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	0.		0.	0.	0.	0.

DAILY TOTALS:

7747. 7747. 2169. 1925. 1925.

ALBANY, NY
FEB 2 1979
DAY NUMBER 33

SUNRISE = 7.21 SUNSET = 17.08 (STD. TIME)
GEOMETRIC DAY LENGTH = 9.87 HOURS
COLL. RISE = 7.21 COLL. SET = 17.10 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX [KJ/SQ.M]	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]				
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.0	815.	815.	0.	1.	0.	0.	*****				
9.00	0.0	9	9	0	0	1.000	0.0	0.023	0.0	1619.	1619.	0.	38.	0.	1.	*****	-100.0	3651.2	-100.0	
10.00	0.267	8	6	0	0	1.000	0.167	0.188	0.173	2225.	2225.	371.	418.	386.	423.	426.0	-12.3	-1.1	-8.8	
11.00	1.000	8	5	0	0	1.000	0.725	0.590	0.700	2555.	2555.	1853.	1509.	1789.	2247.	13.7	-17.5	-32.9	-20.4	
12.00	1.000	8	3	0	0	1.000	0.800	0.590	0.700	2709.	2709.	2168.	1599.	1897.	3048.	-11.1	-28.9	-47.5	-37.8	
13.00	1.000	8	3	0	0	1.000	0.850	0.590	0.700	2723.	2723.	2314.	1607.	1906.	3375.	-19.3	-31.4	-52.4	-43.5	
14.00	1.000	9	4	0	0	1.000	0.825	0.568	0.650	2544.	2544.	2099.	1444.	1654.	2497.	1.9	-16.0	-42.2	-33.8	
15.00	1.000	9	4	0	0	1.000	0.800	0.545	0.600	2252.	2252.	1802.	1228.	1352.	2731.	-17.5	-34.0	-55.0	-50.5	
16.00	1.000	9	4	0	0	1.000	0.800	0.545	0.600	1760.	1760.	1408.	960.	1056.	2473.	-28.8	-43.1	-61.2	-57.3	
17.00	1.000	7	3	0	0	1.000	0.625	0.590	0.700	1179.	1179.	972.	696.	825.	1342.	-12.2	-27.6	-48.2	-38.5	
18.00	1.000	4	4	0	0	1.000	0.825	0.703	0.950	0.	0.	0.	0.	0.	0.	*****				

DAILY TOTALS: 20381. 20381. 12986. 9499. 10866. 18137. 12.4 -28.4 -47.6 -40.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.0	70.		70.	0.	0.	0.
9.00	0.0	9	9	0	0	1.000	0.0	0.023	0.0	353.		353.	0.	8.	0.
10.00	0.267	8	6	0	0	1.000	0.167	0.188	0.173	776.		776.	129.	146.	135.
11.00	1.000	8	5	0	0	1.000	0.725	0.590	0.700	1137.		1137.	824.	671.	796.
12.00	1.000	8	3	0	0	1.000	0.800	0.590	0.700	1351.		1351.	1081.	798.	946.
13.00	1.000	8	3	0	0	1.000	0.850	0.590	0.700	1377.		1377.	1170.	813.	964.
14.00	1.000	9	4	0	0	1.000	0.825	0.568	0.650	1184.		1184.	977.	672.	770.
15.00	1.000	9	4	0	0	1.000	0.800	0.545	0.600	859.		859.	687.	468.	515.
16.00	1.000	9	4	0	0	1.000	0.800	0.545	0.600	457.		457.	365.	249.	274.
17.00	1.000	7	3	0	0	1.000	0.825	0.590	0.700	128.		128.	106.	76.	90.
18.00	1.000	4	4	0	0	1.000	0.825	0.703	0.950	0.		0.	0.	0.	0.

DAILY TOTALS: 7692. 7692. 5340. 3901. 4491.

ALBANY, NY
FEB 3 1979
DAY NUMBER 34

SUNRISE = 7.19 SUNSET = 17.11 (STD. TIME) (MICROCLIMATIC OPTION)
GEOMETRIC DAY LENGTH = 9.91 HOURS
COLL. RISE = 7.19 COLL. SET = 17.12 (STD. TIME)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]				
8.00	0.827	0	0	0	0	1.000	0.827	0.822	0.827	1600.	1600.	1322.	1315.	1322.		869.	84.1	52.2	51.3	52.2
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2541.	2541.	2541.	2414.	2541.		2604.	-2.4	-2.4	-7.3	-2.4
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3039.	3039.	3039.	2887.	3039.		3170.	-4.1	-4.1	-8.9	-4.1
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3315.	3315.	3315.	3149.	3315.		3412.	-2.9	-2.9	-7.7	-2.9
12.00	1.000	1	1	2	0	1.000	0.965	0.958	0.990	3383.	3383.	3265.	3240.	3349.		3513.	-3.7	-7.1	-7.8	-4.7
13.00	1.000	2	1	2	0	1.000	0.930	0.943	0.980	3340.	3340.	3106.	3148.	3273.		3519.	-5.1	-11.7	-10.5	-7.0
14.00	1.000	3	1	2	0	1.000	0.930	0.898	0.980	3180.	3180.	2957.	2854.	3116.		3369.	-5.6	-12.2	-15.3	-7.5
15.00	1.000	2	0	1	0	1.000	0.960	0.883	0.985	3003.	3003.	2883.	2651.	2958.		3248.	-7.5	-11.2	-18.4	-8.9
16.00	1.000	1	0	1	0	1.000	0.990	0.912	0.990	2683.	2683.	2657.	2449.	2657.		2847.	-5.7	-6.7	-14.0	-6.7
17.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	1971.	1971.	1951.	1842.	1951.		1840.	7.1	6.0	0.1	6.0
18.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	0.	0.	0.	0.	0.		42.	-100.0	-100.0	-100.0	-100.0
DAILY TOTALS:										28055.	28055.	27036.	25949.	27522.		28433.	-1.3	-4.9	-8.7	-3.2

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
8.00	0.827	0	0	0	0	1.000	0.827	0.822	0.827	138.	138.	114.	113.	114.	
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	556.	556.	556.	528.	556.	
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1069.	1069.	1069.	1015.	1069.	
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1487.	1487.	1487.	1413.	1487.	
12.00	1.000	1	1	2	0	1.000	0.965	0.958	0.990	1701.	1701.	1642.	1629.	1684.	
13.00	1.000	2	1	2	0	1.000	0.930	0.943	0.980	1703.	1703.	1584.	1606.	1669.	
14.00	1.000	3	1	2	0	1.000	0.930	0.898	0.980	1494.	1494.	1389.	1341.	1464.	
15.00	1.000	2	0	1	0	1.000	0.960	0.883	0.985	1156.	1156.	1110.	1020.	1139.	
16.00	1.000	1	0	1	0	1.000	0.990	0.912	0.990	702.	702.	695.	641.	695.	
17.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	218.	218.	215.	203.	215.	
18.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	0.	0.	0.	0.	0.	
DAILY TOTALS:										10224.	10224.	9861.	9509.	10092.	

ALBANY, NY
FEB 4 1979
DAY NUMBER 35

SUNRISE = 7.18 SUNSET = 17.13 (STD. TIME)
GEOMETRIC DAY LENGTH = 9.95 HOURS
COLL. RISE = 7.17 COLL. SET = 17.14 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
8.00	0.869	8	4	0	0	1.000	0.696	0.482	0.482	1131.	1131.	787.	545.	545.	212.	433.7	271.2	157.0	157.0
9.00	1.000	1	1	0	0	1.000	0.875	0.748	0.748	2434.	2434.	2130.	1820.	1820.	2102.	15.8	1.3	-13.4	-13.4
10.00	1.000	1	1	0	0	1.000	0.950	0.905	0.905	2956.	2956.	2808.	2675.	2675.	2610.	13.2	7.6	2.5	2.5
11.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	3281.	3281.	3199.	3043.	3043.	2753.	19.2	16.2	10.5	10.5
12.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3399.	3399.	3399.	3229.	3229.	2685.	26.6	26.6	20.3	20.3
13.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3399.	3399.	3399.	3229.	3229.	2485.	36.8	36.8	30.0	30.0
14.00	0.700	9	7	9	0	1.000	0.546	0.698	0.698	2755.	2755.	1504.	1922.	1922.	1940.	42.0	-22.5	-0.9	-0.9
15.00	0.050	10	9	0	0	1.000	0.028	0.181	0.181	2364.	2364.	66.	427.	427.	207.	1042.2	-68.3	106.2	106.2
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1863.	1863.	0.	1.	1.	84.	2117.5	-100.0	-98.5	-98.5
17.00	0.0	8	8	0	0	1.000	0.0	0.046	0.046	1265.	1265.	0.	58.	58.	44.	2775.1	-100.0	31.2	31.2
18.00	0.0	10	9	0	0	1.000	0.0	0.046	0.046	0.	0.	0.	0.	0.	0.	*****			

DAILY TOTALS: 24847. 24847. 17291. 16949. 16949. 15122. 64.3 14.3 12.1 12.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	C	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					
8.00	0.869	8	4	0	0	1.000	0.696	0.482	0.482	103.	103.	72.	50.	50.	
9.00	1.000	1	1	0	0	1.000	0.875	0.748	0.748	545.	545.	477.	407.	407.	
10.00	1.000	1	1	0	0	1.000	0.950	0.905	0.905	1051.	1051.	998.	951.	951.	
11.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	1486.	1486.	1448.	1378.	1378.	
12.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	1723.	1723.	1723.	1637.	1637.	
13.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	1748.	1748.	1748.	1661.	1661.	
14.00	0.700	9	7	9	0	1.000	0.546	0.698	0.698	1308.	1308.	714.	912.	912.	
15.00	0.050	10	9	0	0	1.000	0.028	0.181	0.181	922.	922.	26.	166.	166.	
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	498.	498.	0.	0.	0.	
17.00	0.0	8	8	0	0	1.000	0.0	0.046	0.046	147.	147.	0.	7.	7.	
18.00	0.0	10	9	0	0	1.000	0.0	0.046	0.046	0.	0.	0.	0.	0.	

DAILY TOTALS: 9531. 9531. 7206. 7170. 7170.

ALBANY, NY
FEB 5 1979
DAY NUMBER 36

SUNRISE = 7.16 SUNSET = 17.15 (STD. TIME)
GEOMETRIC DAY LENGTH = 9.99 HOURS
COLL. RISE = 7.15 COLL. SET = 17.16 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
8.00	0.495	5	5	0	0	1.000	0.371	0.448	0.448	1432.	1432.	531.	641.	641.	74.	1835.3	617.8	766.8	766.8
9.00	1.000	3	3	0	0	1.000	0.800	0.770	0.770	2274.	2274.	1820.	1752.	1752.	1496.	52.0	21.6	17.1	17.1
10.00	1.000	3	3	0	0	1.000	0.850	0.815	0.815	2807.	2807.	2386.	2288.	2288.	2210.	27.0	8.0	3.5	3.5
11.00	1.000	3	3	0	0	1.000	0.850	0.815	0.815	3103.	3103.	2637.	2529.	2529.	2536.	22.4	4.0	-0.3	-0.3
12.00	0.750	6	7	0	0	1.000	0.563	0.585	0.585	3075.	3075.	1730.	1800.	1800.	2503.	22.8	-30.9	-28.1	-28.1
13.00	0.833	7	7	0	0	1.000	0.542	0.533	0.533	3029.	3029.	1641.	1615.	1615.	1298.	133.4	26.4	24.4	24.4
14.00	0.667	8	8	0	0	1.000	0.417	0.413	0.413	2867.	2867.	1195.	1184.	1184.	693.	313.8	72.4	70.9	70.9
15.00	0.667	8	8	0	0	1.000	0.400	0.391	0.391	2607.	2607.	1043.	1018.	1018.	507.	414.2	105.7	100.8	100.8
16.00	0.417	6	6	0	0	1.000	0.271	0.323	0.323	2271.	2271.	615.	733.	733.	344.	560.2	78.8	113.2	113.2
17.00	0.083	3	3	0	0	1.000	0.065	0.285	0.285	1791.	1791.	116.	511.	511.	202.	786.5	-42.8	152.9	152.9
18.00	0.0	3	3	0	0	1.000	0.0	0.315	0.315	0.	0.	0.	0.	0.	0.	*****			
DAILY TOTALS:										25256.	25256.	13714.	14072.	14072.	11863.	112.9	15.6	18.6	18.6

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

8.00	0.495	5	5	0	0	1.000	0.371	0.448	0.448	118.	118.	44.	53.	53.	
9.00	1.000	3	3	0	0	1.000	0.800	0.770	0.770	516.	516.	413.	398.	398.	
10.00	1.000	3	3	0	0	1.000	0.850	0.815	0.815	1009.	1009.	858.	823.	823.	
11.00	1.000	3	3	0	0	1.000	0.850	0.815	0.815	1418.	1418.	1205.	1156.	1156.	
12.00	0.750	6	7	0	0	1.000	0.563	0.585	0.585	1572.	1572.	884.	920.	920.	
13.00	0.833	7	7	0	0	1.000	0.542	0.533	0.533	1571.	1571.	851.	837.	837.	
14.00	0.667	8	8	0	0	1.000	0.417	0.413	0.413	1372.	1372.	572.	567.	567.	
15.00	0.667	8	8	0	0	1.000	0.400	0.391	0.391	1027.	1027.	411.	401.	401.	
16.00	0.417	6	6	0	0	1.000	0.271	0.323	0.323	615.	615.	166.	199.	199.	
17.00	0.083	3	3	0	0	1.000	0.065	0.285	0.285	211.	211.	14.	60.	60.	
18.00	0.0	3	3	0	0	1.000	0.0	0.315	0.315	0.	0.	0.	0.	0.	
DAILY TOTALS:										9429.	9429.	5418.	5413.	5413.	

ALBANY, NY
FEB 6 1979
DAY NUMBER 37

SUNRISE = 7.14 SUNSET = 17.17 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.03 HOURS
COLL. RISE = 7.14 COLL. SET = 17.19 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1960.	1960.	1960.	1862.	1960.	1071.	83.0	83.0	73.8	83.0
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2672.	2672.	2672.	2539.	2672.	2684.	-0.4	-0.4	-5.4	-0.4
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3126.	3126.	3126.	2970.	3126.	3234.	-3.3	-3.3	-8.2	-3.3
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3390.	3390.	3390.	3221.	3390.	3472.	-2.4	-2.4	-7.2	-2.4
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3514.	3514.	3514.	3338.	3514.	3563.	-1.4	-1.4	-6.3	-1.4
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3534.	3534.	3534.	3357.	3534.	3575.	-1.2	-1.2	-6.1	-1.2
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3448.	3448.	3448.	3276.	3448.	3500.	-1.5	-1.5	-6.4	-1.5
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3238.	3238.	3238.	3076.	3238.	3312.	-2.2	-2.2	-7.1	-2.2
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2839.	2839.	2839.	2697.	2839.	2917.	-2.7	-2.7	-7.5	-2.7
17.00	1.000	1	0	1	0	1.000	0.995	0.942	0.995	2092.	2092.	2081.	1972.	2081.	1185.	76.5	75.6	66.4	75.6
18.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	264.	264.	261.	247.	261.	126.	109.3	107.3	95.7	107.3
DAILY TOTALS:										30077.	30077.	30064.	28554.	30064.	28639.	5.0	5.0	-0.3	5.0

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NG	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	164.	164.	164.	156.	164.	
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	613.	613.	613.	583.	613.	
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1135.	1135.	1135.	1079.	1135.	
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1563.	1563.	1563.	1485.	1563.	
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1812.	1812.	1812.	1721.	1812.	
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1848.	1848.	1848.	1756.	1848.	
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1665.	1665.	1665.	1582.	1665.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1288.	1288.	1288.	1224.	1288.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	779.	779.	779.	740.	779.	
17.00	1.000	1	0	1	0	1.000	0.995	0.942	0.995	256.	256.	255.	241.	255.	
18.00	1.000	1	0	1	0	1.000	0.990	0.935	0.990	4.	4.	4.	4.	4.	
DAILY TOTALS:										11129.	11129.	11127.	10570.	11127.	

ALBANY, NY
FEB 7 1979
DAY NUMBER 38

SUNRISE = 7.12 SUNSET = 17.19 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.07 HOURS
COLL. RISE = 7.12 COLL. SET = 17.21 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	D	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1237.	1237.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1921.	1921.	0.	1.	1.	0.	*****			
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2452.	2452.	0.	2.	2.	1.	*****	-100.0	71.6	71.6
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2766.	2766.	0.	2.	2.	1.	*****	-100.0	93.6	93.6
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2914.	2914.	0.	2.	2.	1.	*****	-100.0	104.0	104.0
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2934.	2934.	0.	2.	2.	3.	97709.9	-100.0	-31.5	-31.5
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2826.	2826.	0.	2.	2.	1.	*****	-100.0	97.8	97.8
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2568.	2568.	0.	2.	2.	0.	*****			
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2106.	2106.	0.	1.	1.	0.	*****			
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1410.	1410.	0.	1.	1.	0.	*****			
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	157.	157.	0.	0.	0.	0.	*****			
DAILY TOTALS:										23290.	23290.	0.	16.	16.	7.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					
		T	D	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	112.	112.	0.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	451.	451.	0.	0.	0.	0.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	902.	902.	0.	1.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1287.	1287.	0.	1.	1.	1.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1515.	1515.	0.	1.	1.	1.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1548.	1548.	0.	1.	1.	1.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1378.	1378.	0.	1.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1034.	1034.	0.	1.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	569.	569.	0.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	181.	181.	0.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	3.	3.	0.	0.	0.	0.
DAILY TOTALS:										9001.	9001.	0.	6.	6.	6.

ALBANY, NY
FEB 8 1979
DAY NUMBER 39

SUNRISE = 7.10 SUNSET = 17.22 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.12 HOURS
COLL. RISE = 7.10 COLL. SET = 17.23 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR			
		T	O	C	FH	TAUF1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1236.	1236.	0.	1.	1.	1.	*****	-100.0	-13.5	-13.5
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1916.	1916.	0.	1.	1.	231.	729.6	-100.0	-99.4	-99.4
10.00	0.500	8	8	0	0	1.000	0.275	0.271	0.271	2556.	2556.	703.	692.	692.	855.	198.9	-17.8	-19.1	-19.1
11.00	0.500	7	7	0	0	1.000	0.313	0.338	0.338	2924.	2924.	914.	988.	988.	1491.	96.1	-38.7	-33.7	-33.7
12.00	1.000	5	5	0	0	1.000	0.700	0.680	0.680	3176.	3176.	2223.	2161.	2161.	1973.	60.9	12.7	9.5	9.5
13.00	1.000	1	1	0	0	1.000	0.850	0.815	0.815	3426.	3426.	2912.	2793.	2793.	3071.	11.6	-5.2	-9.1	-9.1
14.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	3416.	3416.	3331.	3169.	3169.	2918.	17.1	14.2	8.6	8.6
15.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3205.	3205.	3205.	3045.	3045.	2554.	25.5	25.5	19.2	19.2
16.00	1.000	1	1	0	0	1.000	0.975	0.928	0.928	2729.	2729.	2660.	2531.	2531.	1788.	52.6	48.8	41.6	41.6
17.00	0.833	5	4	0	0	1.000	0.729	0.690	0.690	1747.	1747.	1274.	1206.	1206.	590.	196.1	115.9	104.4	104.4
18.00	0.772	0	0	0	0	1.000	0.695	0.685	0.685	238.	238.	165.	163.	163.	13.	1728.3	1169.9	1152.2	1152.2

DAILY TOTALS:

26569. 26569. 17388. 16749. 16749. 15485. 71.6 12.3 8.2 8.2

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	116.	116.	0.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	457.	457.	0.	0.	0.	0.
10.00	0.500	8	8	0	0	1.000	0.275	0.271	0.271	951.	951.	262.	257.	257.	257.
11.00	0.500	7	7	0	0	1.000	0.313	0.338	0.338	1374.	1374.	429.	464.	464.	464.
12.00	1.000	5	5	0	0	1.000	0.700	0.680	0.680	1666.	1666.	1166.	1133.	1133.	1133.
13.00	1.000	1	1	0	0	1.000	0.850	0.815	0.815	1823.	1823.	1549.	1486.	1486.	1486.
14.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	1680.	1680.	1638.	1558.	1558.	1558.
15.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	1304.	1304.	1304.	1238.	1238.	1238.
16.00	1.000	1	1	0	0	1.000	0.975	0.928	0.928	773.	773.	754.	717.	717.	717.
17.00	0.833	5	4	0	0	1.000	0.729	0.690	0.690	232.	232.	169.	160.	160.	160.
18.00	0.772	0	0	0	0	1.000	0.695	0.685	0.685	5.	5.	4.	4.	4.	4.

DAILY TOTALS:

10380. 10380. 7274. 7019. 7019.

ALBANY, NY
FEB 9 1979
DAY NUMBER 40

SUNRISE = 7.03 SUNSET = 17.24 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.16 HOURS
COLL. RISE = 7.03 COLL. SET = 17.25 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
8.00	0.906	8	5	0	0	1.000	0.680	0.498	0.634	1289.	1289.	876.	642.	817.	366.	252.1	139.2	75.3	123.3
9.00	1.000	4	2	0	0	1.000	0.825	0.680	0.900	2242.	2242.	1849.	1525.	2018.	1487.	50.7	24.4	2.5	35.7
10.00	1.000	5	2	0	0	1.000	0.900	0.748	1.000	2723.	2723.	2451.	2036.	2723.	1362.	99.9	79.9	49.5	99.9
11.00	1.000	2	1	0	0	1.000	0.925	0.793	1.000	3198.	3198.	2959.	2535.	3198.	2777.	15.2	6.5	-8.7	15.2
12.00	1.000	0	0	0	0	1.000	0.975	0.905	1.000	3471.	3471.	3384.	3141.	3471.	3351.	3.6	1.0	-6.3	3.6
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3508.	3508.	3508.	3333.	3508.	3362.	4.3	4.3	-0.9	4.3
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3431.	3431.	3431.	3260.	3431.	3215.	6.7	6.7	1.4	6.7
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3234.	3234.	3234.	3072.	3234.	3149.	2.7	2.7	-2.4	2.7
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2853.	2853.	2853.	2710.	2853.	2855.	-0.1	-0.1	-5.1	-0.1
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2211.	2211.	2211.	2100.	2211.	2038.	8.5	8.5	3.1	8.5
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	287.	287.	287.	272.	287.	224.	28.0	28.0	21.6	28.0

DAILY TOTALS:

28446. 28446. 27041. 24626. 27751. 24186. 17.6 11.8 1.8 14.7

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
8.00	0.906	8	5	0	0	1.000	0.680	0.498	0.634	126.	126.	85.	63.	80.	
9.00	1.000	4	2	0	0	1.000	0.825	0.680	0.900	544.	544.	449.	370.	490.	
10.00	1.000	5	2	0	0	1.000	0.900	0.748	1.000	1023.	1023.	921.	765.	1023.	
11.00	1.000	2	1	0	0	1.000	0.925	0.793	1.000	1517.	1517.	1403.	1202.	1517.	
12.00	1.000	0	0	0	0	1.000	0.975	0.905	1.000	1836.	1836.	1790.	1662.	1836.	
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1882.	1882.	1882.	1788.	1882.	
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1703.	1703.	1703.	1618.	1703.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1330.	1330.	1330.	1263.	1330.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	819.	819.	819.	779.	819.	
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	296.	296.	296.	281.	296.	
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	8.	8.	8.	8.	8.	

DAILY TOTALS:

11084. 11084. 10687. 9798. 10984.

ALBANY, NY
FEB 10 1979
DAY NUMBER 41

SUN-RISE = 7.06 SUNSET = 17.26 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.20 HOURS
COLL. RISE = 7.06 COLL. SET = 17.28 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NC	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
8.00	1.000	5	3	0	0	1.000	0.850	0.725	1.000	1699.	1699.	1444.	1232.	1699.	681.	149.4	112.0	80.9	149.4
9.00	1.000	10	3	0	0	1.000	0.850	0.613	0.750	2089.	2089.	1776.	1280.	1567.	1207.	73.1	47.1	6.0	29.8
10.00	1.000	10	6	0	0	1.000	0.725	0.500	0.500	2584.	2584.	1874.	1293.	1293.	418.	518.3	348.3	209.4	209.4
11.00	1.000	8	6	0	0	1.000	0.650	0.545	0.600	2992.	2992.	1945.	1632.	1796.	1317.	127.2	47.7	23.9	36.4
12.00	1.000	7	5	0	0	1.000	0.725	0.613	0.750	3192.	3192.	2315.	1957.	2395.	1438.	122.0	61.0	36.1	66.5
13.00	1.000	5	3	0	0	1.000	0.800	0.680	0.900	3320.	3320.	2656.	2259.	2989.	3017.	10.1	-12.0	-25.1	-0.9
14.00	1.000	3	3	0	0	1.000	0.850	0.770	1.000	3348.	3348.	2846.	2579.	3348.	3457.	-3.1	-17.7	-25.4	-3.1
15.00	1.000	3	3	0	0	1.000	0.850	0.815	1.000	3147.	3147.	2675.	2566.	3147.	3301.	-4.7	-19.0	-22.3	-4.7
16.00	1.000	1	3	0	0	1.000	0.850	0.860	1.000	2888.	2888.	2455.	2485.	2888.	2933.	-1.5	-16.3	-15.3	-1.5
17.00	1.000	0	0	0	0	1.000	0.925	0.928	1.000	2332.	2332.	2157.	2163.	2332.	2099.	11.1	2.8	3.1	11.1
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	308.	308.	308.	292.	308.	254.	21.1	21.1	15.1	21.1
DAILY TOTALS:										27901.	27901.	22451.	19737.	23762.	20122.	38.7	11.6	-1.9	18.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3
8.00	1.000	5	3	0	0	1.000	0.850	0.725	1.000	169.	169.	144.	123.	169.
9.00	1.000	10	3	0	0	1.000	0.850	0.613	0.750	512.	512.	435.	314.	384.
10.00	1.000	10	8	0	0	1.000	0.725	0.500	0.500	983.	983.	713.	492.	492.
11.00	1.000	8	6	0	0	1.000	0.650	0.545	0.600	1432.	1432.	931.	781.	860.
12.00	1.000	7	5	0	0	1.000	0.725	0.613	0.750	1703.	1703.	1235.	1044.	1278.
13.00	1.000	5	3	0	0	1.000	0.800	0.680	0.900	1797.	1797.	1438.	1222.	1617.
14.00	1.000	3	3	0	0	1.000	0.850	0.770	1.000	1677.	1677.	1426.	1292.	1677.
15.00	1.000	3	3	0	0	1.000	0.850	0.815	1.000	1308.	1308.	1112.	1066.	1308.
16.00	1.000	1	3	0	0	1.000	0.850	0.860	1.000	341.	341.	715.	723.	841.
17.00	1.000	0	0	0	0	1.000	0.925	0.928	1.000	321.	321.	297.	297.	321.
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	10.	10.	10.	9.	10.
DAILY TOTALS:										10753.	10753.	8454.	7364.	8957.

ALBANY, NY
FEB 11 1979
DAY NUMBER 42

SUNRISE = 7.04 SUNSET = 17.28 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.24 HOURS
COLL. RISE = 7.03 COLL. SET = 17.30 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
8.00	0.711	0	0	0	0	1.000	0.711	0.770	0.711	2210.	2210.	1571.	1701.	1571.	1350.	63.7	16.4	26.0	16.4
9.00	1.000	4	3	0	0	1.000	0.925	0.860	1.000	2581.	2581.	2387.	2220.	2581.	2347.	10.0	1.7	-5.4	10.0
10.00	1.000	2	2	0	0	1.000	0.875	0.815	1.000	3152.	3152.	2758.	2569.	3152.	3082.	2.3	-10.5	-16.6	2.3
11.00	1.000	2	2	0	0	1.000	0.900	0.860	1.000	3417.	3417.	3075.	2939.	3417.	3515.	-2.8	-12.5	-16.4	-2.8
12.00	1.000	2	1	0	0	1.000	0.925	0.860	1.000	3534.	3534.	3269.	3040.	3534.	3615.	-2.2	-9.6	-15.9	-2.2
13.00	1.000	0	0	0	0	1.000	0.975	0.905	1.000	3657.	3657.	3566.	3310.	3657.	3630.	0.7	-1.8	-8.8	0.7
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3590.	3590.	3590.	3410.	3590.	3580.	0.3	0.3	-4.7	0.3
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3398.	3398.	3398.	3228.	3398.	3427.	-0.8	-0.8	-5.8	-0.8
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3033.	3033.	3033.	2881.	3033.	3098.	-2.1	-2.1	-7.0	-2.1
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2404.	2404.	2404.	2284.	2404.	2280.	5.4	5.4	0.2	5.4
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	319.	319.	319.	303.	319.	349.	-8.7	-8.7	-13.2	-8.7
DAILY TOTALS:										31293.	31293.	29369.	27885.	30655.	30273.	3.4	-3.0	-7.9	1.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

8.00	0.711	0	0	0	0	1.000	0.711	0.770	0.711	225.	225.	160.	173.	160.	
9.00	1.000	4	3	0	0	1.000	0.925	0.860	1.000	642.	642.	593.	552.	642.	
10.00	1.000	2	2	0	0	1.000	0.875	0.815	1.000	1211.	1211.	1060.	987.	1211.	
11.00	1.000	2	2	0	0	1.000	0.900	0.860	1.000	1650.	1650.	1485.	1419.	1650.	
12.00	1.000	2	1	0	0	1.000	0.925	0.860	1.000	1902.	1902.	1759.	1636.	1902.	
13.00	1.000	0	0	0	0	1.000	0.975	0.905	1.000	1996.	1996.	1946.	1807.	1996.	
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1815.	1815.	1815.	1724.	1815.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1427.	1427.	1427.	1356.	1427.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	897.	897.	897.	852.	897.	
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	341.	341.	341.	324.	341.	
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	12.	12.	12.	11.	12.	
DAILY TOTALS:										12116.	12116.	11494.	10840.	12051.	

ALBANY, NY
FEB 12 1979
DAY NUMBER 43

SUNRISE = 7.02 SUNSET = 17.30 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.29 HOURS
COLL. RISE = 7.01 COLL. SET = 17.32 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR			
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]				[KJ/SQ.M]	[PERCENT]			
8.00	1.000	3	0	3	0	1.000	0.970	0.905	0.905	1783.	1783.	1730.	1614.	1614.	1028.	73.5	68.2	57.0	57.0
9.00	1.000	9	1	0	0	1.000	0.960	0.725	0.725	2075.	2075.	1992.	1505.	1505.	2136.	-2.8	-6.7	-29.6	-29.6
10.00	1.000	10	3	0	0	1.000	0.900	0.523	0.523	2499.	2499.	2249.	1306.	1306.	2171.	15.1	3.6	-39.8	-39.8
11.00	0.667	10	4	0	0	1.000	0.550	0.300	0.300	2794.	2794.	1537.	839.	839.	2705.	3.3	-43.2	-69.0	-69.0
12.00	1.000	10	8	0	0	1.000	0.700	0.500	0.500	2937.	2937.	2056.	1470.	1470.	1467.	100.2	40.2	0.2	0.2
13.00	1.000	10	8	0	0	1.000	0.600	0.501	0.501	2952.	2952.	1772.	1478.	1478.	863.	242.1	105.3	71.2	71.2
14.00	1.000	10	7	0	0	1.000	0.625	0.501	0.501	2847.	2847.	1780.	1425.	1425.	1337.	112.9	33.1	6.6	6.6
15.00	0.367	10	9	0	0	1.000	0.220	0.166	0.166	2595.	2595.	571.	430.	430.	404.	542.3	41.3	6.3	6.3
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2144.	2144.	0.	1.	1.	21.	10111.3	-100.0	-93.2	-93.2
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1453.	1453.	0.	1.	1.	1.	*****	-100.0	1.7	1.7
18.00	0.0	10	10	10	0	1.000	0.0	0.151	0.151	164.	164.	0.	25.	25.	0.	*****	*****	*****	*****

DAILY TOTALS:

24243. 24243. 13686. 10092. 10092. 12133. 99.8 12.8 -16.8 -16.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
8.00	1.000	3	0	3	0	1.000	0.970	0.905	0.905	191.	191.	185.	173.	173.
9.00	1.000	9	1	0	0	1.000	0.960	0.725	0.725	526.	526.	505.	381.	381.
10.00	1.000	10	3	0	0	1.000	0.900	0.523	0.523	972.	972.	875.	508.	508.
11.00	0.667	10	4	0	0	1.000	0.550	0.300	0.300	1362.	1362.	749.	409.	409.
12.00	1.000	10	8	0	0	1.000	0.700	0.500	0.500	1594.	1594.	1116.	798.	798.
13.00	1.000	10	8	0	0	1.000	0.600	0.501	0.501	1625.	1625.	975.	814.	814.
14.00	1.000	10	7	0	0	1.000	0.625	0.501	0.501	1453.	1453.	908.	727.	727.
15.00	0.367	10	9	0	0	1.000	0.220	0.166	0.166	1103.	1103.	243.	183.	183.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	646.	646.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	217.	217.	0.	0.	0.
18.00	0.0	10	10	10	0	1.000	0.0	0.151	0.151	7.	7.	0.	1.	1.

DAILY TOTALS:

9695. 9695. 5556. 3993. 3993.

ALBANY, NY
FEB 13 1979
DAY NUMBER 44

SUNRISE = 7.00 SUNSET = 17.33 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.33 HOURS
COLL. RISE = 6.99 COLL. SET = 17.34 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
7.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	128.	128.	128.	122.	122.	9999.	*****			
8.00	1.000	10	3	10	0	1.000	0.875	0.875	0.875	1298.	1298.	1136.	1136.	1136.	813.	59.7	39.7	39.7	39.7
9.00	0.583	10	5	10	0	1.000	0.292	0.563	0.563	2064.	2064.	602.	1162.	1162.	746.	176.7	-19.3	55.7	55.7
10.00	0.417	10	4	0	0	1.000	0.302	0.338	0.338	2584.	2584.	781.	873.	873.	1625.	59.0	-52.0	-46.3	-46.3
11.00	0.667	9	4	0	0	1.000	0.533	0.323	0.323	2938.	2938.	1567.	948.	948.	1555.	89.0	0.8	-39.0	-39.0
12.00	0.833	10	5	0	0	1.000	0.646	0.398	0.398	3041.	3041.	1964.	1210.	1210.	2648.	14.9	-25.8	-54.3	-54.3
13.00	1.000	6	3	0	0	1.000	0.800	0.590	0.590	3257.	3257.	2606.	1923.	1923.	2762.	17.9	-5.7	-30.4	-30.4
14.00	0.917	9	5	0	0	1.000	0.733	0.525	0.525	3039.	3039.	2229.	1597.	1597.	2539.	19.7	-12.2	-37.1	-37.1
15.00	1.000	4	4	0	0	1.000	0.775	0.658	0.658	3074.	3074.	2382.	2022.	2022.	2873.	7.0	-17.1	-29.6	-29.6
16.00	1.000	1	1	0	0	1.000	0.875	0.838	0.838	2908.	2908.	2544.	2436.	2436.	2834.	2.6	-10.2	-14.1	-14.1
17.00	1.000	1	1	0	0	1.000	0.950	0.905	0.905	2294.	2294.	2180.	2077.	2077.	1904.	20.5	14.5	9.1	9.1
18.00	1.000	1	1	1	0	1.000	0.945	0.920	0.920	301.	301.	284.	277.	277.	259.	16.2	9.8	6.9	6.9

DAILY TOTALS:

26799. 26799. 18275. 15659. 15659. 20558. *****

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]									[KJ/SQ.M]			
7.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	0.	0.	0.	0.	0.
8.00	1.000	10	3	10	0	1.000	0.875	0.875	0.875	130.	130.	114.	114.	114.
9.00	0.583	10	5	10	0	1.000	0.292	0.563	0.563	534.	534.	156.	301.	301.
10.00	0.417	10	4	0	0	1.000	0.302	0.338	0.338	1017.	1017.	307.	343.	343.
11.00	0.667	9	4	0	0	1.000	0.533	0.323	0.323	1446.	1446.	771.	467.	467.
12.00	0.833	10	5	0	0	1.000	0.646	0.398	0.398	1665.	1665.	1075.	662.	662.
13.00	1.000	6	3	0	0	1.000	0.800	0.590	0.590	1808.	1808.	1447.	1067.	1067.
14.00	0.917	9	5	0	0	1.000	0.733	0.525	0.525	1565.	1565.	1148.	822.	822.
15.00	1.000	4	4	0	0	1.000	0.775	0.658	0.658	1318.	1318.	1022.	867.	867.
16.00	1.000	1	1	0	0	1.000	0.875	0.838	0.838	884.	884.	774.	741.	741.
17.00	1.000	1	1	0	0	1.000	0.950	0.905	0.905	345.	345.	328.	312.	312.
18.00	1.000	1	1	1	0	1.000	0.945	0.920	0.920	13.	13.	13.	12.	12.

DAILY TOTALS:

10727. 10727. 7154. 5709. 5709.

ALBANY, NY
FEB 14 1979
DAY NUMBER 45

SUNRISE = 6.97 SUNSET = 17.35 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.37 HOURS
COLL. RISE = 6.97 COLL. SET = 17.36 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUF1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				

7.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	236.	236.	225.	214.	236.	0.	*****			
8.00	1.000	1	0	0	0	1.000	0.975	0.905	1.000	1853.	1853.	1806.	1677.	1853.	1367.	35.5	32.1	22.6	35.5
9.00	1.000	3	2	0	0	1.000	0.950	0.860	1.000	2437.	2437.	2315.	2096.	2437.	2732.	-10.8	-15.2	-23.3	-10.8
10.00	1.000	3	2	0	0	1.000	0.900	0.815	1.000	2897.	2897.	2607.	2361.	2897.	3183.	-9.0	-18.1	-25.8	-9.0
11.00	1.000	4	3	0	0	1.000	0.875	0.793	1.000	3102.	3102.	2714.	2459.	3102.	3364.	-7.8	-19.3	-26.9	-7.8
12.00	1.000	7	4	0	0	1.000	0.825	0.703	0.950	3059.	3059.	2523.	2150.	2906.	2100.	45.7	20.2	2.4	38.4
13.00	1.000	7	4	0	0	1.000	0.800	0.635	0.800	3054.	3054.	2443.	1940.	2443.	2989.	2.2	-18.3	-35.1	-18.3
14.00	1.000	5	3	0	0	1.000	0.825	0.680	0.900	3058.	3058.	2523.	2080.	2752.	3466.	-11.8	-27.2	-40.0	-20.6
15.00	1.000	7	3	0	0	1.000	0.850	0.680	0.900	2707.	2707.	2301.	1842.	2437.	3264.	-17.0	-29.5	-43.6	-25.3
16.00	1.000	6	3	0	0	1.000	0.850	0.658	0.950	2317.	2317.	1969.	1524.	1970.	2893.	-19.9	-31.9	-47.3	-31.9
17.00	0.917	3	2	0	0	1.000	0.802	0.660	0.917	1839.	1839.	1475.	1214.	1686.	1561.	17.8	-5.5	-22.2	8.0
18.00	0.240	3	3	0	0	1.000	0.210	0.423	0.240	429.	429.	90.	181.	103.	2.	21333.9	4404.0	8971.8	5047.4
DAILY TOTALS:										26988.	26988.	22993.	19738.	24822.	26921.	0.2	-14.6	-26.7	-7.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
7.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	1.	1.	1.	1.	1.
8.00	1.000	1	0	0	0	1.000	0.975	0.905	1.000	187.	187.	183.	169.	187.
9.00	1.000	3	2	0	0	1.000	0.950	0.860	1.000	639.	639.	607.	549.	639.
10.00	1.000	3	2	0	0	1.000	0.900	0.815	1.000	1152.	1152.	1037.	939.	1152.
11.00	1.000	4	3	0	0	1.000	0.875	0.793	1.000	1541.	1541.	1348.	1221.	1541.
12.00	1.000	7	4	0	0	1.000	0.825	0.703	0.950	1689.	1689.	1393.	1187.	1604.
13.00	1.000	7	4	0	0	1.000	0.800	0.635	0.800	1710.	1710.	1368.	1086.	1368.
14.00	1.000	5	3	0	0	1.000	0.825	0.680	0.900	1598.	1598.	1310.	1081.	1430.
15.00	1.000	7	3	0	0	1.000	0.850	0.680	0.900	1176.	1176.	999.	800.	1058.
16.00	1.000	6	3	0	0	1.000	0.850	0.658	0.850	717.	717.	610.	472.	610.
17.00	0.917	3	2	0	0	1.000	0.802	0.660	0.917	285.	285.	229.	188.	262.
18.00	0.240	3	3	0	0	1.000	0.210	0.423	0.240	15.	15.	3.	6.	4.
DAILY TOTALS:										10700.	10700.	9088.	7700.	9855.

ALBANY, NY
FEB 15 1979
DAY NUMBER 46

SUNRISE = 6.95 SUNSET = 17.37 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.42 HOURS
COLL. RISE = 6.95 COLL. SET = 17.38 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
7.00	1.000	2	2	0	0	1.000	0.900	0.860	1.000	196.	196.	176.	168.	196.	0.	*****			
8.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	1685.	1685.	1558.	1487.	1685.	1103.	52.7	41.3	34.8	52.7
9.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	2513.	2513.	2451.	2331.	2513.	2484.	1.2	-1.3	-6.1	1.2
10.00	1.000	2	2	0	0	1.000	0.950	0.905	1.000	2850.	2850.	2707.	2579.	2850.	3005.	-5.2	-9.9	-14.2	-5.2
11.00	1.000	3	1	0	0	1.000	0.925	0.838	1.000	3047.	3047.	2819.	2552.	3047.	3276.	-7.0	-14.0	-22.1	-7.0
12.00	1.000	5	2	5	0	1.000	0.900	0.845	0.975	3057.	3057.	2752.	2584.	2981.	3312.	-7.7	-16.9	-22.0	-10.0
13.00	1.000	5	2	5	0	1.000	0.850	0.875	0.950	3063.	3063.	2604.	2681.	2910.	3042.	0.7	-14.4	-11.9	-4.3
14.00	1.000	4	1	4	0	1.000	0.880	0.883	0.955	3022.	3022.	2659.	2667.	2886.	3234.	-6.6	-17.8	-17.5	-10.8
15.00	1.000	3	0	3	0	1.000	0.940	0.896	0.965	2855.	2855.	2684.	2562.	2755.	2974.	-4.0	-9.8	-13.8	-7.4
16.00	1.000	3	1	3	0	1.000	0.945	0.905	0.970	2430.	2439.	2305.	2208.	2366.	1572.	55.2	46.6	40.4	50.5
17.00	0.250	9	5	9	0	1.000	0.187	0.473	0.200	1379.	1379.	259.	652.	276.	723.	90.7	-64.2	-9.8	-61.9
18.00	0.0	9	6	0	0	1.000	0.0	0.180	0.0	275.	275.	0.	50.	0.	0.	*****			

DAILY TOTALS:

26382. 26382. 22973. 22521. 24465. 24725. 6.7 -7.1 -8.9 -1.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	1.000	2	2	0	0	1.000	0.900	0.860	1.000	2.		2.	2.	1.	2.
8.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	179.		179.	166.	158.	179.
9.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	671.		671.	654.	622.	671.
10.00	1.000	2	2	0	0	1.000	0.950	0.905	1.000	1146.		1146.	1088.	1037.	1146.
11.00	1.000	3	1	0	0	1.000	0.925	0.838	1.000	1528.		1528.	1413.	1280.	1528.
12.00	1.000	5	2	5	0	1.000	0.900	0.845	0.975	1703.		1703.	1532.	1439.	1660.
13.00	1.000	5	2	5	0	1.000	0.850	0.875	0.950	1730.		1730.	1470.	1514.	1643.
14.00	1.000	4	1	4	0	1.000	0.880	0.883	0.955	1584.		1584.	1394.	1398.	1513.
15.00	1.000	3	0	3	0	1.000	0.940	0.898	0.965	1252.		1252.	1177.	1123.	1208.
16.00	1.000	3	1	3	0	1.000	0.945	0.905	0.970	766.		766.	724.	693.	743.
17.00	0.250	9	5	9	0	1.000	0.187	0.473	0.200	226.		226.	42.	107.	45.
18.00	0.0	9	6	0	0	1.000	0.0	0.180	0.0	11.		11.	0.	2.	0.

DAILY TOTALS:

10796. 10796. 9663. 9375. 10338.

ALBANY, NY
FEB 16 1979
DAY NUMBER 47

SUNRISE = 6.93 SUNSET = 17.39 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.46 HOURS
COLL. RISE = 6.92 COLL. SET = 17.41 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]				
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	100.	100.	0.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	962.	962.	0.	1.	1.	0.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1670.	1670.	0.	1.	1.	0.	0.	*****			
10.00	0.083	5	5	0	0	1.000	0.052	0.151	0.151	2494.	2494.	130.	375.	375.	12.	20680.8	982.6	3028.0	3028.0	
11.00	1.000	0	0	0	0	1.000	0.875	0.838	0.838	3141.	3141.	2749.	2631.	2631.	2510.	25.2	9.5	4.8	4.8	
12.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3302.	3302.	3302.	3137.	3137.	3088.	6.9	6.9	1.6	1.6	
13.00	1.000	2	2	0	0	1.000	0.950	0.905	0.905	3199.	3199.	3039.	2895.	2895.	3139.	1.9	-3.2	-7.8	-7.8	
14.00	1.000	2	1	0	0	1.000	0.925	0.860	0.860	3100.	3100.	2867.	2666.	2666.	2578.	20.2	11.2	3.4	3.4	
15.00	1.000	7	2	0	0	1.000	0.925	0.748	0.748	2561.	2561.	2369.	1915.	1915.	2404.	6.5	-1.5	-20.4	-20.4	
16.00	0.750	8	8	0	0	1.000	0.563	0.450	0.450	2040.	2040.	1148.	919.	919.	710.	187.3	61.6	29.4	29.4	
17.00	0.0	6	6	0	0	1.000	0.0	0.135	0.135	1490.	1490.	0.	202.	202.	5.	29699.9	-100.0	3937.6	3937.6	
18.00	0.0	8	8	0	0	1.000	0.0	0.135	0.135	295.	295.	0.	40.	40.	7.	4116.1	-100.0	471.2	471.2	

DAILY TOTALS:

24354. 24354. 15603. 14782. 14782. 14453. 68.5 8.0 2.3 2.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1.	1.	0.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	110.	110.	0.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	456.	456.	0.	0.	0.	0.
10.00	0.083	5	5	0	0	1.000	0.052	0.151	0.151	1017.	1017.	53.	153.	153.	153.
11.00	1.000	0	0	0	0	1.000	0.875	0.838	0.838	1591.	1591.	1392.	1333.	1333.	1333.
12.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	1855.	1855.	1855.	1762.	1762.	1762.
13.00	1.000	2	2	0	0	1.000	0.950	0.905	0.905	1822.	1822.	1731.	1649.	1649.	1649.
14.00	1.000	2	1	0	0	1.000	0.925	0.860	0.860	1640.	1640.	1517.	1410.	1410.	1410.
15.00	1.000	7	2	0	0	1.000	0.925	0.748	0.748	1137.	1137.	1052.	850.	850.	850.
16.00	0.750	8	8	0	0	1.000	0.563	0.450	0.450	651.	651.	366.	293.	293.	293.
17.00	0.0	6	6	0	0	1.000	0.0	0.135	0.135	246.	246.	0.	33.	33.	33.
18.00	0.0	8	8	0	0	1.000	0.0	0.135	0.135	13.	13.	0.	2.	2.	2.

DAILY TOTALS:

10539. 10539. 7965. 7486. 7486.

ALBANY, NY
FEB 17 1979
DAY NUMBER 48

SUNRISE = 6.91 SUNSET = 17.41 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.51 HOURS
COLL. RISE = 6.90 COLL. SET = 17.43 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER			TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]					[PERCENT]			

7.00	1.000	0	0	0	C	1.000	1.000	0.950	1.000	228.	228.	228.	217.	228.	0.	*****			
8.00	1.000	0	0	0	C	1.000	1.000	0.950	1.000	1817.	1817.	1817.	1726.	1817.	1365.	33.1	33.1	26.5	33.1
9.00	1.000	0	0	0	C	1.000	1.000	0.950	1.000	2557.	2557.	2557.	2429.	2557.	2738.	-6.6	-6.6	-11.3	-6.6
10.00	1.000	0	0	0	C	1.000	1.000	0.950	1.000	3025.	3025.	3025.	2874.	3025.	3250.	-6.9	-6.9	-11.6	-6.9
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3287.	3287.	3287.	3123.	3287.	3456.	-4.9	-4.9	-9.6	-4.9
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3412.	3412.	3412.	3242.	3412.	3529.	-3.3	-3.3	-8.1	-3.3
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3434.	3434.	3434.	3262.	3434.	3572.	-3.9	-3.9	-8.7	-3.9
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3356.	3356.	3356.	3189.	3356.	3499.	-4.1	-4.1	-8.9	-4.1
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3157.	3157.	3157.	2999.	3157.	3344.	-5.6	-5.6	-10.3	-5.6
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2780.	2780.	2780.	2641.	2780.	3012.	-7.7	-7.7	-12.3	-7.7
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2145.	2145.	2145.	2037.	2145.	2236.	-4.1	-4.1	-8.9	-4.1
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	527.	527.	527.	501.	527.	479.	10.1	10.1	4.6	10.1
DAILY TOTALS:										29725.	29725.	29725.	28239.	29725.	30480.	-2.5	-2.5	-7.4	-2.5

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	4.	4.	4.	4.	4.
8.00	1.000	0.	0	0	0	1.000	1.000	0.950	1.000	207.	207.	207.	197.	207.
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	705.	705.	705.	670.	705.
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1245.	1245.	1245.	1183.	1245.
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1679.	1679.	1679.	1596.	1679.
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1933.	1933.	1933.	1837.	1933.
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1972.	1972.	1972.	1874.	1972.
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1791.	1791.	1791.	1702.	1791.
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1413.	1413.	1413.	1342.	1413.
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	896.	896.	896.	851.	896.
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	359.	359.	359.	341.	359.
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	24.	24.	24.	23.	24.
DAILY TOTALS:										12229.	12229.	12229.	11618.	12229.

ALBANY, NY
FEB 18 1979
DAY NUMBER 49

SUNRISE = 6.88 SUNSET = 17.43 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.55 HOURS
COLL. RISE = 6.88 COLL. SET = 17.45 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUF1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
7.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	269.	269.	269.	256.	256.	0.	*****			
8.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	2072.	2072.	2072.	1969.	1969.	1605.	29.1	29.1	22.6	22.6
9.00	1.000	2	1	0	0	1.000	0.975	0.905	0.905	2656.	2656.	2590.	2404.	2404.	2848.	-6.7	-9.1	-15.6	-15.6
10.00	1.000	10	3	0	0	1.000	0.900	0.680	0.680	2650.	2650.	2385.	1802.	1802.	2939.	-9.8	-18.9	-38.7	-38.7
11.00	0.833	10	8	0	0	1.000	0.604	0.375	0.375	2909.	2909.	1758.	1092.	1092.	1212.	140.0	45.0	-9.9	-9.9
12.00	1.000	10	6	0	0	1.000	0.650	0.500	0.500	3061.	3061.	1990.	1532.	1532.	1177.	160.0	69.1	30.1	30.1
13.00	0.500	10	9	0	0	1.000	0.313	0.226	0.226	3097.	3097.	968.	698.	698.	549.	464.1	76.3	27.2	27.2
14.00	0.167	10	9	0	0	1.000	0.092	0.076	0.076	3022.	3022.	277.	229.	229.	170.	1677.4	63.0	34.4	34.4
15.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	2812.	2812.	0.	2.	2.	162.	1635.7	-100.0	-98.9	-98.9
16.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	2419.	2419.	0.	2.	2.	13.	18511.4	-100.0	-88.3	-88.3
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1780.	1780.	0.	1.	1.	0.	*****			
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	414.	414.	0.	0.	0.	0.	*****			
DAILY TOTALS:										27162.	27162.	12309.	9986.	9986.	10675.	154.4	15.3	-6.5	-6.5

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				

7.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	6.	6.	6.	6.	6.
8.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	244.	244.	244.	232.	232.
9.00	1.000	2	1	0	0	1.000	0.975	0.905	0.905	743.	743.	725.	673.	673.
10.00	1.000	10	3	0	0	1.000	0.900	0.680	0.680	1101.	1101.	991.	749.	749.
11.00	0.833	10	8	0	0	1.000	0.604	0.375	0.375	1501.	1501.	907.	563.	563.
12.00	1.000	10	6	0	0	1.000	0.650	0.500	0.500	1749.	1749.	1137.	875.	875.
13.00	0.500	10	9	0	0	1.000	0.313	0.226	0.226	1794.	1794.	561.	404.	404.
14.00	0.167	10	9	0	0	1.000	0.092	0.076	0.076	1627.	1627.	149.	123.	123.
15.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	1272.	1272.	0.	1.	1.
16.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	792.	792.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	307.	307.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	21.	21.	0.	0.	0.
DAILY TOTALS:										11156.	11156.	4719.	3627.	3627.

ALBANY, NY
FEB 19 1979
DAY NUMBER 50

SUNRISE = 6.83 SUNSET = 17.45 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.60 HOURS
COLL. RISE = 6.83 COLL. SET = 17.47 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
<hr/>																			
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	101.	101.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	973.	973.	0.	1.	1.	1.	97156.3	-100.0	-31.9	-31.9
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1678.	1678.	0.	1.	1.	1.	*****	-100.0	17.4	17.4
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2196.	2196.	0.	2.	2.	2.	*****	-100.0	-23.2	-23.2
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2510.	2510.	0.	2.	2.	64.	3822.3	-100.0	-97.3	-97.3
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2667.	2667.	0.	2.	2.	95.	2707.8	-100.0	-98.0	-98.0
13.00	0.083	9	8	0	0	1.000	0.046	0.061	0.061	2747.	2747.	126.	167.	167.	543.	406.0	-76.8	-69.3	-69.3
14.00	0.167	9	7	0	0	1.000	0.104	0.121	0.121	2656.	2656.	277.	320.	320.	499.	432.3	-44.5	-35.8	-35.8
15.00	0.250	7	7	0	0	1.000	0.163	0.203	0.203	2530.	2530.	411.	514.	514.	559.	352.6	-26.4	-8.1	-8.1
16.00	0.250	6	6	0	0	1.000	0.169	0.270	0.270	2179.	2179.	368.	589.	589.	2065.	5.5	-82.2	-71.5	-71.5
17.00	1.000	1	1	0	0	1.000	0.825	0.793	0.793	1885.	1885.	1555.	1494.	1494.	1333.	41.4	16.7	12.1	12.1
18.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	476.	476.	464.	441.	441.	193.	146.4	140.3	128.6	128.6
DAILY TOTALS:										22598.	22598.	3201.	3532.	3532.	5355.	322.0	-40.2	-34.0	-34.0

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	3.	3.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	124.	124.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	481.	481.	0.	0.	0.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	926.	926.	0.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1308.	1308.	0.	1.	1.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1537.	1537.	0.	1.	1.
13.00	0.083	9	8	0	0	1.000	0.046	0.061	0.061	1605.	1605.	74.	97.	97.
14.00	0.167	9	7	0	0	1.000	0.104	0.121	0.121	1443.	1443.	150.	174.	174.
15.00	0.250	7	7	0	0	1.000	0.163	0.203	0.203	1156.	1156.	188.	235.	235.
16.00	0.250	6	6	0	0	1.000	0.169	0.270	0.270	723.	723.	122.	196.	196.
17.00	1.000	1	1	0	0	1.000	0.825	0.793	0.793	330.	330.	272.	262.	262.
18.00	1.000	0	0	0	0	1.000	0.975	0.928	0.928	26.	26.	25.	24.	24.
DAILY TOTALS:										9662.	9662.	831.	990.	990.

SUNRISE = 6.84 SUNSET = 17.48 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.64 HOURS
COLL. RISE = 6.83 COLL. SET = 17.50 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUF1	TAUP2	TAUP3	TAUP4	NO	C_D	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
7.00	0.0	10	8	0	0	1.000	0.0	0.001	0.0	129.	129.	0.	0.	0.	0.	*****			
8.00	0.333	4	3	0	0	1.000	0.242	0.285	0.267	1520.	1520.	367.	434.	405.	264.	475.8	39.2	64.3	53.6
9.00	1.000	2	1	2	0	1.000	0.890	0.845	0.990	2419.	2419.	2153.	2045.	2395.	1781.	35.8	20.9	14.8	34.5
10.00	1.000	1	0	1	0	1.000	0.960	0.928	0.985	2961.	2961.	2843.	2747.	2917.	2432.	21.8	16.9	12.9	19.9
11.00	1.000	0	0	0	0	1.000	0.995	0.942	0.995	3283.	3283.	3267.	3094.	3267.	2585.	27.0	26.4	19.7	26.4
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3403.	3403.	3403.	3233.	3403.	2719.	25.2	25.2	18.9	25.2
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3415.	3415.	3415.	3244.	3415.	2748.	24.3	24.3	18.1	24.3
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3328.	3328.	3328.	3161.	3328.	2714.	22.6	22.6	16.5	22.6
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3118.	3118.	3118.	2962.	3118.	2599.	20.0	20.0	14.0	20.0
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2732.	2732.	2732.	2596.	2732.	2250.	21.4	21.4	15.4	21.4
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2089.	2089.	2089.	1985.	2089.	1629.	28.2	28.2	21.8	28.2
18.00	0.805	2	0	2	0	1.000	0.797	0.797	0.797	464.	464.	370.	370.	370.	298.	55.6	24.0	24.1	24.0

28861. 28861. 27084. 25870. 27438. 22019. 31.1 23.0 17.5 24.6

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKY COVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	N0	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

7.00	0.0	10	8	0	0	1.000	0.0	0.001	0.0	4.	4.	0.	0.	0.	
8.00	0.333	4	3	0	0	1.000	0.242	0.285	0.267	199.	199.	48.	57.	53.	
9.00	1.000	2	1	2	0	1.000	0.890	0.845	0.990	703.	703.	625.	594.	696.	
10.00	1.000	1	0	1	0	1.000	0.960	0.928	0.985	1262.	1262.	1212.	1171.	1243.	
11.00	1.000	0	0	0	0	1.000	0.995	0.942	0.995	1726.	1726.	1717.	1627.	1717.	
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1978.	1978.	1978.	1879.	1978.	
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2011.	2011.	2011.	1911.	2011.	
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1924.	1924.	1924.	1732.	1924.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1438.	1438.	1438.	1367.	1438.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	917.	917.	917.	871.	917.	
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	376.	376.	376.	358.	376.	
18.00	0.805	2	0	2	0	1.000	0.797	0.797	0.797	28.	28.	22.	22.	22.	

12465. 12465. 12169. 11587. 12275.

ALBANY, NY
FEB 21 1979
DAY NUMBER 52

SUNRISE = 6.81 SUNSET = 17.50 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.69 HOURS
COLL. RISE = 6.83 COLL. SET = 17.51 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]				
7.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	265.	265.	0.	0.	0.	0.	0.	*****			
8.00	0.200	10	6	0	0	1.000	0.130	0.090	0.090	1190.	1190.	155.	108.	108.	119.	899.7	30.0	-9.5	-9.5	
9.00	0.567	10	8	0	0	1.000	0.368	0.255	0.255	1841.	1841.	678.	470.	470.	1018.	80.9	-33.4	-53.8	-53.8	
10.00	0.567	10	8	0	0	1.000	0.340	0.256	0.256	2287.	2287.	778.	585.	585.	888.	157.6	-12.4	-34.2	-34.2	
11.00	0.317	10	9	0	0	1.000	0.182	0.143	0.143	2539.	2539.	463.	363.	363.	417.	509.0	10.9	-12.9	-12.9	
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2644.	2644.	0.	2.	2.	51.	5085.2	-100.0	-96.6	-96.6	
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2626.	2626.	0.	2.	2.	0.	*****				
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2484.	2484.	0.	2.	2.	0.	*****				
15.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1765.	1765.	0.	1.	1.	0.	*****				
16.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1273.	1273.	0.	1.	1.	0.	*****				
17.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	693.	693.	0.	0.	0.	0.	*****				
18.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	109.	109.	0.	0.	0.	0.	*****				

DAILY TOTALS:

19718. 19718. 2074. 1534. 1534. 2493. 690.9 -16.8 -38.5 -38.5

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

7.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	5.		5.	0.	0.	0.
8.00	0.200	10	6	0	0	1.000	0.130	0.090	0.090	160.		160.	21.	15.	15.
9.00	0.567	10	8	0	0	1.000	0.368	0.255	0.255	545.		545.	201.	139.	139.
10.00	0.567	10	8	0	0	1.000	0.340	0.256	0.256	987.		987.	336.	252.	252.
11.00	0.317	10	9	0	0	1.000	0.182	0.143	0.143	1348.		1348.	246.	193.	193.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1550.		1550.	0.	1.	1.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1560.		1560.	0.	1.	1.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1374.		1374.	0.	1.	1.
15.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	826.		826.	0.	1.	1.
16.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	436.		436.	0.	0.	0.
17.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	133.		133.	0.	0.	0.
18.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	7.		7.	0.	0.	0.

DAILY TOTALS:

8932. 8932. 803. 603. 603.

ALBANY, NY
FEB 22 1979
DAY NUMBER 53

SUNRISE = 6.79 SUNSET = 17.52 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.73 HOURS
COLL. RISE = 6.78 COLL. SET = 17.53 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				

7.00	0.0	8	8	0	0	1.000	0.0	0.091	0.091	201.	201.	0.	18.	18.	0.	*****			
8.00	0.0	8	8	0	0	1.000	0.0	0.091	0.091	1031.	1031.	0.	93.	93.	0.	*****			
9.00	0.0	10	10	0	16	1.000	0.0	0.046	0.046	1198.	1198.	0.	55.	55.	10.	11879.6	-100.0	446.6	446.6
10.00	0.017	10	10	0	16	1.000	0.008	0.008	0.008	1645.	1645.	14.	13.	13.	279.	489.8	-95.1	-95.2	-95.2
11.00	0.100	10	10	0	16	1.000	0.050	0.046	0.046	1961.	1961.	98.	90.	90.	8.	24411.2	1126.4	1020.2	1020.2
12.00	0.0	9	9	0	16	1.000	0.0	0.023	0.023	2182.	2182.	0.	51.	51.	37.	5798.6	-100.0	36.6	36.6
13.00	0.500	5	4	0	16	1.000	0.338	0.360	0.360	2463.	2463.	831.	888.	888.	611.	303.1	36.1	45.3	45.3
14.00	1.000	5	4	0	16	1.000	0.800	0.725	0.725	2386.	2386.	1909.	1731.	1731.	1831.	30.3	4.3	-5.5	-5.5
15.00	0.833	3	2	0	16	1.000	0.708	0.645	0.645	2281.	2281.	1616.	1472.	1472.	1802.	26.6	-10.3	-18.3	-18.3
16.00	1.000	1	1	0	16	1.000	0.925	0.860	0.860	2025.	2025.	1873.	1742.	1742.	1546.	31.0	21.2	12.7	12.7
17.00	0.500	2	2	0	16	1.000	0.462	0.608	0.608	1322.	1322.	611.	803.	803.	878.	50.5	-30.4	-8.5	-8.5
18.00	0.161	2	2	0	16	1.000	0.145	0.432	0.432	380.	380.	55.	164.	164.	87.	336.4	-36.9	88.7	88.7
DAILY TOTALS:										19075.	19075.	7007.	7119.	7119.	7089.	169.1	-1.2	0.4	0.4

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUF1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUF1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	0.0	8	8	0	0	1.000	0.0	0.091	0.091	5.	5.	0.	0.	0.	0.
8.00	0.0	8	8	0	0	1.000	0.0	0.091	0.091	145.	145.	0.	13.	13.	13.
9.00	0.0	10	10	0	16	1.000	0.0	0.046	0.046	359.	359.	0.	16.	16.	16.
10.00	0.017	10	10	0	16	1.000	0.008	0.008	0.008	720.	720.	6.	6.	6.	6.
11.00	0.100	10	10	0	16	1.000	0.050	0.046	0.046	1051.	1051.	53.	48.	48.	48.
12.00	0.0	9	9	0	16	1.000	0.0	0.023	0.023	1291.	1291.	0.	30.	30.	30.
13.00	0.500	5	4	0	16	1.000	0.338	0.360	0.360	1475.	1475.	498.	532.	532.	532.
14.00	1.000	5	4	0	16	1.000	0.800	0.725	0.725	1331.	1331.	1065.	965.	965.	965.
15.00	0.833	3	2	0	16	1.000	0.708	0.645	0.645	1074.	1074.	761.	693.	693.	693.
16.00	1.000	1	1	0	16	1.000	0.925	0.860	0.860	699.	699.	646.	601.	601.	601.
17.00	0.500	2	2	0	16	1.000	0.462	0.608	0.608	253.	253.	117.	154.	154.	154.
18.00	0.161	2	2	0	16	1.000	0.145	0.432	0.432	21.	21.	3.	9.	9.	9.
DAILY TOTALS:										8423.	8423.	3148.	3067.	3067.	3067.

ALBANY, NY
FEB 23 1979
DAY NUMBER 54

SUNRISE = 6.76 SUNSET = 17.54 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.78 HOURS
COLL. RISE = 6.76 COLL. SET = 17.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	83.	83.	0.	0.	0.	1.	8182.4	-100.0	-94.2	-94.2
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	521.	521.	0.	0.	0.	2.	25954.5	-100.0	-81.8	-81.8
9.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1064.	1064.	0.	1.	1.	5.	21183.2	-100.0	-85.1	-85.1
10.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1518.	1518.	0.	1.	1.	5.	30263.2	-100.0	-78.7	-78.7
11.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1809.	1809.	0.	1.	1.	2.	90366.9	-100.0	-36.7	-36.7
12.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1950.	1950.	0.	1.	1.	0.	*****			
13.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1957.	1957.	0.	1.	1.	0.	*****			
14.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1832.	1832.	0.	1.	1.	0.	*****			
15.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1562.	1562.	0.	1.	1.	0.	*****			
16.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1135.	1135.	0.	1.	1.	1.	*****	-100.0	-20.5	-20.5
17.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	600.	600.	0.	0.	0.	1.	59879.2	-100.0	-58.0	-58.0
18.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	121.	121.	0.	0.	0.	0.	*****			
DAILY TOTALS:										14153.	14153.	0.	10.	10.	17.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	3.		3.	0.	0.	0.
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	78.		78.	0.	0.	0.
9.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	328.		328.	0.	0.	0.
10.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	672.		672.	0.	0.	0.
11.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	979.		979.	0.	1.	1.
12.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1163.		1163.	0.	1.	1.
13.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1181.		1181.	0.	1.	1.
14.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1031.		1031.	0.	1.	1.
15.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	744.		744.	0.	1.	1.
16.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	400.		400.	0.	0.	0.
17.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	120.		120.	0.	0.	0.
18.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	7.		7.	0.	0.	0.
DAILY TOTALS:										6707.		6707.	0.	5.	5.

ALBANY, NY
FEB 24 1979
DAY NUMBER 55

SUNRISE = 6.74 SUNSET = 17.56 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.82 HOURS
COLL. RISE = 6.73 COLL. SET = 17.58 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY F.LUX				EXPTAL. EN. FLUX	RELATIVE ERROR				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2		TAUP3	TAUP4	TAUP1	TAUP2	TAUP3
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]				[KJ/SQ.M]	[PERCENT]				
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	73.	73.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	489.	489.	0.	0.	0.	0.	*****			
9.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1035.	1035.	0.	1.	1.	0.	*****			
10.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1504.	1504.	0.	1.	1.	0.	*****			
11.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1814.	1814.	0.	1.	1.	1.	1.	-100.0	27.0	27.0
12.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1974.	1974.	0.	1.	1.	2.	98590.1	-100.0	-30.9	-30.9
13.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	2001.	2001.	0.	1.	1.	2.	99928.1	-100.0	-30.0	-30.0
14.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1895.	1895.	0.	1.	1.	1.	1.	-100.0	32.6	32.6
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2046.	2046.	0.	1.	1.	2.	*****	-100.0	-28.4	-28.4
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1659.	1659.	0.	1.	1.	2.	82781.7	-100.0	-42.0	-42.0
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1045.	1045.	0.	1.	1.	2.	52165.5	-100.0	-63.4	-63.4
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	275.	275.	0.	0.	0.	2.	13631.0	-100.0	-90.4	-90.4
DAILY TOTALS:										15808.	15808.	0.	11.	11.	14.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY F_UX					
[HOUR]	[ADIM.]	T	O	C	FH	TAU=1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	3.		3.	0.	0.	0.
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	76.		76.	0.	0.	0.
9.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	324.		324.	0.	0.	0.
10.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	673.		673.	0.	0.	0.
11.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	991.		991.	0.	1.	1.
12.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1187.		1187.	0.	1.	1.
13.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1218.		1218.	0.	1.	1.
14.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1075.		1075.	0.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	982.		982.	0.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	588.		588.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	210.		210.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	17.		17.	0.	0.	0.
DAILY TOTALS:										7344.		7344.	0.	5.	5.

ALBANY, NY
FEB 25 1979
DAY NUMBER 56

SUNRISE = 6.71 SUNSET = 17.56 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.87 HOURS
COLL. RISE = 6.71 COLL. SET = 17.60 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	204.	204.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1005.	1005.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1655.	1655.	0.	1.	1.	0.	*****			
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2118.	2118.	0.	1.	1.	0.	*****			
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2390.	2390.	0.	2.	2.	1.	*****	-100.0	67.3	67.3
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2513.	2513.	0.	2.	2.	1.	*****	-100.0	75.9	75.9
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2509.	2509.	0.	2.	2.	1.	*****	-100.0	75.7	75.7
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2383.	2383.	0.	2.	2.	0.	*****			
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2111.	2111.	0.	1.	1.	1.	*****	-100.0	47.8	47.8
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1661.	1661.	0.	1.	1.	0.	*****			
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1028.	1028.	0.	1.	1.	0.	*****			
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	261.	261.	0.	0.	0.	0.	*****			
DAILY TOTALS:										19837.	19837.	0.	14.	14.	4.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	8.	8.	0.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	156.	156.	0.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	523.	523.	0.	0.	0.	0.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	957.	957.	0.	1.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1317.	1317.	0.	1.	1.	1.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1524.	1524.	0.	1.	1.	1.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1540.	1540.	0.	1.	1.	1.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1363.	1363.	0.	1.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1024.	1024.	0.	1.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	597.	597.	0.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	211.	211.	0.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	18.	18.	0.	0.	0.	0.
DAILY TOTALS:										9239.	9239.	0.	6.	6.	6.

ALBANY, NY
FEB 26 1979
DAY NUMBER 57

SUNRISE = 6.69 SUNSET = 17.60 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.92 HOURS
COLL. RISE = 6.68 COLL. SET = 17.61 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]			
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	98.	98.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	600.	600.	0.	0.	0.	0.	*****			
9.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1181.	1181.	0.	1.	1.	1.	1.	*****	-100.0	-17.3
10.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1660.	1660.	0.	1.	1.	1.	1.	*****	-100.0	16.2
11.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1966.	1966.	0.	1.	1.	1.	1.	*****	-100.0	37.6
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2531.	2531.	0.	2.	2.	2.	1.	*****	-100.0	77.2
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2590.	2590.	0.	2.	2.	2.	0.	*****		
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2490.	2490.	0.	2.	2.	2.	1.	*****	-100.0	74.3
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2247.	2247.	0.	2.	2.	2.	1.	*****	-100.0	57.3
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1825.	1825.	0.	1.	1.	1.	0.	*****		
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1199.	1199.	0.	1.	1.	1.	0.	*****		
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	334.	334.	0.	0.	0.	0.	0.	*****		
DAILY TOTALS:										18722.	18722.	0.	13.	13.	6.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	4.	4.	0.	0.	0.	0.
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	98.	98.	0.	0.	0.	0.
9.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	381.	381.	0.	0.	0.	0.
10.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	760.	760.	0.	1.	1.	1.
11.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1094.	1094.	0.	1.	1.	1.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1549.	1549.	0.	1.	1.	1.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1602.	1602.	0.	1.	1.	1.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1435.	1435.	0.	1.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1100.	1100.	0.	1.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	663.	663.	0.	0.	0.	0.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	250.	250.	0.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	24.	24.	0.	0.	0.	0.
DAILY TOTALS:										8962.	8962.	0.	6.	6.	6.

ALBANY, NY
FEB 27 1979
DAY NUMBER 58

SUNRISE = 6.66 SUNSET = 17.62 (STD. TIME)
GEOMETRIC DAY LENGTH = 10.96 HOURS
COLL. RISE = 6.65 COLL. SET = 17.64 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	393.	393.	0.	0.	0.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1286.	1286.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1959.	1959.	0.	1.	1.	1.	*****	-100.0	37.1	37.1
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2411.	2411.	0.	2.	2.	0.	*****			
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2669.	2669.	0.	2.	2.	0.	*****			
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2784.	2784.	0.	2.	2.	0.	*****			
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2781.	2781.	0.	2.	2.	0.	*****			
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2660.	2660.	0.	2.	2.	0.	*****			
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2402.	2402.	0.	2.	2.	0.	*****			
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1961.	1961.	0.	1.	1.	0.	*****			
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1306.	1306.	0.	1.	1.	0.	*****			
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	369.	369.	0.	0.	0.	0.	*****			
DAILY TOTALS:										22982.	22982.	0.	16.	16.	1.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	14.		14.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	210.		210.	0.	0.	0.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	638.		638.	0.	0.	0.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1113.		1113.	0.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1498.		1498.	0.	1.	1.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1716.		1716.	0.	1.	1.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1734.		1734.	0.	1.	1.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1547.		1547.	0.	1.	1.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1187.		1187.	0.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	721.		721.	0.	1.	1.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	277.		277.	0.	0.	0.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	27.		27.	0.	0.	0.
DAILY TOTALS:										10685.	10685.	0.	7.	7.	7.

ALBANY, NY
FEB 28 1979
DAY NUMBER 59

SUNRISE = 6.63 SUNSET = 17.64 (STD. TIME)
GEOMETRIC DAY LENGTH = 11.01 HOURS
COLL. RISE = 6.63 COLL. SET = 17.66 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	759.	759.	759.	721.	759.	182.	317.3	317.3	296.4	317.3
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2093.	2099.	2099.	1994.	2099.	1799.	16.7	16.7	10.9	16.7
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2763.	2768.	2768.	2630.	2768.	2760.	0.3	0.3	-4.7	0.3
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3169.	3169.	3169.	3010.	3169.	3219.	-1.6	-1.6	-6.5	-1.6
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3389.	3389.	3389.	3219.	3389.	3371.	0.5	0.5	-4.5	0.5
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3439.	3489.	3489.	3315.	3489.	3424.	1.9	1.9	-3.2	1.9
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3497.	3497.	3497.	3322.	3497.	3412.	2.5	2.5	-2.6	2.5
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3414.	3414.	3414.	3243.	3414.	3308.	3.2	3.2	-2.0	3.2
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3220.	3220.	3220.	3059.	3220.	3215.	0.1	0.1	-4.9	0.1
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2862.	2862.	2862.	2719.	2862.	2857.	0.2	0.2	-4.8	0.2
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2256.	2256.	2256.	2144.	2256.	2184.	3.3	3.3	-1.8	3.3
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	812.	812.	812.	771.	812.	493.	64.6	64.6	56.4	64.6
DAILY TOTALS:										31734.	31734.	31734.	30148.	31734.	30224.	5.0	5.0	-0.3	5.0

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	30.	30.	30.	29.	30.	
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	347.	347.	347.	330.	347.	
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	911.	911.	911.	866.	911.	
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1478.	1478.	1478.	1404.	1478.	
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1919.	1919.	1919.	1823.	1919.	
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2169.	2169.	2169.	2061.	2169.	
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2198.	2198.	2198.	2088.	2198.	
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2002.	2002.	2002.	1902.	2002.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1604.	1604.	1604.	1524.	1604.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1060.	1060.	1060.	1007.	1060.	
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	481.	481.	481.	457.	481.	
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	62.	62.	62.	59.	62.	
DAILY TOTALS:										14252.	14262.	14262.	13549.	14262.	

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

1979 YEARLY TOTALS (FOR DAYS SELECTED)

(MICROCLIMATIC OPTION)

COMPUTED DIRECT ENERGY FLUX
TAUP1 TAUP2 TAUP3 TAUP4
[KJ/SQ.M]

686268. 410680. 379237. 405277.

EXPTAL.
EN. FLUX
[KJ/SQ.M]

404876.

RELATIVE ERROR
TAUP1 TAUP2 TAUP3 TAUP4
[PERCENT]

69.5 1.4 -6.3 0.1

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

MONTHLY TOTALS (FOR DAYS SELECTED)

(MICROCLIMATIC OPTION)

		COMPUTED DIRECT ENERGY FLUX TAUP1 TAUP2 TAUP3 TAUP4 [KJ/SQ.M]						EXPTAL. EN. FLUX [KJ/SQ.M]				RELATIVE ERROR TAUP1 TAUP2 TAUP3 TAUP4 [PERCENT]			
		-----						-----				-----			
JAN	1979	0.	0.	0.	0.			0.				*****			
FEB	1979	686268.	410380.	379237.	405277.			404876.				69.5	1.4	-6.3	0.1
MAR	1979	0.	0.	0.	0.			0.				*****			
APR	1979	0.	0.	0.	0.			0.				*****			
MAY	1979	0.	0.	0.	0.			0.				*****			
JUN	1979	0.	0.	0.	0.			0.				*****			
JUL	1979	0.	0.	0.	0.			0.				*****			
AUG	1979	0.	0.	0.	0.			0.				*****			
SEP	1979	0.	0.	0.	0.			0.				*****			
OCT	1979	0.	0.	0.	0.			0.				*****			
NOV	1979	0.	0.	0.	0.			0.				*****			
DEC	1979	0.	0.	0.	0.			0.				*****			

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

(MICROCLIMATIC OPTION)

COMPUTED	DIRECT	ENERGY	FLUX	EXPTAL.	RELATIVE ERROR
TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1 TAUP2 TAUP3 TAUP4
	[KJ/SQ.M]			[KJ/SQ.M]	[PERCENT]

FEB	1	1979	DAY NUMBER	32	21020.	6681.	5925.	5925.	5442.	286.3	22.8	8.9	8.9
FEB	2	1979	DAY NUMBER	33	20381.	12986.	9499.	10866.	18137.	12.4	-28.4	-47.6	-40.1
FEB	3	1979	DAY NUMBER	34	28055.	27036.	25949.	27522.	28433.	-1.3	-4.9	-8.7	-3.2
FEB	4	1979	DAY NUMBER	35	24847.	17291.	16949.	16949.	15122.	64.3	14.3	12.1	12.1
FEB	5	1979	DAY NUMBER	36	25256.	13714.	14072.	14072.	11863.	112.9	15.6	18.6	18.6
FEB	6	1979	DAY NUMBER	37	30077.	30064.	28554.	30064.	28639.	5.0	5.0	-0.3	5.0
FEB	7	1979	DAY NUMBER	38	23290.	0.	16.	16.	7.	*****			
FEB	8	1979	DAY NUMBER	39	26569.	17388.	16749.	16749.	15485.	71.6	12.3	8.2	8.2
FEB	9	1979	DAY NUMBER	40	28446.	27041.	24626.	27751.	24186.	17.6	11.8	1.8	14.7
FEB	10	1979	DAY NUMBER	41	27901.	22451.	19737.	23762.	20122.	38.7	11.6	-1.9	18.1
FEB	11	1979	DAY NUMBER	42	31293.	29369.	27885.	30655.	30273.	3.4	-3.0	-7.9	1.3
FEB	12	1979	DAY NUMBER	43	24243.	13686.	10092.	10092.	12133.	99.8	12.8	-16.8	-16.8
FEB	13	1979	DAY NUMBER	44	26799.	18275.	15659.	15659.	20558.	*****			
FEB	14	1979	DAY NUMBER	45	26988.	22993.	19738.	24822.	26921.	0.2	-14.6	-26.7	-7.8
FEB	15	1979	DAY NUMBER	46	26382.	22973.	22521.	24465.	24725.	6.7	-7.1	-8.9	-1.1
FEB	16	1979	DAY NUMBER	47	24354.	15603.	14782.	14782.	14453.	68.5	8.0	2.3	2.3
FEB	17	1979	DAY NUMBER	48	29725.	29725.	28239.	29725.	30480.	-2.5	-2.5	-7.4	-2.5
FEB	18	1979	DAY NUMBER	49	27162.	12309.	9986.	9986.	10675.	154.4	15.3	-6.5	-6.5
FEB	19	1979	DAY NUMBER	50	22598.	3201.	3532.	3532.	5355.	322.0	-40.2	-34.0	-34.0
FEB	20	1979	DAY NUMBER	51	28861.	27084.	25870.	27438.	22019.	31.1	23.0	17.5	24.6

DIRECT ENERGY FLJX ON A SUN-TRACKING COLLECTOR

(MICROCLIMATIC OPTION)

COMPUTED DIRECT ENERGY FLUX				EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
[KJ/SQ.M]					[PERCENT]			

FEB 21 1979	DAY NUMBER 52	19718.	2074.	1534.	1534.	2493.	690.9	-16.8	-38.5	-38.5
FEB 22 1979	DAY NUMBER 53	19075.	7007.	7119.	7119.	7069.	169.1	-1.2	0.4	0.4
FEB 23 1979	DAY NUMBER 54	14153.	0.	10.	10.	17.	*****			
FEB 24 1979	DAY NUMBER 55	15808.	0.	11.	11.	14.	*****			
FEB 25 1979	DAY NUMBER 56	19837.	0.	14.	14.	4.	*****			
FEB 26 1979	DAY NUMBER 57	18722.	0.	13.	13.	6.	*****			
FEB 27 1979	DAY NUMBER 58	22982.	0.	16.	16.	1.	*****			
FEB 28 1979	DAY NUMBER 59	31734.	31734.	30148.	31734.	30224.	5.0	5.0	-0.3	5.0

BREAKDOWN OF ERRORS AND SYNOPTIC TABLE

ALBANY, NY

LATITUDE 42.70 DEG. LONGITUDE 73.83 DEG.

SYNOPTIC TABLE

DIRECT ENERGY FLUX ON A HORIZONTAL SURFACE

SUMMARY OF DAILY RELATIVE ERRORS

[MICROCLIMATIC OPTION]

		TAUP1		NO. OF DAYS AND RELATIVE ERROR TAUP2 [ADIM] TAUP3 TAUP4			
		-----		-----			
MAXIMUM	REL. ERROR	690.9		23.0		18.6	
MINIMUM	REL. ERROR	-2.5		-40.2		-47.6	
AVERAGE	REL. ERROR	21	102.7	21	1.8	21	-6.5
AVERAGE POS.	REL. ERROR	19	113.7	12	13.1	8	8.7
AVERAGE NEG.	REL. ERROR	2	-1.9	9	-13.2	13	-15.8

DIRECT ENERGY FLUX ON A SUN-TRACKING SURFACE

BREAKDOWN OF ERRORS

(MICROCLIMATIC OPTION)

ERROR LESS THAN [ADIM]	NUMBER OF DAYS AND PERCENT OF TOTAL DAYS							
	TAUP1		TAUP2 [DAYS]		TAUP3		TAUP4	
5. %	5	17.9 %	6	21.4 %	6	21.4 %	8	28.6 %
10. %	7	25.0 %	8	28.6 %	13	46.4 %	12	42.9 %
15. %	8	28.6 %	14	50.0 %	14	50.0 %	14	50.0 %
20. %	9	32.1 %	17	60.7 %	17	60.7 %	17	60.7 %
30. %	9	32.1 %	20	71.4 %	18	64.3 %	18	64.3 %
40. %	11	39.3 %	20	71.4 %	20	71.4 %	20	71.4 %
50. %	11	39.3 %	21	75.0 %	21	75.0 %	21	75.0 %
100. %	15	53.6 %	21	75.0 %	21	75.0 %	21	75.0 %

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

ALBANY, NY

LATITUDE 42.70 DEG. LONGITUDE 73.83 DEG.

TIME = STANDARD TIME [HOURS]
S/D = HOURS OF DIRECT SUNSHINE PER HOUR [ADIM.]
TAUP1 = TAU-PRIME FOR NO CLOUDS (= 1.0)
TAUP2 = TAU-PRIME USING S/D ALGORITHM
TAUP3 = TAU-PRIME USING HYBRID ALGORITHM
TAUP4 = TAU-PRIME USING SELECTIVE ALGORITHM

SKY COVER:
T = TOTAL SKY COVER (IN TENTHS)
O = TOTAL OPAQUE SKY COVER (IN TENTHS)
C = TOTAL CIRRUS SKY COVER (IN TENTHS)
FH = 1 FOR FOG, 16 FOR HAZE, ELSE 0

ALBANY, NY
JUN 1 1979
DAY NUMBER 152

SUNRISE = 4.42 SUNSET = 19.35 (STD. TIME) (MICROCLIMATIC OPTION)
GEOMETRIC DAY LENGTH = 14.93 HOURS
COLL. RISE = 4.41 COLL. SET = 19.36 (STD. TIME)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]					[PERCENT]			
5.00	0.0	8	3	0	0	1.000	0.0	0.090	0.0	357.	357.	0.	32.	0.	165.	116.4	-100.0	-80.5	-100.0
6.00	0.967	10	4	0	0	1.000	0.797	0.480	0.580	905.	905.	722.	435.	525.	1025.	-11.7	-29.6	-57.6	-48.8
7.00	1.000	10	5	0	0	1.000	0.775	0.500	0.500	1530.	1530.	1185.	765.	765.	1515.	1.0	-21.8	-49.5	-49.5
8.00	1.000	10	4	0	0	1.000	0.775	0.500	0.500	2045.	2045.	1585.	1023.	1023.	2181.	-6.3	-27.3	-53.1	-53.1
9.00	0.983	10	5	0	0	1.000	0.762	0.443	0.492	2405.	2405.	1833.	1065.	1183.	2747.	-12.4	-33.3	-61.2	-56.9
10.00	0.800	5	5	0	0	1.000	0.600	0.473	0.600	2893.	2893.	1736.	1368.	1736.	2188.	32.2	-20.7	-37.5	-20.6
11.00	1.000	2	2	0	0	1.000	0.825	0.793	1.000	3200.	3200.	2640.	2536.	3200.	2853.	12.1	-7.5	-11.1	12.1
12.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	3317.	3317.	3068.	2927.	3317.	3132.	5.9	-2.1	-6.5	5.9
13.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	3311.	3311.	3145.	2996.	3311.	3120.	6.1	0.8	-4.0	6.1
14.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	3240.	3240.	3078.	2932.	3240.	3067.	5.6	0.3	-4.4	5.6
15.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	3158.	3158.	3079.	2930.	3158.	2961.	6.7	4.0	-1.1	6.7
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2934.	2934.	2934.	2787.	2934.	2771.	5.9	5.9	0.6	5.9
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2572.	2572.	2572.	2444.	2572.	2550.	0.9	0.9	-4.2	0.9
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2029.	2029.	2029.	1927.	2029.	2062.	-1.6	-1.6	-6.5	-1.6
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1308.	1308.	1308.	1242.	1308.	1208.	8.2	8.2	2.8	8.2
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	271.	271.	271.	257.	271.	70.	287.0	287.0	267.7	287.0

DAILY TOTALS: 35473. 35473. 31184. 27667. 30571. 33615. 5.5 -7.2 -17.7 -9.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]			
5.00	0.0	8	3	0	0	1.000	0.0	0.090	0.0	22.	22.	0.	2.	0.
6.00	0.967	10	4	0	0	1.000	0.797	0.480	0.580	179.	179.	142.	86.	104.
7.00	1.000	10	5	0	0	1.000	0.775	0.500	0.500	566.	566.	439.	283.	283.
8.00	1.000	10	4	0	0	1.000	0.775	0.500	0.500	1099.	1099.	851.	549.	549.
9.00	0.983	10	5	0	0	1.000	0.762	0.443	0.492	1650.	1650.	1258.	731.	812.
10.00	0.800	5	5	0	0	1.000	0.600	0.473	0.600	2335.	2335.	1401.	1104.	1401.
11.00	1.000	2	2	0	0	1.000	0.825	0.793	1.000	2848.	2848.	2350.	2258.	2848.
12.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	3086.	3086.	2854.	2723.	3086.
13.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	3062.	3062.	2909.	2771.	3062.
14.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	2831.	2831.	2690.	2562.	2831.
15.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	2466.	2466.	2405.	2287.	2466.
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1914.	1914.	1914.	1818.	1914.
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1280.	1280.	1280.	1216.	1280.
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	664.	664.	664.	631.	664.
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	202.	202.	202.	192.	202.
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	9.	9.	9.	8.	9.

DAILY TOTALS: 24210. 24210. 21365. 19222. 21510.

ALBANY, NY
JUN 2 1979
DAY NUMBER 153

SUNRISE = 4.41 SUNSET = 19.36 (STD. TIME)
GEOMETRIC DAY LENGTH = 14.95 HOURS
COLL. RISE = 4.40 COLL. SET = 19.37 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2		TAUP3	TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
5.00	0.0	1	1	1	0	1.000	0.0	0.435	0.435	614.	614.	0.	267.	267.	36.	1606.8	-100.0	642.6	642.6
6.00	0.617	3	2	3	0	1.000	0.558	0.698	0.698	1310.	1310.	731.	914.	914.	368.	255.9	98.6	148.3	148.3
7.00	1.000	3	2	3	0	1.000	0.870	0.905	0.905	1948.	1948.	1694.	1763.	1763.	1004.	94.0	68.8	75.6	75.6
8.00	1.000	7	3	7	0	1.000	0.825	0.875	0.875	2181.	2181.	1800.	1909.	1909.	9999.	*****			
9.00	1.000	10	3	9	16	1.000	0.650	0.808	0.808	1995.	1995.	1297.	1611.	1611.	9999.	*****			
10.00	1.000	3	1	2	16	1.000	0.825	0.823	0.823	2589.	2589.	2136.	2130.	2130.	9999.	*****			
11.00	0.833	6	3	2	16	1.000	0.733	0.683	0.683	2576.	2576.	1889.	1759.	1759.	9999.	*****			
12.00	0.0	3	3	0	16	1.000	0.0	0.278	0.278	2785.	2785.	0.	774.	774.	9999.	*****			
13.00	0.0	8	7	0	16	1.000	0.0	0.203	0.203	2493.	2493.	0.	506.	506.	9999.	*****			
14.00	0.0	10	8	0	16	1.000	0.0	0.046	0.046	2257.	2257.	0.	103.	103.	9999.	*****			
15.00	0.533	9	9	0	16	1.000	0.307	0.263	0.263	2107.	2107.	646.	554.	554.	9999.	*****			
16.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	1758.	1758.	0.	41.	41.	9999.	*****			
17.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1336.	1336.	0.	1.	1.	9999.	*****			
18.00	0.0	9	9	5	16	1.000	0.0	0.098	0.098	865.	865.	0.	85.	85.	179.	383.1	-100.0	-52.6	-52.6
19.00	0.0	9	4	5	16	1.000	0.0	0.195	0.195	366.	366.	0.	72.	72.	147.	149.3	-100.0	-51.3	-51.3
20.00	0.0	10	10	6	16	1.000	0.0	0.188	0.188	42.	42.	0.	8.	8.	0.	*****			

DAILY TOTALS:

5145. 5145. 2425. 3108. 3108. 1734. *****

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TALP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	1	1	1	0	1.000	0.0	0.435	0.435	38.	38.	0.	17.	17.	
6.00	0.617	3	2	3	0	1.000	0.558	0.698	0.698	256.	256.	143.	179.	179.	
7.00	1.000	3	2	3	0	1.000	0.870	0.905	0.905	720.	720.	626.	652.	652.	
8.00	1.000	7	3	7	0	1.000	0.825	0.875	0.875	1170.	1170.	906.	1024.	1024.	
9.00	1.000	10	3	9	16	1.000	0.650	0.808	0.808	1367.	1367.	889.	1104.	1104.	
10.00	1.000	3	1	2	16	1.000	0.825	0.823	0.823	2092.	2092.	1726.	1721.	1721.	
11.00	0.833	6	3	2	16	1.000	0.733	0.683	0.683	2294.	2294.	1682.	1566.	1566.	
12.00	0.0	3	3	0	16	1.000	0.0	0.278	0.278	2594.	2594.	0.	720.	720.	
13.00	0.0	8	7	0	16	1.000	0.0	0.203	0.203	2308.	2308.	0.	468.	468.	
14.00	0.0	10	8	0	16	1.000	0.0	0.046	0.046	1975.	1975.	0.	90.	90.	
15.00	0.533	9	9	0	16	1.000	0.307	0.263	0.263	1649.	1649.	506.	434.	434.	
16.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	1152.	1152.	0.	27.	27.	
17.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	670.	670.	0.	0.	0.	
18.00	0.0	9	9	5	16	1.000	0.0	0.098	0.098	288.	288.	0.	28.	28.	
19.00	0.0	9	4	5	16	1.000	0.0	0.195	0.195	60.	60.	0.	12.	12.	
20.00	0.0	10	10	6	16	1.000	0.0	0.188	0.188	2.	2.	0.	0.	0.	

DAILY TOTALS:

1365. 1365. 769. 887. 887.

ALBANY, NY
JUN 3 1979
DAY NUMBER 154

SUNRISE = 4.40 SUNSET = 19.37 (STD. TIME)
GEOMETRIC DAY LENGTH = 14.97 HOURS
COLL. RISE = 4.40 COLL. SET = 19.39 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]				EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2		TAUP3	TAUP4	TAUP1	TAUP2	TAUP3
5.00	0.C	10	8	0	0	1.000	0.0	0.001	0.001	254.	254.	0.	0.	0.	0.	*****			
6.00	0.C	10	8	0	0	1.000	0.0	0.001	0.001	801.	801.	0.	0.	0.	40.	1903.1	-100.0	-98.9	-98.9
7.00	0.C67	10	8	0	0	1.000	0.040	0.031	0.031	1434.	1434.	57.	44.	44.	7.	20389.6	719.9	526.2	526.2
8.00	0.C	10	9	0	0	1.000	0.0	0.001	0.001	1970.	1970.	0.	1.	1.	49.	3919.5	-100.0	-97.6	-97.6
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2356.	2356.	0.	2.	2.	14.	16730.3	-100.0	-88.8	-88.8
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2615.	2615.	0.	2.	2.	31.	8334.0	-100.0	-94.1	-94.1
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2774.	2774.	0.	2.	2.	142.	1853.7	-100.0	-98.6	-98.6
12.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2855.	2855.	24.	23.	23.	116.	2361.3	-79.5	-79.8	-79.8
13.00	0.033	10	10	0	0	1.000	0.017	0.016	0.016	2865.	2865.	48.	45.	45.	198.	1347.2	-75.9	-77.3	-77.3
14.00	0.017	10	8	0	0	1.000	0.009	0.008	0.008	2805.	2805.	23.	23.	23.	327.	732.4	-92.4	-93.2	-93.2
15.00	0.017	10	8	0	0	1.000	0.010	0.008	0.008	2665.	2665.	27.	21.	21.	68.	3819.7	-60.8	-68.4	-68.4
16.00	0.0	9	7	0	0	1.000	0.0	0.023	0.023	2478.	2478.	0.	57.	57.	9.	27432.9	-100.0	533.9	533.9
17.00	0.667	10	7	0	0	1.000	0.433	0.323	0.323	2061.	2061.	893.	666.	666.	570.	261.6	56.7	16.8	16.8
18.00	0.283	10	7	0	0	1.000	0.184	0.128	0.128	1526.	1526.	281.	195.	195.	332.	359.8	-15.3	-41.2	-41.2
19.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	885.	885.	0.	0.	0.	76.	1064.6	-100.0	-99.4	-99.4
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	164.	164.	0.	0.	0.	1.	16349.8	-100.0	-89.6	-89.6
DAILY TOTALS:										30510.	30510.	1356.	1082.	1082.	1990.	1433.2	-31.9	-45.6	-45.6

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3
5.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	17.	17.	0.	0.	0.
6.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	161.	161.	0.	0.	0.
7.00	0.067	10	8	0	0	1.000	0.040	0.031	0.031	534.	534.	21.	16.	16.
8.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	1061.	1061.	0.	1.	1.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1620.	1620.	0.	1.	1.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2112.	2112.	0.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2473.	2473.	0.	2.	2.
12.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2661.	2661.	22.	22.	22.
13.00	0.033	10	10	0	0	1.000	0.017	0.016	0.016	2655.	2655.	44.	42.	42.
14.00	0.017	10	8	0	0	1.000	0.009	0.008	0.008	2457.	2457.	23.	20.	20.
15.00	0.017	10	8	0	0	1.000	0.010	0.008	0.008	2088.	2088.	21.	17.	17.
16.00	0.0	9	7	0	0	1.000	0.0	0.023	0.023	1624.	1624.	0.	37.	37.
17.00	0.667	10	7	0	0	1.000	0.433	0.323	0.323	1034.	1034.	448.	334.	334.
18.00	0.283	10	7	0	0	1.000	0.184	0.128	0.128	507.	507.	93.	65.	65.
19.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	142.	142.	0.	0.	0.
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	6.	6.	0.	0.	0.
DAILY TOTALS:										21152.	21152.	673.	558.	558.

ALBANY, NY
JUN 4 1979
DAY NUMBER 155

SUNRISE = 4.40 SUNSET = 19.38 (STD. TIME)
GEOMETRIC DAY LENGTH = 14.99 HOURS
COLL. RISE = 4.39 COLL. SET = 19.40 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]					[PERCENT]			
5.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	351.	351.	0.	0.	0.	10.	3411.4	-100.0	-98.3	-98.3
6.00	0.517	9	4	0	0	1.000	0.375	0.255	0.255	1043.	1043.	391.	266.	266.	34.	2967.1	1048.9	683.3	683.3
7.00	1.000	9	4	0	0	1.000	0.800	0.545	0.545	1703.	1703.	1363.	929.	929.	58.	2836.9	2249.5	1501.4	1501.4
8.00	1.000	10	3	0	0	1.000	0.825	0.523	0.523	2167.	2167.	1788.	1133.	1133.	1179.	83.8	51.6	-3.9	-3.9
9.00	1.000	10	3	0	0	1.000	0.850	0.500	0.500	2521.	2521.	2143.	1261.	1261.	1572.	60.4	36.3	-19.8	-19.8
10.00	1.000	10	5	0	0	1.000	0.800	0.500	0.500	2755.	2755.	2204.	1378.	1378.	2027.	35.9	8.7	-32.0	-32.0
11.00	0.900	10	8	0	0	1.000	0.608	0.405	0.405	2893.	2893.	1758.	1173.	1173.	1662.	74.1	5.8	-29.4	-29.4
12.00	0.267	10	7	0	0	1.000	0.167	0.121	0.121	2955.	2955.	493.	356.	356.	1212.	143.8	-59.4	-70.6	-70.6
13.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	2949.	2949.	0.	2.	2.	854.	245.3	-100.0	-99.8	-99.8
14.00	0.933	10	8	0	0	1.000	0.560	0.421	0.421	2874.	2874.	1610.	1209.	1209.	979.	193.5	64.4	23.4	23.4
15.00	1.000	10	8	5	0	1.000	0.575	0.576	0.576	2719.	2719.	1564.	1565.	1565.	1508.	80.3	3.7	3.8	3.8
16.00	1.000	5	1	5	0	1.000	0.725	0.763	0.763	2729.	2729.	1978.	2081.	2081.	2257.	20.9	-12.3	-7.8	-7.8
17.00	1.000	2	1	5	0	1.000	0.900	0.943	0.943	2576.	2576.	2318.	2428.	2428.	2322.	10.9	-0.2	4.6	4.6
18.00	1.000	6	1	0	0	1.000	0.925	0.845	0.845	1796.	1796.	1661.	1517.	1517.	1845.	-2.7	-10.0	-17.8	-17.8
19.00	0.967	7	2	5	0	1.000	0.870	0.668	0.668	1026.	1026.	892.	685.	685.	883.	16.2	1.1	-22.4	-22.4
20.00	0.0	7	2	0	0	1.000	0.0	0.210	0.210	194.	194.	0.	41.	41.	41.	374.2	-100.0	-0.3	-0.3

DAILY TOTALS: 33250. 33250. 20162. 16024. 16024. 18443. 80.3 9.3 -13.1 -13.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]			
5.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	23.	23.	0.	0.	0.
6.00	0.517	9	4	0	0	1.000	0.375	0.255	0.255	209.	209.	78.	53.	53.
7.00	1.000	9	4	0	0	1.000	0.800	0.545	0.545	634.	634.	507.	346.	346.
8.00	1.000	10	3	0	0	1.000	0.825	0.523	0.523	1167.	1167.	963.	610.	610.
9.00	1.000	10	3	0	0	1.000	0.850	0.500	0.500	1734.	1734.	1474.	868.	868.
10.00	1.000	10	5	0	0	1.000	0.800	0.500	0.500	2227.	2227.	1782.	1114.	1114.
11.00	0.900	10	8	0	0	1.000	0.608	0.405	0.405	2580.	2580.	1568.	1046.	1046.
12.00	0.267	10	7	0	0	1.000	0.167	0.121	0.121	2755.	2755.	459.	332.	332.
13.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	2735.	2735.	0.	1.	1.
14.00	0.933	10	8	0	0	1.000	0.560	0.421	0.421	2520.	2520.	1412.	1060.	1060.
15.00	1.000	10	8	5	0	1.000	0.575	0.576	0.576	2133.	2133.	1227.	1228.	1228.
16.00	1.000	5	1	5	0	1.000	0.725	0.763	0.763	1790.	1790.	1298.	1366.	1366.
17.00	1.000	2	1	5	0	1.000	0.900	0.943	0.943	1292.	1292.	1163.	1218.	1218.
18.00	1.000	6	1	0	0	1.000	0.925	0.845	0.845	601.	601.	556.	508.	508.
19.00	0.967	7	2	5	0	1.000	0.870	0.668	0.668	166.	166.	145.	111.	111.
20.00	0.0	7	2	0	0	1.000	0.0	0.210	0.210	7.	7.	0.	2.	2.

DAILY TOTALS: 22575. 22575. 12631. 9862. 9862.

ALBANY, NY
JUN 5 1979
DAY NUMBER 156

SUNRISE = 4.39 SUNSET = 19.39 (STD. TIME) (MICROCLIMATIC OPTION)
GEOMETRIC DAY LENGTH = 15.00 HOURS
COLL. RISE = 4.38 COLL. SET = 19.41 (STD. TIME)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	1	1	0	0	1.000	0.0	0.405	0.405	611.	611.	0.	248.	248.	93.	557.1	-100.0	166.2	166.2
6.00	0.883	2	2	0	16	1.000	0.817	0.780	0.780	1053.	1053.	860.	821.	821.	934.	12.7	-7.9	-12.0	-12.0
7.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	1664.	1664.	1498.	1431.	1431.	1682.	-1.1	-11.0	-14.9	-14.9
8.00	1.000	6	1	0	16	1.000	0.925	0.770	0.770	1908.	1908.	1765.	1469.	1469.	2008.	-5.0	-12.1	-26.8	-26.8
9.00	1.000	6	2	5	0	1.000	0.900	0.755	0.755	2580.	2580.	2322.	1948.	1948.	2339.	10.3	-0.7	-16.7	-16.7
10.00	1.000	5	2	5	0	1.000	0.850	0.853	0.853	2885.	2885.	2452.	2460.	2460.	2647.	9.0	-7.4	-7.1	-7.1
11.00	1.000	3	2	5	0	1.000	0.850	0.920	0.920	3121.	3121.	2653.	2872.	2872.	2753.	13.4	-3.6	4.3	4.3
12.00	1.000	3	1	0	0	1.000	0.900	0.890	0.890	3181.	3181.	2863.	2831.	2831.	2562.	24.2	11.7	10.5	10.5
13.00	1.000	3	3	0	0	1.000	0.900	0.815	0.815	3170.	3170.	2853.	2584.	2584.	2520.	25.8	13.2	2.5	2.5
14.00	0.500	7	7	0	0	1.000	0.375	0.450	0.450	2886.	2886.	1082.	1300.	1300.	629.	358.8	72.1	106.6	106.6
15.00	0.0	9	9	5	0	1.000	0.0	0.166	0.166	2599.	2599.	0.	430.	430.	5.	51882.9	-100.0	8506.3	8506.3
16.00	0.867	8	6	4	0	1.000	0.503	0.593	0.593	2371.	2371.	1192.	1406.	1406.	988.	140.0	20.7	42.3	42.3
17.00	0.017	9	9	5	0	1.000	0.010	0.211	0.211	1918.	1918.	19.	404.	404.	282.	580.2	-93.4	43.2	43.2
18.00	1.000	5	4	4	0	1.000	0.630	0.770	0.770	1592.	1592.	1003.	1227.	1227.	992.	60.5	1.1	23.6	23.6
19.00	1.000	2	2	1	0	1.000	0.825	0.868	0.868	1115.	1115.	920.	968.	968.	1000.	11.5	-8.0	-3.2	-3.2
20.00	1.000	0	0	0	0	1.000	0.945	0.920	0.920	255.	255.	241.	235.	235.	68.	275.3	254.6	245.3	245.3
DAILY TOTALS:										32910.	32910.	21723.	22634.	22634.	21502.	53.1	1.0	5.3	5.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	0.0	1	1	0	0	1.000	0.0	0.405	0.405	40.	40.	0.	16.	16.	
6.00	0.883	2	2	0	16	1.000	0.817	0.780	0.780	208.	208.	170.	162.	162.	
7.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	620.	620.	558.	533.	533.	
8.00	1.000	6	1	0	16	1.000	0.925	0.770	0.770	1026.	1026.	951.	792.	792.	
9.00	1.000	6	2	5	0	1.000	0.900	0.755	0.755	1778.	1778.	1600.	1342.	1342.	
10.00	1.000	5	2	5	0	1.000	0.850	0.853	0.853	2334.	2334.	1984.	1990.	1990.	
11.00	1.000	3	2	5	0	1.000	0.850	0.920	0.920	2785.	2785.	2368.	2563.	2563.	
12.00	1.000	3	1	0	0	1.000	0.900	0.890	0.890	2968.	2968.	2671.	2642.	2642.	
13.00	1.000	3	3	0	0	1.000	0.900	0.815	0.815	2942.	2942.	2648.	2398.	2398.	
14.00	0.500	7	7	0	0	1.000	0.375	0.450	0.450	2534.	2534.	950.	1141.	1141.	
15.00	0.0	9	9	5	0	1.000	0.0	0.166	0.166	2043.	2043.	0.	338.	338.	
16.00	0.867	8	6	4	0	1.000	0.503	0.593	0.593	1561.	1561.	785.	926.	926.	
17.00	0.017	9	9	5	0	1.000	0.010	0.211	0.211	969.	969.	9.	204.	204.	
18.00	1.000	5	4	4	0	1.000	0.630	0.770	0.770	532.	532.	335.	410.	410.	
19.00	1.000	2	2	1	0	1.000	0.825	0.868	0.868	180.	180.	149.	156.	156.	
20.00	1.000	0	0	0	0	1.000	0.945	0.920	0.920	10.	10.	9.	9.	9.	
DAILY TOTALS:										22533.	22533.	15188.	15624.	15624.	

ALBANY, NY
JUN 6 1979
DAY NUMBER 157

SUNRISE = 4.39 SUNSET = 19.41 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.02 HOURS
COLL. RISE = 4.38 COLL. SET = 19.43 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	8	3	0	0	1.000	0.0	0.090	0.0	351.	351.	0.	32.	0.	1.	35033.7	-100.0	3069.4	-100.0
6.00	0.817	9	4	0	0	1.000	0.674	0.435	0.531	934.	934.	629.	406.	496.	788.	18.5	-20.1	-48.4	-37.1
7.00	1.000	5	2	0	0	1.000	0.850	0.635	0.800	1797.	1797.	1528.	1142.	1438.	2155.	-16.6	-29.1	-47.0	-33.3
8.00	1.000	1	1	0	0	1.000	0.925	0.815	1.000	2582.	2582.	2388.	2104.	2582.	2811.	-8.2	-15.0	-25.1	-8.2
9.00	1.000	2	1	2	0	1.000	0.940	0.913	0.990	2862.	2862.	2691.	2612.	2834.	3087.	-7.3	-12.8	-15.4	-8.2
10.00	1.000	3	2	3	0	1.000	0.900	0.913	0.975	3004.	3004.	2704.	2741.	2929.	3196.	-6.0	-15.4	-14.2	-8.4
11.00	1.000	3	2	3	0	1.000	0.870	0.905	0.970	3118.	3118.	2713.	2822.	3025.	2571.	21.3	5.5	9.8	17.6
12.00	1.000	2	2	2	0	1.000	0.875	0.913	0.975	3222.	3222.	2819.	2940.	3141.	3328.	-3.2	-15.3	-11.7	-5.6
13.00	1.000	1	1	0	0	1.000	0.915	0.913	0.990	3269.	3269.	2991.	2983.	3236.	3350.	-2.4	-10.7	-10.9	-3.4
14.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	3203.	3203.	3042.	2899.	3203.	3282.	-2.4	-7.3	-11.7	-2.4
15.00	0.883	7	1	6	0	1.000	0.813	0.758	0.857	2720.	2720.	2210.	2060.	2330.	3107.	-12.5	-28.9	-33.7	-25.0
16.00	1.000	7	1	6	0	1.000	0.850	0.815	0.700	2426.	2426.	2062.	1977.	1699.	2715.	-10.6	-24.0	-27.2	-37.4
17.00	1.000	4	1	3	0	1.000	0.905	0.838	0.905	2215.	2215.	2005.	1855.	2005.	2533.	-12.6	-20.9	-26.8	-20.9
18.00	1.000	3	1	3	0	1.000	0.920	0.883	0.970	1745.	1745.	1606.	1540.	1693.	1921.	-9.2	-16.4	-19.8	-11.9
19.00	0.217	3	1	3	0	1.000	0.199	0.503	0.210	1057.	1057.	211.	531.	222.	1090.	-3.0	-80.7	-51.2	-79.6
20.00	1.000	2	1	2	0	1.000	0.925	0.913	0.975	217.	217.	201.	198.	212.	79.	174.6	154.0	150.6	167.8
DAILY TOTALS:										34722.	34722.	29799.	28845.	31043.	36014.	-3.6	-17.3	-19.9	-13.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	8	3	0	0	1.000	0.0	0.090	0.0	24.	24.	0.	2.	0.	
6.00	0.817	9	4	0	0	1.000	0.674	0.435	0.531	188.	188.	127.	82.	100.	
7.00	1.000	5	2	0	0	1.000	0.850	0.635	0.800	672.	672.	571.	427.	538.	
8.00	1.000	1	1	0	0	1.000	0.925	0.815	1.000	1394.	1394.	1280.	1135.	1394.	
9.00	1.000	2	1	2	0	1.000	0.940	0.913	0.990	1970.	1970.	1852.	1798.	1950.	
10.00	1.000	3	2	3	0	1.000	0.900	0.913	0.975	2431.	2431.	2187.	2218.	2370.	
11.00	1.000	3	2	3	0	1.000	0.870	0.905	0.970	2784.	2784.	2422.	2520.	2701.	
12.00	1.000	2	2	2	0	1.000	0.875	0.913	0.975	3008.	3008.	2632.	2745.	2933.	
13.00	1.000	1	1	0	0	1.000	0.915	0.913	0.990	3037.	3037.	2779.	2771.	3006.	
14.00	1.000	1	1	0	0	1.000	0.950	0.905	1.000	2814.	2814.	2674.	2547.	2814.	
15.00	0.883	7	1	6	0	1.000	0.813	0.758	0.857	2142.	2142.	1741.	1623.	1835.	
16.00	1.000	7	1	6	0	1.000	0.850	0.815	0.700	1600.	1600.	1360.	1304.	1120.	
17.00	1.000	4	1	3	0	1.000	0.905	0.838	0.905	1119.	1119.	1013.	937.	1013.	
18.00	1.000	3	1	3	0	1.000	0.920	0.883	0.970	587.	587.	540.	518.	569.	
19.00	0.217	3	1	3	0	1.000	0.199	0.503	0.210	174.	174.	35.	88.	37.	
20.00	1.000	2	1	2	0	1.000	0.925	0.913	0.975	9.	9.	8.	8.	9.	
DAILY TOTALS:										23953.	23953.	21230.	20725.	22389.	

ALBANY, NY
JUN 7 1979
DAY NUMBER 158

SUNRISE = 4.38 SUNSET = 19.42 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.04 HOURS
COLL. RISE = 4.38 COLL. SET = 19.43 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
5.00	0.0	10	3	0	0	1.000	0.0	0.000	0.000	255.	255.	0.	0.	0.	24.	963.0	-100.0	-99.8	-99.8
6.00	0.050	9	2	0	0	1.000	0.044	0.045	0.045	832.	832.	36.	38.	38.	264.	215.1	-86.2	-85.8	-85.8
7.00	0.933	9	4	0	0	1.000	0.793	0.465	0.465	1450.	1450.	1151.	675.	675.	492.	194.8	133.9	37.1	37.1
8.00	1.000	2	2	0	0	1.000	0.850	0.703	0.703	2394.	2394.	2035.	1682.	1682.	810.	195.5	151.2	107.7	107.7
9.00	0.883	2	2	0	16	1.000	0.795	0.758	0.758	2467.	2467.	1961.	1869.	1869.	1407.	75.3	39.4	32.8	32.8
10.00	1.000	4	2	0	16	1.000	0.900	0.815	0.815	2546.	2546.	2291.	2075.	2075.	1470.	73.2	55.9	41.2	41.2
11.00	1.000	5	5	0	16	1.000	0.825	0.748	0.748	2618.	2618.	2160.	1958.	1958.	1574.	66.3	37.2	24.4	24.4
12.00	1.000	5	5	0	16	1.000	0.750	0.725	0.725	2677.	2677.	2008.	1942.	1942.	1645.	62.7	22.0	18.0	18.0
13.00	0.833	7	7	0	16	1.000	0.583	0.555	0.555	2555.	2555.	1491.	1419.	1419.	1465.	74.4	1.7	-3.1	-3.1
14.00	1.000	6	6	0	16	1.000	0.675	0.658	0.658	2515.	2515.	1698.	1655.	1655.	1252.	100.9	35.6	32.2	32.2
15.00	0.750	6	6	0	16	1.000	0.525	0.518	0.518	2348.	2348.	1233.	1216.	1216.	1147.	104.7	7.5	6.0	6.0
16.00	1.000	3	3	0	16	1.000	0.775	0.748	0.748	2267.	2267.	1757.	1695.	1695.	965.	134.9	82.0	75.7	75.7
17.00	0.833	5	5	0	16	1.000	0.667	0.645	0.645	1750.	1750.	1167.	1129.	1129.	833.	110.1	40.1	35.6	35.6
18.00	1.000	2	2	0	0	1.000	0.825	0.793	0.793	1723.	1723.	1421.	1366.	1366.	536.	221.4	165.1	154.8	154.8
19.00	0.500	2	2	0	0	1.000	0.450	0.585	0.585	1081.	1081.	486.	632.	632.	95.	1037.5	411.9	565.6	565.6
20.00	0.0	2	2	0	0	1.000	0.0	0.360	0.360	210.	210.	0.	76.	76.	0.	*****			

DAILY TOTALS:

29687. 29687. 20894. 19426. 19426. 13979. 112.4 49.5 39.0 39.0

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
5.00	0.0	10	3	0	0	1.000	0.0	0.000	0.000	17.	17.	0.	0.	0.
6.00	0.050	9	2	0	0	1.000	0.044	0.045	0.045	170.	170.	7.	8.	8.
7.00	0.933	9	4	0	0	1.000	0.793	0.465	0.465	543.	543.	431.	253.	253.
8.00	1.000	2	2	0	0	1.000	0.850	0.703	0.703	1295.	1295.	1101.	910.	910.
9.00	0.883	2	2	0	16	1.000	0.795	0.758	0.758	1698.	1698.	1350.	1286.	1286.
10.00	1.000	4	2	0	16	1.000	0.900	0.815	0.815	2061.	2061.	1655.	1680.	1680.
11.00	1.000	5	5	0	16	1.000	0.825	0.748	0.748	2339.	2339.	1930.	1749.	1749.
12.00	1.000	5	5	0	16	1.000	0.750	0.725	0.725	2501.	2501.	1876.	1814.	1814.
13.00	0.833	7	7	0	16	1.000	0.583	0.555	0.555	2375.	2375.	1386.	1319.	1319.
14.00	1.000	6	6	0	16	1.000	0.675	0.658	0.658	2212.	2212.	1493.	1456.	1456.
15.00	0.750	6	6	0	16	1.000	0.525	0.518	0.518	1851.	1851.	972.	958.	958.
16.00	1.000	3	3	0	16	1.000	0.775	0.748	0.748	1497.	1497.	1160.	1120.	1120.
17.00	0.833	5	5	0	16	1.000	0.667	0.645	0.645	890.	890.	594.	574.	574.
18.00	1.000	2	2	0	0	1.000	0.825	0.793	0.793	579.	579.	477.	459.	459.
19.00	0.500	2	2	0	0	1.000	0.450	0.585	0.585	180.	180.	81.	105.	105.
20.00	0.0	2	2	0	0	1.000	0.0	0.360	0.360	9.	9.	0.	3.	3.

DAILY TOTALS:

20217. 20217. 14712. 13694. 13694.

ALBANY, NY
JUN 8 1979
DAY NUMBER 159

SUNRISE = 4.38 SUNSET = 19.43 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.05 HOURS
COLL. RISE = 4.37 COLL. SET = 19.44 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	D	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	130.	130.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	481.	481.	0.	0.	0.	0.	*****			
7.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	983.	983.	0.	1.	1.	0.	*****			
8.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1457.	1457.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1819.	1819.	0.	1.	1.	4.	45370.8	-100.0	-68.2	-68.2
10.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2066.	2066.	0.	1.	1.	47.	4296.3	-100.0	-96.9	-96.9
11.00	1.000	10	5	0	16	1.000	0.625	0.501	0.501	2214.	2214.	1384.	1108.	1108.	1040.	112.9	33.1	6.6	6.6
12.00	1.000	10	6	0	16	1.000	0.725	0.500	0.500	2277.	2277.	1651.	1139.	1139.	1414.	61.0	16.7	-19.4	-19.4
13.00	1.000	10	6	0	16	1.000	0.760	0.500	0.500	2260.	2260.	1582.	1131.	1131.	1786.	26.5	-11.4	-36.7	-36.7
14.00	1.000	10	5	0	16	1.000	0.725	0.500	0.500	2162.	2162.	1568.	1082.	1082.	798.	171.0	96.5	35.6	35.6
15.00	0.917	10	5	0	16	1.000	0.687	0.413	0.413	1976.	1976.	1358.	816.	816.	1259.	56.9	7.9	-35.2	-35.2
16.00	0.667	9	8	0	16	1.000	0.450	0.323	0.323	1741.	1741.	784.	562.	562.	364.	378.3	115.3	54.5	54.5
17.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	1288.	1288.	0.	30.	30.	25.	5050.7	-100.0	19.1	19.1
18.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	789.	789.	0.	1.	1.	2.	39325.0	-100.0	-72.4	-72.4
19.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	325.	325.	0.	0.	0.	3.	10748.8	-100.0	-92.4	-92.4
20.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	40.	40.	0.	0.	0.	1.	3861.4	-100.0	-97.2	-97.2
DAILY TOTALS:										22006.	22006.	8326.	5874.	5874.	6743.	226.4	23.5	-12.9	-12.9

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUF1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	9.	9.	0.	0.	0.	0.
6.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	100.	100.	0.	0.	0.	0.
7.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	370.	370.	0.	0.	0.	0.
8.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	769.	769.	0.	1.	1.	1.
9.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1255.	1255.	0.	1.	1.	1.
10.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1674.	1674.	0.	1.	1.	1.
11.00	1.000	10	5	0	16	1.000	0.625	0.501	0.501	1979.	1979.	1237.	991.	991.	991.
12.00	1.000	10	6	0	16	1.000	0.725	0.500	0.500	2128.	2128.	1543.	1065.	1065.	1065.
13.00	1.000	10	6	0	16	1.000	0.700	0.500	0.500	2102.	2102.	1472.	1052.	1052.	1052.
14.00	1.000	10	5	0	16	1.000	0.725	0.500	0.500	1904.	1904.	1381.	953.	953.	953.
15.00	0.917	10	5	0	16	1.000	0.687	0.413	0.413	1560.	1560.	1072.	644.	644.	644.
16.00	0.667	9	8	0	16	1.000	0.450	0.323	0.323	1154.	1154.	519.	373.	373.	373.
17.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	658.	658.	0.	15.	15.	15.
18.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	271.	271.	0.	0.	0.	0.
19.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	57.	57.	0.	0.	0.	0.
20.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2.	2.	0.	0.	0.	0.
DAILY TOTALS:										16013.	16013.	7224.	5095.	5095.	5095.

ALBANY, NY
JUN 3 1979
DAY NUMBER 160

SUNRISE = 4.37 SUNSET = 19.44 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.06 HOURS
COLL. RISE = 4.36 COLL. SET = 19.45 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			

5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	181.	181.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	421.	421.	0.	0.	0.	0.	*****			
7.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	888.	888.	0.	1.	1.	0.	*****			
8.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1361.	1361.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2035.	2035.	0.	1.	1.	0.	*****			
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2316.	2316.	0.	2.	2.	0.	*****			
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2470.	2470.	0.	2.	2.	0.	*****			
12.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2253.	2253.	0.	2.	2.	0.	*****			
13.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2221.	2221.	0.	2.	2.	1.	*****	-100.0	55.5	55.5
14.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2134.	2134.	0.	1.	1.	1.	*****	-100.0	49.4	49.4
15.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1958.	1958.	0.	1.	1.	228.	758.9	-100.0	-99.4	-99.4
16.00	0.0	9	9	0	16	1.000	0.0	0.023	0.023	1737.	1737.	0.	40.	40.	306.	467.5	-100.0	-86.9	-86.9
17.00	0.0	9	9	0	16	1.000	0.0	0.046	0.046	1348.	1348.	0.	62.	62.	111.	1114.6	-100.0	-44.6	-44.6
18.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	809.	809.	0.	19.	19.	94.	761.0	-100.0	-80.1	-80.1
19.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	341.	341.	0.	0.	0.	49.	596.7	-100.0	-99.5	-99.5
20.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	43.	43.	0.	0.	0.	2.	2058.5	-100.0	-98.5	-98.5
DAILY TOTALS:										22516.	22516.	0.	134.	134.	792.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	13.	13.	0.	0.	0.	0.
6.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	87.	87.	0.	0.	0.	0.
7.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	335.	335.	0.	0.	0.	0.
8.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	739.	739.	0.	1.	1.	1.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1406.	1406.	0.	1.	1.	1.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1877.	1877.	0.	1.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2208.	2208.	0.	2.	2.	2.
12.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2107.	2107.	0.	1.	1.	1.
13.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2067.	2067.	0.	1.	1.	1.
14.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1881.	1881.	0.	1.	1.	1.
15.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	1548.	1548.	0.	1.	1.	1.
16.00	0.0	9	9	0	16	1.000	0.0	0.023	0.023	1153.	1153.	0.	27.	27.	27.
17.00	0.0	9	9	0	16	1.000	0.0	0.046	0.046	690.	690.	0.	31.	31.	31.
18.00	0.0	10	10	0	16	1.000	0.0	0.023	0.023	280.	280.	0.	6.	6.	6.
19.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	60.	60.	0.	0.	0.	0.
20.00	0.0	10	10	0	16	1.000	0.0	0.001	0.001	2.	2.	0.	0.	0.	0.
DAILY TOTALS:										16452.	16452.	0.	75.	75.	75.

ALBANY, NY
JUN 11 1979
DAY NUMBER 162

SUNRISE = 4.37 SUNSET = 19.46 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.09 HOURS
COLL. RISE = 4.36 COLL. SET = 19.47 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				

5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	179.	179.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	625.	625.	0.	0.	0.	0.	*****			
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1206.	1206.	0.	1.	1.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1729.	1729.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2122.	2122.	0.	1.	1.	0.	*****			
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2392.	2392.	0.	2.	2.	1.	*****	-100.0	67.4	67.4
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2564.	2564.	0.	2.	2.	1.	*****	-100.0	79.5	79.5
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2652.	2652.	0.	2.	2.	2.	*****	-100.0	-7.2	-7.2
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2668.	2668.	0.	2.	2.	1.	*****	-100.0	86.7	86.7
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2610.	2610.	0.	2.	2.	0.	*****			
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2471.	2471.	0.	2.	2.	0.	*****			
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2234.	2234.	0.	2.	2.	0.	*****			
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1870.	1870.	0.	1.	1.	1.	*****	-100.0	30.9	30.9
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1361.	1361.	0.	1.	1.	2.	67937.5	-100.0	-52.4	-52.4
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	765.	765.	0.	1.	1.	0.	*****			
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	137.	137.	0.	0.	0.	21.	553.8	-100.0	-99.5	-99.5
DAILY TOTALS:										27583.	27583.	0.	19.	19.	29.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	13.	13.	0.	0.	0.	
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	129.	129.	0.	0.	0.	
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	454.	454.	0.	0.	0.	
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	937.	937.	0.	1.	1.	
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1464.	1464.	0.	1.	1.	
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1939.	1939.	0.	1.	1.	
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2294.	2294.	0.	2.	2.	
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2482.	2482.	0.	2.	2.	
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2486.	2486.	0.	2.	2.	
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2304.	2304.	0.	2.	2.	
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1957.	1957.	0.	1.	1.	
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1486.	1486.	0.	1.	1.	
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	959.	959.	0.	1.	1.	
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	470.	470.	0.	0.	0.	
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	133.	133.	0.	0.	0.	
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	7.	7.	0.	0.	0.	
DAILY TOTALS:										19515.	19515.	0.	14.	14.	

ALBANY, NY
JUN 12 1979
DAY NUMBER 163

SUNRISE = 4.37 SUNSET = 19.46 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.10 HOURS
COLL. RISE = 4.35 COLL. SET = 19.48 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	C	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
5.00	0.0	4	4	0	0	1.000	0.0	0.270	0.270	690.	690.	0.	186.	186.	5.	13700.3	-100.0	3630.0	3630.0
6.00	0.550	3	3	0	0	1.000	0.454	0.540	0.540	1658.	1658.	753.	896.	896.	1488.	11.5	-49.4	-39.8	-39.8
7.00	0.983	5	5	0	0	1.000	0.787	0.713	0.713	2193.	2193.	1725.	1563.	1563.	1444.	51.9	19.5	8.3	8.3
8.00	0.983	5	5	0	0	1.000	0.737	0.668	0.668	2657.	2657.	1959.	1774.	1774.	2611.	1.8	-25.0	-32.0	-32.0
9.00	0.700	8	9	0	0	1.000	0.455	0.473	0.473	2817.	2817.	1282.	1332.	1332.	2088.	34.9	-38.6	-36.2	-36.2
10.00	0.633	9	9	0	0	1.000	0.349	0.353	0.353	2965.	2965.	1033.	1047.	1047.	1342.	120.9	-23.0	-22.0	-22.0
11.00	0.483	8	8	0	0	1.000	0.278	0.236	0.286	3125.	3125.	869.	893.	893.	2089.	49.6	-58.4	-57.3	-57.3
12.00	0.933	7	7	0	0	1.000	0.583	0.533	0.533	3222.	3222.	1880.	1718.	1718.	1561.	106.4	20.5	10.0	10.0
13.00	0.650	7	7	0	0	1.000	0.423	0.428	0.428	3215.	3215.	1359.	1376.	1376.	394.	715.9	244.8	249.2	249.2
14.00	0.417	8	8	0	0	1.000	0.250	0.301	0.301	3096.	3096.	907.	930.	930.	112.	2664.5	620.1	730.8	730.8
15.00	1.000	8	8	0	0	1.000	0.600	0.591	0.591	2944.	2944.	1767.	1739.	1739.	248.	1087.1	612.5	601.0	601.0
16.00	0.133	7	7	0	0	1.000	0.083	0.173	0.173	2753.	2753.	229.	476.	476.	1577.	74.5	-85.5	-69.8	-69.8
17.00	1.000	7	7	0	0	1.000	0.650	0.635	0.635	2387.	2387.	1552.	1517.	1517.	1664.	43.5	-6.7	-8.8	-8.8
18.00	0.533	7	7	0	0	1.000	0.347	0.375	0.375	1847.	1847.	640.	694.	694.	1137.	62.5	-43.7	-39.0	-39.0
19.00	0.383	3	3	0	0	1.000	0.287	0.398	0.398	1398.	1398.	402.	556.	556.	1569.	-10.9	-74.4	-64.5	-64.5
20.00	1.000	2	2	0	0	1.000	0.875	0.838	0.838	323.	323.	283.	271.	271.	160.	102.2	76.9	69.3	69.3
DAILY TOTALS:										37291.	37291.	16541.	16969.	16969.	19489.	91.3	-15.1	-12.9	-12.9

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	4	4	0	0	1.000	0.0	0.270	0.270	47.	47.	0.	13.	13.	
6.00	0.550	3	3	0	0	1.000	0.454	0.540	0.540	333.	333.	151.	180.	180.	
7.00	0.983	5	5	0	0	1.000	0.787	0.713	0.713	818.	818.	643.	583.	583.	
8.00	0.933	5	5	0	0	1.000	0.737	0.669	0.669	1426.	1426.	1059.	959.	959.	
9.00	0.700	8	9	0	0	1.000	0.455	0.473	0.473	1942.	1942.	884.	913.	913.	
10.00	0.633	9	9	0	0	1.000	0.349	0.353	0.353	2403.	2403.	837.	849.	849.	
11.00	0.483	8	8	0	0	1.000	0.278	0.286	0.286	2797.	2797.	778.	799.	799.	
12.00	0.933	7	7	0	0	1.000	0.583	0.533	0.533	3017.	3017.	1761.	1608.	1608.	
13.00	0.650	7	7	0	0	1.000	0.423	0.428	0.428	2998.	2998.	1267.	1283.	1283.	
14.00	0.417	8	8	0	0	1.000	0.260	0.301	0.301	2735.	2735.	712.	822.	822.	
15.00	1.000	8	8	0	0	1.000	0.600	0.591	0.591	2333.	2333.	1400.	1378.	1378.	
16.00	0.133	7	7	0	0	1.000	0.083	0.173	0.173	1833.	1833.	153.	317.	317.	
17.00	1.000	7	7	0	0	1.000	0.650	0.635	0.635	1225.	1225.	796.	778.	778.	
18.00	0.533	7	7	0	0	1.000	0.347	0.375	0.375	637.	637.	221.	239.	239.	
19.00	0.383	3	3	0	0	1.000	0.287	0.398	0.398	239.	239.	69.	95.	95.	
20.00	1.000	2	2	0	0	1.000	0.875	0.838	0.838	16.	16.	14.	14.	14.	
DAILY TOTALS:										24808.	24808.	10745.	10834.	10834.	

ALBANY, NY
JUN 13 1979
DAY NUMBER 164

SUNRISE = 4.36 SUNSET = 19.47 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.11 HOURS
COLL. RISE = 4.36 COLL. SET = 19.49 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2		TAUP3	TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
5.00	0.0	0	0	0	0	1.000	0.0	0.450	0.450	844.	844.	0.	380.	380.	79.	967.7	-100.0	380.5	380.5
6.00	0.950	0	0	0	0	1.000	0.950	0.877	0.877	1838.	1838.	1746.	1613.	1613.	1856.	-1.0	-5.9	-13.1	-13.1
7.00	1.000	1	1	1	0	1.000	0.970	0.943	0.943	2415.	2415.	2343.	2277.	2277.	2593.	-6.8	-9.6	-12.2	-12.2
8.00	0.983	0	0	0	0	1.000	0.954	0.885	0.885	2929.	2929.	2794.	2593.	2593.	2919.	0.4	-4.3	-11.2	-11.2
9.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3221.	3221.	3221.	3060.	3060.	3149.	2.3	2.3	-2.8	-2.8
10.00	1.000	2	2	0	0	1.000	0.950	0.905	0.905	3293.	3293.	3128.	2980.	2980.	3329.	-1.1	-6.0	-10.5	-10.5
11.00	0.917	6	6	0	0	1.000	0.733	0.683	0.683	3200.	3200.	2347.	2185.	2185.	2255.	41.9	4.1	-3.1	-3.1
12.00	0.800	9	9	0	0	1.000	0.500	0.473	0.473	3102.	3102.	1551.	1467.	1467.	1755.	76.7	-11.6	-16.4	-16.4
13.00	0.150	9	9	0	0	1.000	0.083	0.113	0.113	3080.	3080.	254.	348.	348.	377.	716.9	-32.6	-7.6	-7.6
14.00	0.663	8	8	0	0	1.000	0.393	0.376	0.376	3050.	3050.	1199.	1145.	1145.	1133.	169.2	5.8	1.1	1.1
15.00	1.000	7	7	0	0	1.000	0.625	0.613	0.613	2955.	2955.	1847.	1812.	1812.	1807.	63.5	2.2	0.3	0.3
16.00	1.000	4	4	0	0	1.000	0.725	0.703	0.703	2883.	2883.	2091.	2027.	2027.	2120.	36.0	-1.4	-4.4	-4.4
17.00	1.000	2	2	0	0	1.000	0.850	0.815	0.815	2673.	2673.	2272.	2179.	2179.	2726.	-2.0	-16.7	-20.1	-20.1
18.00	1.000	1	1	0	0	1.000	0.925	0.883	0.883	2243.	2243.	2075.	1980.	1980.	2298.	-2.4	-9.7	-13.9	-13.9
19.00	0.217	2	2	0	0	1.000	0.200	0.480	0.480	1476.	1476.	296.	708.	708.	1351.	9.2	-78.1	-47.6	-47.6
20.00	1.000	1	1	0	0	1.000	0.925	0.883	0.883	339.	339.	314.	299.	299.	187.	81.3	67.7	60.0	60.0
DAILY TOTALS:										39540.	39540.	27477.	27052.	27052.	29934.	32.1	-8.2	-9.6	-9.6

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	0	0	0	0	1.000	0.0	0.450	0.450	57.	57.	0.	26.	26.	
6.00	0.950	0	0	0	0	1.000	0.950	0.877	0.877	367.	367.	349.	322.	322.	
7.00	1.000	1	1	1	0	1.000	0.970	0.943	0.943	900.	900.	873.	848.	848.	
8.00	0.983	0	0	0	0	1.000	0.954	0.835	0.885	1582.	1582.	1509.	1400.	1400.	
9.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	2221.	2221.	2221.	2110.	2110.	
10.00	1.000	2	2	0	0	1.000	0.950	0.905	0.905	2668.	2668.	2535.	2415.	2415.	
11.00	0.917	6	6	0	0	1.000	0.733	0.683	0.683	2863.	2863.	2100.	1955.	1955.	
12.00	0.800	9	9	0	0	1.000	0.500	0.473	0.473	2905.	2905.	1453.	1374.	1374.	
13.00	0.150	9	9	0	0	1.000	0.083	0.113	0.113	2873.	2873.	237.	325.	325.	
14.00	0.683	8	8	0	0	1.000	0.393	0.376	0.376	2696.	2696.	1060.	1012.	1012.	
15.00	1.000	7	7	0	0	1.000	0.625	0.613	0.613	2344.	2344.	1465.	1437.	1437.	
16.00	1.000	4	4	0	0	1.000	0.725	0.703	0.703	1922.	1922.	1393.	1351.	1351.	
17.00	1.000	2	2	0	0	1.000	0.850	0.815	0.815	1372.	1372.	1167.	1119.	1119.	
18.00	1.000	1	1	0	0	1.000	0.925	0.883	0.883	773.	773.	715.	682.	682.	
19.00	0.217	2	2	0	0	1.000	0.200	0.480	0.480	256.	256.	51.	123.	123.	
20.00	1.000	1	1	0	0	1.000	0.925	0.883	0.883	18.	18.	16.	15.	15.	
DAILY TOTALS:										25818.	25818.	17145.	16516.	16516.	

ALBANY, NY
JUN 14 1979
DAY NUMBER 165

SUNRISE = 4.36 SUNSET = 19.48 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.12 HOURS
CCLL. RISE = 4.36 COLL. SET = 19.49 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	781.	781.	781.	742.	781.	436.	79.1	79.1	70.2	79.1
6.00	1.000	1	0	1	0	1.000	0.995	0.942	0.995	1668.	1668.	1659.	1572.	1659.	1843.	-9.5	-10.0	-14.7	-10.0
7.00	1.000	2	0	2	0	1.000	0.985	0.927	0.985	2256.	2256.	2222.	2092.	2222.	2468.	-8.6	-10.0	-15.2	-10.0
8.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	2727.	2727.	2673.	2509.	2673.	2860.	-4.6	-6.5	-12.3	-6.5
9.00	1.000	1	0	1	0	1.000	0.985	0.927	0.985	3099.	3099.	3052.	2874.	3052.	3104.	-0.2	-1.7	-7.4	-1.7
10.00	1.000	0	0	0	0	1.000	0.995	0.942	0.995	3350.	3350.	3334.	3158.	3334.	3230.	3.7	3.2	-2.2	3.2
11.00	1.000	3	1	3	0	1.000	0.960	0.928	0.985	3313.	3313.	3180.	3073.	3263.	3287.	0.8	-3.2	-6.5	-0.7
12.00	1.000	3	1	3	0	1.000	0.920	0.905	0.970	3352.	3352.	3084.	3034.	3252.	3296.	1.7	-6.4	-8.0	-1.3
13.00	1.000	3	1	0	0	1.000	0.935	0.860	0.985	3350.	3350.	3132.	2881.	3299.	3291.	1.8	-4.8	-12.5	0.3
14.00	1.000	5	2	0	0	1.000	0.925	0.770	1.000	3192.	3192.	2953.	2458.	3192.	3128.	2.0	-5.6	-21.4	2.0
15.00	0.933	7	3	7	0	1.000	0.784	0.705	0.807	2950.	2950.	2313.	2080.	2382.	2826.	4.4	-18.2	-26.4	-15.7
16.00	1.000	2	0	2	0	1.000	0.880	0.883	0.955	2986.	2986.	2627.	2635.	2851.	2707.	10.3	-2.9	-2.7	5.3
17.00	1.000	6	2	6	0	1.000	0.910	0.890	0.960	2430.	2430.	2211.	2163.	2333.	2285.	6.3	-3.2	-5.3	2.1
18.00	1.000	4	1	2	0	1.000	0.885	0.845	0.960	2010.	2010.	1779.	1699.	1930.	1732.	16.1	2.7	-1.9	11.4
19.00	1.000	2	1	1	0	1.000	0.935	0.860	0.985	1466.	1466.	1371.	1267.	1444.	1426.	2.8	-3.9	-11.6	1.3
20.00	1.000	1	0	1	0	1.000	0.965	0.913	0.990	344.	344.	332.	314.	341.	147.	134.2	126.0	113.7	131.9
DAILY TOTALS:										39274.	39274.	36704.	34546.	38008.	38066.	3.2	-3.6	-9.2	-0.2

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]										[KJ/SQ.M]			
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	53.	53.	53.	50.	53.	
6.00	1.000	1	0	1	0	1.000	0.995	0.942	0.995	334.	334.	332.	315.	332.	
7.00	1.000	2	0	2	0	1.000	0.985	0.927	0.985	841.	841.	829.	780.	829.	
8.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	1473.	1473.	1444.	1355.	1444.	
9.00	1.000	1	0	1	0	1.000	0.985	0.927	0.985	2137.	2137.	2105.	1982.	2105.	
10.00	1.000	0	0	0	0	1.000	0.995	0.942	0.995	2716.	2716.	2702.	2560.	2702.	
11.00	1.000	3	1	3	0	1.000	0.960	0.928	0.985	2965.	2965.	2846.	2750.	2929.	
12.00	1.000	3	1	3	0	1.000	0.920	0.905	0.970	3141.	3141.	2889.	2842.	3045.	
13.00	1.000	3	1	0	0	1.000	0.935	0.860	0.985	3126.	3126.	2923.	2689.	3079.	
14.00	1.000	5	2	0	0	1.000	0.925	0.770	1.000	2824.	2824.	2612.	2175.	2824.	
15.00	0.933	7	3	7	0	1.000	0.784	0.705	0.807	2343.	2343.	1837.	1652.	1891.	
16.00	1.000	2	0	2	0	1.000	0.880	0.883	0.955	1992.	1992.	1753.	1758.	1902.	
17.00	1.000	6	2	6	0	1.000	0.910	0.890	0.960	1254.	1254.	1141.	1116.	1204.	
18.00	1.000	4	1	2	0	1.000	0.885	0.845	0.960	696.	696.	616.	588.	663.	
19.00	1.000	2	1	1	0	1.000	0.935	0.860	0.985	254.	254.	238.	219.	251.	
20.00	1.000	1	0	1	0	1.000	0.965	0.913	0.990	18.	18.	18.	17.	13.	
DAILY TOTALS:										26166.	26166.	24337.	22847.	25263.	

ALBANY, NY
JUN 15 1979
DAY NUMBER 166

SUNRISE = 4.36 SUNSET = 19.49 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.12 HOURS
COLL. RISE = 4.36 COLL. SET = 19.51 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	10	4	0	0	1.000	0.0	0.000	0.000	296.	296.	0.	0.	0.	8.	3601.4	-100.0	-99.0	-99.0
6.00	0.250	10	4	0	0	1.000	0.200	0.113	0.113	870.	870.	174.	98.	98.	294.	195.9	-40.8	-66.6	-66.6
7.00	1.000	4	2	0	0	1.000	0.850	0.635	0.635	1846.	1846.	1569.	1172.	1172.	678.	172.2	131.4	72.9	72.9
8.00	1.000	4	3	0	0	1.000	0.875	0.770	0.770	2379.	2379.	2082.	1832.	1832.	1392.	70.9	49.5	31.6	31.6
9.00	0.833	7	7	0	0	1.000	0.625	0.578	0.578	2548.	2548.	1592.	1472.	1472.	558.	356.6	185.4	163.8	163.8
10.00	1.000	0	0	0	0	1.000	0.825	0.793	0.793	3149.	3149.	2598.	2497.	2497.	1763.	78.6	47.4	41.6	41.6
11.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	3300.	3300.	3300.	3135.	3135.	2079.	58.7	58.7	50.8	50.8
12.00	1.000	1	1	0	0	1.000	0.975	0.928	0.928	3314.	3314.	3231.	3074.	3074.	2043.	62.2	58.2	50.5	50.5
13.00	0.957	4	4	0	0	1.000	0.846	0.773	0.773	3126.	3126.	2644.	2416.	2416.	1370.	128.2	93.0	76.3	76.3
14.00	0.650	6	6	0	0	1.000	0.487	0.518	0.518	2935.	2935.	1431.	1520.	1520.	1298.	126.1	10.2	17.1	17.1
15.00	1.000	3	3	0	0	1.000	0.775	0.748	0.748	2941.	2941.	2279.	2199.	2199.	1550.	89.7	47.0	41.9	41.9
16.00	1.000	1	1	0	0	1.000	0.900	0.860	0.860	2846.	2846.	2562.	2448.	2448.	1546.	84.1	65.7	58.4	58.4
17.00	1.000	3	2	0	0	1.000	0.925	0.860	0.860	2367.	2367.	2189.	2036.	2036.	1272.	86.1	72.1	60.0	60.0
18.00	0.433	3	2	0	0	1.000	0.390	0.510	0.510	1821.	1821.	710.	929.	929.	875.	108.1	-18.8	6.2	6.2
19.00	0.0	2	2	0	0	1.000	0.0	0.338	0.338	1203.	1203.	0.	406.	406.	375.	220.8	-100.0	8.3	8.3
20.00	0.0	3	2	0	0	1.000	0.0	0.338	0.338	232.	232.	0.	78.	78.	26.	793.1	-100.0	201.6	201.6
DAILY TOTALS:										35173.	35173.	26362.	25313.	25313.	17127.	105.4	53.9	47.8	47.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX						
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						

5.00	0.0	10	4	0	0	1.000	0.0	0.000	0.000	21.	21.	0.	0.	0.		
6.00	0.250	10	4	0	0	1.000	0.200	0.113	0.113	178.	178.	36.	20.	20.		
7.00	1.000	4	2	0	0	1.000	0.850	0.635	0.635	693.	693.	589.	440.	440.		
8.00	1.000	4	3	0	0	1.000	0.875	0.770	0.770	1285.	1286.	1125.	990.	990.		
9.00	0.833	7	7	0	0	1.000	0.625	0.578	0.578	1756.	1756.	1098.	1015.	1015.		
10.00	1.000	0	0	0	0	1.000	0.825	0.793	0.793	2555.	2555.	2108.	2025.	2025.		
11.00	1.000	0	0	0	0	1.000	1.000	0.950	0.950	2954.	2954.	2954.	2806.	2806.		
12.00	1.000	1	1	0	0	1.000	0.975	0.928	0.928	3106.	3106.	3028.	2881.	2881.		
13.00	0.967	4	4	0	0	1.000	0.846	0.773	0.773	2919.	2919.	2469.	2256.	2256.		
14.00	0.650	6	6	0	0	1.000	0.487	0.518	0.518	2598.	2598.	1266.	1345.	1345.		
15.00	1.000	3	3	0	0	1.000	0.775	0.748	0.748	2336.	2336.	1811.	1747.	1747.		
16.00	1.000	1	1	0	0	1.000	0.900	0.860	0.860	1903.	1903.	1712.	1636.	1636.		
17.00	1.000	3	2	0	0	1.000	0.925	0.860	0.860	1223.	1223.	1131.	1052.	1052.		
18.00	0.433	3	2	0	0	1.000	0.390	0.510	0.510	634.	634.	247.	324.	324.		
19.00	0.0	2	2	0	0	1.000	0.0	0.338	0.338	212.	212.	0.	72.	72.		
20.00	0.0	3	2	0	0	1.000	0.0	0.338	0.338	13.	13.	0.	4.	4.		
DAILY TOTALS:										24386.	24386.	19574.	18613.	18613.		

ALBANY, NY
JUN 16 1979
DAY NUMBER 167

SUNRISE = 4.36 SUNSET = 19.49 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.13 HOURS
COLL. RISE = 4.36 COLL. SET = 19.51 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
5.00	0.0	3	3	0	0	1.000	0.0	0.315	0.315	489.	489.	0.	154.	154.	46.	964.0	-100.0	235.4	235.4
6.00	1.000	1	1	0	16	1.000	0.900	0.860	0.860	1059.	1059.	953.	911.	911.	530.	99.8	79.9	71.9	71.9
7.00	1.000	1	1	0	16	1.000	0.950	0.905	0.905	1689.	1689.	1604.	1528.	1528.	1333.	26.7	20.3	14.7	14.7
8.00	1.000	1	1	0	16	1.000	0.950	0.905	0.905	2198.	2198.	2088.	1989.	1989.	1797.	22.3	16.2	10.7	10.7
9.00	1.000	2	2	0	16	1.000	0.925	0.883	0.883	2481.	2481.	2294.	2189.	2189.	2113.	17.4	8.6	3.6	3.6
10.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	2706.	2706.	2436.	2328.	2328.	2109.	28.3	15.5	10.4	10.4
11.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	2843.	2843.	2559.	2446.	2446.	1676.	69.6	52.7	45.9	45.9
12.00	1.000	3	3	0	0	1.000	0.875	0.838	0.838	3118.	3118.	2729.	2612.	2612.	1957.	59.3	39.4	33.5	33.5
13.00	0.800	5	5	0	0	1.000	0.640	0.630	0.630	3026.	3026.	1937.	1907.	1907.	2066.	46.5	-6.3	-7.7	-7.7
14.00	0.817	3	3	0	0	1.000	0.653	0.638	0.638	3050.	3050.	1993.	1945.	1945.	1475.	106.8	35.1	31.9	31.9
15.00	0.633	0	0	0	0	1.000	0.586	0.668	0.668	3096.	3096.	1813.	2067.	2067.	1907.	62.3	-4.9	8.4	8.4
16.00	1.000	3	2	0	0	1.000	0.950	0.883	0.883	2693.	2693.	2559.	2377.	2377.	1617.	66.6	58.2	47.0	47.0
17.00	1.000	4	2	0	0	1.000	0.900	0.793	0.793	2242.	2242.	2018.	1777.	1777.	1319.	70.0	53.0	34.7	34.7
18.00	1.000	2	2	2	0	1.000	0.890	0.845	0.845	1838.	1838.	1636.	1554.	1554.	789.	133.0	107.4	96.9	96.9
19.00	1.000	2	2	2	0	1.000	0.880	0.920	0.920	1166.	1166.	1026.	1073.	1073.	384.	203.6	167.2	179.4	179.4
20.00	1.000	1	1	1	0	1.000	0.910	0.928	0.928	251.	251.	228.	232.	232.	34.	637.1	570.7	583.7	583.7

DAILY TOTALS: 33945. 33945. 27872. 27090. 27090. 21152. 60.5 31.8 28.1 28.1

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	3	3	0	0	1.000	0.0	0.315	0.315	34.	34.	0.	11.	11.	
6.00	1.000	1	1	0	16	1.000	0.900	0.860	0.860	214.	214.	193.	184.	184.	
7.00	1.000	1	1	0	16	1.000	0.950	0.905	0.905	632.	632.	601.	572.	572.	
8.00	1.000	1	1	0	16	1.000	0.950	0.905	0.905	1188.	1188.	1129.	1075.	1075.	
9.00	1.000	2	2	0	16	1.000	0.925	0.883	0.883	1710.	1710.	1582.	1509.	1509.	
10.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	2194.	2194.	1974.	1887.	1887.	
11.00	1.000	2	2	0	16	1.000	0.900	0.860	0.860	2545.	2545.	2291.	2189.	2189.	
12.00	1.000	3	3	0	0	1.000	0.875	0.838	0.838	2923.	2923.	2558.	2449.	2449.	
13.00	0.800	5	5	0	0	1.000	0.640	0.630	0.630	2827.	2827.	1809.	1782.	1782.	
14.00	0.817	3	3	0	0	1.000	0.653	0.638	0.638	2701.	2701.	1764.	1722.	1722.	
15.00	0.633	0	0	0	0	1.000	0.586	0.668	0.668	2461.	2461.	1442.	1643.	1643.	
16.00	1.000	3	2	0	0	1.000	0.950	0.883	0.883	1805.	1805.	1714.	1593.	1593.	
17.00	1.000	4	2	0	0	1.000	0.900	0.793	0.793	1161.	1161.	1044.	920.	920.	
18.00	1.000	2	2	2	0	1.000	0.890	0.845	0.845	641.	641.	571.	542.	542.	
19.00	1.000	2	2	2	0	1.000	0.880	0.920	0.920	208.	208.	183.	191.	191.	
20.00	1.000	1	1	1	0	1.000	0.910	0.928	0.928	14.	14.	13.	13.	13.	

DAILY TOTALS: 23256. 23256. 18866. 18281. 18281.

ALBANY, NY
JUN 17 1979
DAY NUMBER 168

SUNRISE = 4.36 SUNSET = 19.50 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.36 COLL. SET = 19.51 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
5.00	0.0	7	6	2	16	1.000	0.0	0.195	0.195	194.	194.	0.	38.	38.	24.	708.1	-100.0	57.9	57.9
6.00	0.183	7	7	2	16	1.000	0.120	0.278	0.278	647.	647.	78.	180.	180.	309.	109.3	-74.9	-41.8	-41.8
7.00	0.317	8	4	4	16	1.000	0.220	0.345	0.345	1162.	1162.	256.	401.	401.	492.	136.2	-48.0	-18.4	-18.4
8.00	1.000	7	3	4	16	1.000	0.785	0.733	0.733	1718.	1718.	1349.	1259.	1259.	880.	95.2	53.3	43.1	43.1
9.00	0.700	5	5	0	16	1.000	0.546	0.555	0.555	2220.	2220.	1212.	1233.	1233.	938.	136.6	29.2	31.4	31.4
10.00	0.417	10	9	0	16	1.000	0.271	0.300	0.300	2199.	2199.	596.	661.	661.	702.	213.3	-15.1	-5.9	-5.9
11.00	0.100	10	10	0	16	1.000	0.053	0.046	0.046	2332.	2332.	123.	106.	106.	28.	8228.5	337.5	280.3	280.3
12.00	0.250	9	9	0	16	1.000	0.131	0.136	0.136	2457.	2457.	323.	333.	333.	1034.	137.6	-68.8	-67.8	-67.8
13.00	1.000	6	6	0	16	1.000	0.625	0.613	0.613	2621.	2621.	1639.	1607.	1607.	1898.	38.1	-13.7	-15.4	-15.4
14.00	0.700	10	9	0	16	1.000	0.438	0.406	0.406	2340.	2340.	1024.	949.	949.	327.	615.7	213.2	190.2	190.2
15.00	0.983	6	6	0	16	1.000	0.615	0.533	0.533	2375.	2375.	1460.	1266.	1266.	1913.	24.2	-23.7	-33.8	-33.8
16.00	0.967	6	5	0	16	1.000	0.701	0.615	0.615	2133.	2133.	1495.	1312.	1312.	1554.	37.2	-3.8	-15.6	-15.6
17.00	0.517	9	9	0	16	1.000	0.401	0.390	0.390	1567.	1567.	628.	612.	612.	202.	676.0	211.1	203.0	203.0
18.00	0.150	10	5	0	0	1.000	0.098	0.090	0.090	1303.	1303.	127.	118.	118.	89.	1364.4	42.8	32.5	32.5
19.00	0.0	10	5	0	0	1.000	0.0	0.000	0.000	720.	720.	0.	0.	0.	142.	406.9	-100.0	-99.8	-99.8
20.00	0.0	9	9	0	0	1.000	0.0	0.023	0.023	179.	179.	0.	4.	4.	7.	2459.0	-100.0	-41.2	-41.2
DAILY TOTALS:										26168.	26168.	10308.	10080.	10080.	10539.	148.3	-2.2	-4.4	-4.4

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	0.0	7	6	2	16	1.000	0.0	0.195	0.195	14.	14.	0.	3.	3.	
6.00	0.183	7	7	2	16	1.000	0.120	0.278	0.278	133.	133.	16.	37.	37.	
7.00	0.317	8	4	4	16	1.000	0.220	0.345	0.345	437.	437.	96.	151.	151.	
8.00	1.000	7	3	4	16	1.000	0.785	0.733	0.733	930.	930.	730.	682.	682.	
9.00	0.700	5	5	0	16	1.000	0.546	0.555	0.555	1532.	1532.	836.	850.	850.	
10.00	0.417	10	9	0	16	1.000	0.271	0.300	0.300	1782.	1782.	483.	535.	535.	
11.00	0.100	10	10	0	16	1.000	0.053	0.046	0.046	2088.	2088.	110.	95.	95.	
12.00	0.250	9	9	0	16	1.000	0.131	0.136	0.136	2303.	2303.	302.	312.	312.	
13.00	1.000	6	6	0	16	1.000	0.625	0.613	0.613	2449.	2449.	1531.	1501.	1501.	
14.00	0.700	10	9	0	16	1.000	0.438	0.406	0.406	2075.	2075.	908.	841.	841.	
15.00	0.983	6	6	0	16	1.000	0.615	0.533	0.533	1890.	1890.	1162.	1008.	1008.	
16.00	0.967	6	5	0	16	1.000	0.701	0.615	0.615	1431.	1431.	1003.	880.	880.	
17.00	0.617	9	9	0	16	1.000	0.401	0.390	0.390	816.	816.	327.	319.	319.	
18.00	0.150	10	5	0	0	1.000	0.098	0.090	0.090	457.	457.	45.	41.	41.	
19.00	0.0	10	5	0	0	1.000	0.0	0.000	0.000	131.	131.	0.	0.	0.	
20.00	0.0	9	9	0	0	1.000	0.0	0.023	0.023	8.	8.	0.	0.	0.	
DAILY TOTALS:										18474.	18474.	7548.	7256.	7256.	

ALBANY, NY
JUN 18 1979
DAY NUMBER 169

SUNRISE = 4.37 SUNSET = 19.51 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.36 COLL. SET = 19.53 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]					[PERCENT]			
5.00	0.394	4	4	0	0	1.000	0.316	0.448	0.448	431.	431.	136.	193.	193.	104.	314.3	30.7	85.5	85.5
6.00	0.250	8	8	0	0	1.000	0.175	0.293	0.293	922.	922.	161.	270.	270.	361.	155.3	-55.3	-25.2	-25.2
7.00	0.083	4	4	0	0	1.000	0.058	0.218	0.218	1785.	1785.	104.	389.	389.	528.	238.0	-80.3	-26.3	-26.3
8.00	1.000	2	2	0	0	1.000	0.850	0.815	0.815	2451.	2451.	2083.	1998.	1998.	1272.	92.7	63.8	57.1	57.1
9.00	1.000	5	2	0	0	1.000	0.900	0.793	0.793	2623.	2623.	2361.	2079.	2079.	1184.	121.5	99.4	75.6	75.6
10.00	0.667	7	7	0	0	1.000	0.517	0.480	0.480	2730.	2730.	1411.	1311.	1311.	576.	374.0	144.9	127.7	127.7
11.00	0.683	10	8	0	0	1.000	0.427	0.376	0.376	2732.	2732.	1167.	1026.	1026.	926.	195.0	26.0	10.8	10.8
12.00	0.267	10	10	0	0	1.000	0.147	0.121	0.121	2774.	2774.	407.	335.	335.	19.	14500.9	2042.6	1661.3	1661.3
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2770.	2770.	0.	2.	2.	55.	4936.6	-100.0	-96.5	-96.5
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2696.	2696.	0.	2.	2.	65.	4048.4	-100.0	-97.1	-97.1
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2541.	2541.	0.	2.	2.	0.	*****			
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2286.	2286.	0.	2.	2.	0.	*****			
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1905.	1905.	0.	1.	1.	0.	*****			
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1376.	1376.	0.	1.	1.	0.	*****			
19.00	0.500	10	10	0	0	1.000	0.250	0.226	0.226	758.	758.	190.	171.	171.	0.	*****			
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	180.	180.	0.	0.	0.	0.	*****			
DAILY TOTALS:										30960.	30960.	8020.	7781.	7781.	5090.	508.3	57.6	52.9	52.9

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	C	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]			
5.00	0.394	4	4	0	0	1.000	0.316	0.448	0.448	30.	30.	9.	13.	13.
6.00	0.250	8	8	0	0	1.000	0.175	0.293	0.293	186.	186.	33.	55.	55.
7.00	0.083	4	4	0	0	1.000	0.058	0.218	0.218	668.	668.	39.	146.	146.
8.00	1.000	2	2	0	0	1.000	0.850	0.815	0.815	1323.	1323.	1125.	1079.	1079.
9.00	1.000	5	2	0	0	1.000	0.900	0.793	0.793	1806.	1806.	1625.	1431.	1431.
10.00	0.667	7	7	0	0	1.000	0.517	0.480	0.480	2212.	2212.	1143.	1062.	1062.
11.00	0.683	10	8	0	0	1.000	0.427	0.376	0.376	2445.	2445.	1044.	918.	918.
12.00	0.267	10	10	0	0	1.000	0.147	0.121	0.121	2601.	2601.	382.	314.	314.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2589.	2589.	0.	2.	2.
14.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2390.	2390.	0.	2.	2.
15.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2025.	2025.	0.	1.	1.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1535.	1535.	0.	1.	1.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	990.	990.	0.	1.	1.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	485.	485.	0.	0.	0.
19.00	0.500	10	10	0	0	1.000	0.250	0.226	0.226	139.	139.	35.	31.	31.
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	8.	8.	0.	0.	0.
DAILY TOTALS:										21432.	21432.	5434.	5056.	5056.

ALBANY, NY
JUN 19 1979
DAY NUMBER 170

SUNRISE = 4.37 SUNSET = 19.51 (STD. TIME) (MICROCLIMATIC OPTION)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.36 COLL. SET = 19.53 (STD. TIME)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	753.	753.	753.	715.	753.	432.	74.2	74.2	65.5	74.2
6.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1701.	1701.	1701.	1616.	1701.	1847.	-7.9	-7.9	-12.5	-7.9
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2367.	2367.	2367.	2249.	2367.	2542.	-6.9	-6.9	-11.5	-6.9
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2835.	2835.	2835.	2693.	2835.	2939.	-3.5	-3.5	-8.4	-3.5
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3139.	3139.	3139.	2982.	3139.	3129.	0.3	0.3	-4.7	0.3
10.00	1.000	1	1	0	0	1.000	0.975	0.928	1.000	3273.	3273.	3192.	3036.	3273.	3255.	0.6	-1.9	-6.7	0.6
11.00	1.000	3	3	0	0	1.000	0.900	0.860	1.000	3281.	3281.	2953.	2823.	3281.	3214.	2.1	-8.1	-12.2	2.1
12.00	0.967	3	3	0	0	1.000	0.822	0.750	0.967	3327.	3327.	2734.	2496.	3216.	2884.	15.4	-5.2	-13.4	11.5
13.00	0.950	3	3	0	0	1.000	0.807	0.743	0.950	3326.	3326.	2686.	2470.	3160.	2737.	21.5	-1.9	-9.7	15.4
14.00	1.000	2	2	0	0	1.000	0.875	0.838	1.000	3316.	3316.	2902.	2778.	3316.	3240.	2.4	-10.4	-14.3	2.4
15.00	1.000	3	3	0	0	1.000	0.875	0.838	1.000	3144.	3144.	2751.	2633.	3144.	3249.	-3.2	-15.3	-18.9	-3.2
16.00	0.600	2	2	0	0	1.000	0.525	0.608	0.600	2983.	2983.	1566.	1812.	1790.	3122.	-4.5	-49.8	-41.9	-42.7
17.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	2723.	2723.	2518.	2403.	2723.	2894.	-5.9	-13.0	-17.0	-5.9
18.00	0.550	1	1	0	0	1.000	0.522	0.653	0.550	2233.	2233.	1167.	1457.	1228.	2469.	-9.6	-52.7	-41.0	-50.3
19.00	0.817	1	1	0	0	1.000	0.776	0.773	0.817	1547.	1547.	1200.	1195.	1263.	1653.	-6.4	-27.4	-27.7	-23.6
20.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	524.	524.	510.	486.	524.	205.	155.4	149.0	136.9	155.4
DAILY TOTALS:										40471.	40471.	34973.	33845.	37713.	39811.	1.7	-12.2	-15.0	-5.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	51.		51.	51.	48.	51.
6.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	339.		339.	339.	322.	339.
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	880.		880.	880.	836.	880.
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1527.		1527.	1527.	1451.	1527.
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2160.		2160.	2160.	2052.	2160.
10.00	1.000	1	1	0	0	1.000	0.975	0.928	1.000	2651.		2651.	2584.	2459.	2651.
11.00	1.000	3	3	0	0	1.000	0.900	0.860	1.000	2936.		2936.	2643.	2526.	2936.
12.00	0.957	3	3	0	0	1.000	0.822	0.750	0.967	3119.		3119.	2563.	2340.	3015.
13.00	0.950	3	3	0	0	1.000	0.807	0.743	0.950	3109.		3109.	2510.	2309.	2953.
14.00	1.000	2	2	0	0	1.000	0.875	0.838	1.000	2941.		2941.	2573.	2463.	2941.
15.00	1.000	3	3	0	0	1.000	0.875	0.838	1.000	2506.		2506.	2193.	2099.	2506.
16.00	0.600	2	2	0	0	1.000	0.525	0.608	0.600	2002.		2002.	1051.	1217.	1201.
17.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	1413.		1413.	1307.	1247.	1413.
18.00	0.550	1	1	0	0	1.000	0.522	0.653	0.550	784.		784.	409.	511.	431.
19.00	0.817	1	1	0	0	1.000	0.776	0.773	0.817	277.		277.	215.	214.	226.
20.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	24.		24.	23.	22.	24.
DAILY TOTALS:										26718.		26718.	23028.	22115.	25254.

ALBANY, NY
JUN 20 1979
DAY NUMBER 171

SUNRISE = 4.37 SUNSET = 19.52 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.36 COLL. SET = 19.53 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUFI	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	772.	772.	772.	734.	772.	420.	83.9	83.9	74.7	83.9
6.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1726.	1726.	1726.	1640.	1726.	1858.	-7.1	-7.1	-11.7	-7.1
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2385.	2385.	2385.	2266.	2385.	2558.	-6.8	-6.8	-11.4	-6.8
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2846.	2846.	2846.	2704.	2846.	2930.	-2.9	-2.9	-7.7	-2.9
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3144.	3144.	3144.	2986.	3144.	3136.	0.2	0.2	-4.8	0.2
10.00	1.000	2	0	2	0	1.000	0.990	0.935	0.990	3221.	3221.	3188.	3011.	3188.	3256.	-1.1	-2.1	-7.5	-2.1
11.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	3324.	3324.	3258.	3058.	3258.	3343.	-0.6	-2.5	-8.5	-2.5
12.00	1.000	1	1	1	0	1.000	0.960	0.928	0.985	3425.	3425.	3288.	3177.	3374.	3396.	0.9	-3.2	-6.5	-0.7
13.00	1.000	1	1	1	0	1.000	0.940	0.935	0.990	3425.	3425.	3219.	3202.	3390.	3374.	1.5	-4.6	-5.1	0.5
14.00	1.000	0	0	0	0	1.000	0.970	0.943	0.995	3418.	3418.	3315.	3221.	3401.	3286.	4.0	0.9	-2.0	3.5
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3301.	3301.	3301.	3136.	3301.	3171.	4.1	4.1	-1.1	4.1
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3098.	3098.	3098.	2943.	3098.	2986.	3.8	3.8	-1.4	3.8
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2777.	2777.	2777.	2638.	2777.	2767.	0.3	0.3	-4.7	0.3
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2280.	2280.	2280.	2166.	2280.	2378.	-4.1	-4.1	-8.9	-4.1
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1589.	1589.	1589.	1509.	1589.	1626.	-2.3	-2.3	-7.2	-2.3
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	509.	509.	509.	483.	509.	213.	138.8	138.8	126.8	138.8
DAILY TOTALS:										41238.	41238.	40694.	38875.	41037.	40698.	1.3	-0.0	-4.5	0.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	51.	51.	51.	49.	51.	
6.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	343.	343.	343.	326.	343.	
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	885.	885.	885.	841.	885.	
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1532.	1532.	1532.	1455.	1532.	
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2162.	2162.	2162.	2054.	2162.	
10.00	1.000	2	0	2	0	1.000	0.990	0.935	0.990	2607.	2607.	2581.	2437.	2581.	
11.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	2974.	2974.	2915.	2736.	2915.	
12.00	1.000	1	1	1	0	1.000	0.960	0.928	0.985	3211.	3211.	3083.	2978.	3163.	
13.00	1.000	1	1	1	0	1.000	0.940	0.935	0.990	3202.	3202.	3010.	2994.	3170.	
14.00	1.000	0	0	0	0	1.000	0.970	0.943	0.995	3032.	3032.	2941.	2858.	3017.	
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2632.	2632.	2632.	2500	2632.	
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2082.	2082.	2082.	1978.	2082.	
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1443.	1443.	1443.	1371.	1443.	
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	802.	802.	802.	762.	802.	
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	285.	285.	285.	271.	285.	
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	24.	24.	24.	23.	24.	
DAILY TOTALS:										27267.	27267.	26770.	25633.	27086.	

ALBANY, NY
JUN 21 1979
DAY NUMBER 172

SUNRISE = 4.37 SUNSET = 19.52 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.15 HOURS
COLL. RISE = 4.37 COLL. SET = 19.54 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	1.000	3	0	3	0	1.000	0.970	0.905	0.970	611.	611.	593.	553.	593.	357.	71.2	66.0	54.9	66.0
6.00	1.000	2	0	2	0	1.000	0.975	0.912	0.975	1526.	1526.	1488.	1392.	1488.	1617.	-5.6	-8.0	-13.9	-8.0
7.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	2194.	2194.	2150.	2018.	2150.	2312.	-5.1	-7.0	-12.7	-7.0
8.00	1.000	3	0	3	0	1.000	0.975	0.912	0.975	2605.	2605.	2540.	2377.	2540.	2714.	-4.0	-6.4	-12.4	-6.4
9.00	1.000	3	0	0	0	1.000	0.985	0.860	0.985	2918.	2918.	2875.	2510.	2875.	2966.	-1.6	-3.1	-15.4	-3.1
10.00	1.000	3	1	0	0	1.000	0.975	0.815	1.000	3119.	3119.	3041.	2542.	3119.	3115.	0.1	-2.4	-18.4	0.1
11.00	1.000	2	1	0	0	1.000	0.950	0.838	1.000	3286.	3286.	3122.	2752.	3286.	3187.	3.1	-2.1	-13.6	3.1
12.00	1.000	1	0	0	0	1.000	0.975	0.883	1.000	3390.	3390.	3305.	2991.	3390.	3183.	6.5	3.8	-6.0	6.5
13.00	1.000	1	0	0	0	1.000	1.000	0.905	1.000	3386.	3386.	3386.	3064.	3386.	3256.	4.0	4.0	-5.9	4.0
14.00	1.000	0	0	0	0	1.000	1.000	0.928	1.000	3376.	3376.	3376.	3132.	3376.	3155.	6.7	6.7	-1.1	6.7
15.00	1.000	1	0	0	0	1.000	1.000	0.928	1.000	3197.	3197.	3197.	2966.	3197.	3015.	6.0	6.0	-1.6	6.0
16.00	1.000	1	0	0	0	1.000	1.000	0.905	1.000	2975.	2975.	2975.	2693.	2975.	2754.	8.0	8.0	-2.2	8.0
17.00	1.000	2	1	0	0	1.000	0.975	0.883	1.000	2567.	2567.	2503.	2266.	2567.	2398.	7.1	4.4	-5.5	7.1
18.00	1.000	2	1	0	0	1.000	0.950	0.860	1.000	2043.	2043.	1941.	1757.	2043.	1840.	11.0	5.5	-4.5	11.0
19.00	0.633	2	1	0	0	1.000	0.602	0.645	0.633	1350.	1350.	812.	871.	855.	748.	80.5	8.6	16.4	14.3
20.00	0.0	3	2	0	0	1.000	0.0	0.338	0.0	378.	378.	0.	127.	0.	1.	37661.4	-100.0	12648.4	-100.0
DAILY TOTALS:										38922.	38922.	37304.	34012.	37840.	36628.	6.3	1.8	-7.1	3.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	1.000	3	0	3	0	1.000	0.970	0.905	0.970	41.	41.	40.	37.	40.	
6.00	1.000	2	0	2	0	1.000	0.975	0.912	0.975	304.	304.	296.	277.	296.	
7.00	1.000	2	0	2	0	1.000	0.980	0.920	0.980	814.	814.	797.	749.	797.	
8.00	1.000	3	0	3	0	1.000	0.975	0.912	0.975	1401.	1401.	1366.	1278.	1366.	
9.00	1.000	3	0	0	0	1.000	0.985	0.860	0.985	2007.	2007.	1976.	1726.	1976.	
10.00	1.000	3	1	0	0	1.000	0.975	0.815	1.000	2524.	2524.	2461.	2057.	2524.	
11.00	1.000	2	1	0	0	1.000	0.950	0.838	1.000	2940.	2940.	2793.	2462.	2940.	
12.00	1.000	1	0	0	0	1.000	0.975	0.883	1.000	3178.	3178.	3098.	2804.	3178.	
13.00	1.000	1	0	0	0	1.000	1.000	0.905	1.000	3166.	3166.	3166.	2865.	3166.	
14.00	1.000	0	0	0	0	1.000	1.000	0.928	1.000	2996.	2996.	2996.	2779.	2996.	
15.00	1.000	1	0	0	0	1.000	1.000	0.928	1.000	2551.	2551.	2551.	2366.	2551.	
16.00	1.000	1	0	0	0	1.000	1.000	0.905	1.000	2002.	2002.	2002.	1811.	2002.	
17.00	1.000	2	1	0	0	1.000	0.975	0.883	1.000	1338.	1338.	1304.	1180.	1338.	
18.00	1.000	2	1	0	0	1.000	0.950	0.860	1.000	721.	721.	685.	620.	721.	
19.00	0.633	2	1	0	0	1.000	0.602	0.645	0.633	245.	245.	147.	158.	155.	
20.00	0.0	3	2	0	0	1.000	0.0	0.338	0.0	18.	18.	0.	6.	0.	
DAILY TOTALS:										26244.	26244.	25679.	23177.	26046.	

ALBANY, NY
JUN 22 1979
DAY NUMBER 173

SUNRISE = 4.38 SUNSET = 19.52 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.15 HOURS
COLL. RISE = 4.37 COLL. SET = 19.54 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]			
5.00	0.0	9	7	0	0	1.000	0.0	0.045	0.045	312.	312.	0.	14.	14.	38.	720.8	-100.0	-62.7	-62.7
6.00	0.183	10	8	0	0	1.000	0.115	0.106	0.106	855.	855.	98.	90.	90.	102.	738.6	-3.9	-11.5	-11.5
7.00	0.567	10	10	0	0	1.000	0.312	0.256	0.256	1466.	1466.	457.	375.	375.	157.	833.9	191.2	138.7	138.7
8.00	0.767	9	9	0	0	1.000	0.403	0.368	0.368	2031.	2031.	818.	748.	748.	934.	117.4	-12.4	-20.0	-20.0
9.00	1.000	9	8	0	0	1.000	0.575	0.546	0.546	2396.	2396.	1378.	1307.	1307.	1624.	47.6	-15.1	-19.5	-19.5
10.00	0.900	9	9	0	0	1.000	0.518	0.451	0.451	2632.	2632.	1363.	1186.	1186.	689.	282.0	97.8	72.1	72.1
11.00	0.783	10	9	0	0	1.000	0.431	0.376	0.376	2724.	2724.	1174.	1023.	1023.	391.	596.6	200.3	161.6	161.6
12.00	0.050	10	10	0	0	1.000	0.026	0.023	0.023	2783.	2783.	73.	64.	64.	70.	3875.1	4.4	-7.9	-7.9
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2775.	2775.	0.	2.	2.	16.	17241.4	-100.0	-87.9	-87.9
14.00	0.667	10	8	0	0	1.000	0.367	0.301	0.301	2696.	2696.	989.	810.	810.	142.	1798.5	596.5	470.7	470.7
15.00	0.083	10	9	0	0	1.000	0.048	0.038	0.038	2534.	2534.	121.	97.	97.	449.	464.3	-72.9	-78.5	-78.5
16.00	0.167	9	9	0	0	1.000	0.092	0.098	0.098	2325.	2325.	213.	228.	228.	631.	268.5	-66.2	-63.8	-63.8
17.00	0.383	9	7	0	0	1.000	0.230	0.218	0.218	1942.	1942.	447.	423.	423.	839.	131.5	-46.7	-49.5	-49.5
18.00	0.067	9	8	0	0	1.000	0.042	0.076	0.076	1406.	1406.	59.	106.	106.	64.	2096.2	-8.5	65.9	65.9
19.00	0.0	10	8	0	0	1.000	0.0	0.023	0.023	738.	738.	0.	17.	17.	10.	7283.3	-100.0	70.3	70.3
20.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	170.	170.	0.	0.	0.	0.	*****			
DAILY TOTALS:										29784.	29784.	7190.	6491.	6491.	6156.	383.8	16.8	5.4	5.4

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	9	7	0	0	1.000	0.0	0.045	0.045	21.		21.	0.	1.	1.
6.00	0.183	10	8	0	0	1.000	0.115	0.106	0.106	172.		172.	20.	18.	18.
7.00	0.567	10	10	0	0	1.000	0.312	0.256	0.256	546.		546.	170.	140.	140.
8.00	0.767	9	9	0	0	1.000	0.403	0.368	0.368	1093.		1093.	440.	403.	403.
9.00	1.000	9	8	0	0	1.000	0.575	0.546	0.546	1647.		1647.	948.	899.	899.
10.00	0.900	9	9	0	0	1.000	0.518	0.451	0.451	2129.		2129.	1102.	959.	959.
11.00	0.783	10	9	0	0	1.000	0.431	0.376	0.376	2436.		2436.	1050.	915.	915.
12.00	0.050	10	10	0	0	1.000	0.026	0.023	0.023	2608.		2608.	69.	60.	60.
13.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2595.		2595.	0.	2.	2.
14.00	0.667	10	8	0	0	1.000	0.367	0.301	0.301	2393.		2393.	878.	719.	719.
15.00	0.083	10	9	0	0	1.000	0.048	0.038	0.038	2023.		2023.	97.	77.	77.
16.00	0.167	9	9	0	0	1.000	0.092	0.098	0.098	1567.		1567.	144.	154.	154.
17.00	0.383	9	7	0	0	1.000	0.230	0.218	0.218	1015.		1015.	233.	221.	221.
18.00	0.067	9	8	0	0	1.000	0.042	0.076	0.076	500.		500.	21.	38.	38.
19.00	0.0	10	8	0	0	1.000	0.0	0.023	0.023	138.		138.	0.	3.	3.
20.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	9.		9.	0.	0.	0.
DAILY TOTALS:										20892.		20892.	5172.	4609.	4609.

ALBANY, NY
JUN 23 1979
DAY NUMBER 174

SUNRISE = 4.38 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.37 COLL. SET = 19.54 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL.	RELATIVE ERROR				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]				
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	293.	293.	0.	0.	0.	0.	*****				
6.00	0.500	3	3	0	0	1.000	0.338	0.383	0.383	1263.	1263.	426.	484.	484.	847.	49.1	-49.7	-42.9	-42.9	
7.00	0.450	10	10	0	0	1.000	0.304	0.360	0.360	1543.	1543.	469.	556.	556.	367.	320.4	27.7	51.5	51.5	
8.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	2028.	2028.	1015.	1015.	1015.	582.	248.4	74.3	74.5	74.5	
9.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	2401.	2401.	1201.	1202.	1202.	151.	1490.1	695.6	696.1	696.1	
10.00	0.500	9	9	0	0	1.000	0.263	0.248	0.248	2697.	2697.	708.	669.	669.	387.	596.8	83.0	72.9	72.9	
11.00	0.217	8	8	0	0	1.000	0.125	0.166	0.166	2897.	2897.	361.	480.	480.	1678.	72.6	-78.5	-71.4	-71.4	
12.00	0.533	6	6	0	0	1.000	0.347	0.375	0.375	3066.	3066.	1063.	1151.	1151.	27.	11254.7	3837.2	4163.6	4163.6	
13.00	0.983	5	5	0	0	1.000	0.713	0.645	0.645	3126.	3126.	2229.	2018.	2018.	1222.	155.8	82.4	65.1	65.1	
14.00	1.000	4	4	0	0	1.000	0.775	0.748	0.748	3121.	3121.	2419.	2334.	2334.	2774.	12.5	-12.8	-15.9	-15.9	
15.00	1.000	4	3	0	0	1.000	0.825	0.770	0.770	2996.	2996.	2472.	2308.	2308.	2824.	6.1	-12.5	-18.3	-18.3	
16.00	1.000	3	3	0	0	1.000	0.850	0.793	0.793	2834.	2834.	2409.	2247.	2247.	2657.	6.7	-9.3	-15.4	-15.4	
17.00	0.983	3	3	0	0	1.000	0.836	0.758	0.758	2500.	2500.	2090.	1894.	1894.	2337.	7.0	-10.6	-18.9	-18.9	
18.00	0.233	7	8	0	0	1.000	0.169	0.330	0.330	1733.	1733.	293.	573.	573.	924.	87.6	-68.3	-38.0	-38.0	
19.00	0.0	8	10	0	0	1.000	0.0	0.113	0.113	1001.	1001.	0.	113.	113.	53.	1787.8	-100.0	113.6	113.6	
20.00	0.0	10	7	0	0	1.000	0.0	0.046	0.046	235.	235.	0.	11.	11.	0.	*****				

DAILY TOTALS: 33733. 33733. 17155. 17054. 17054. 16830. 100.4 1.9 1.3 1.3

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	20.	20.	0.	0.	0.	
6.00	0.500	3	3	0	0	1.000	0.338	0.383	0.383	254.	254.	86.	97.	97.	
7.00	0.450	10	10	0	0	1.000	0.304	0.360	0.360	570.	570.	173.	205.	205.	
8.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	1090.	1090.	545.	546.	546.	
9.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	1649.	1649.	825.	826.	826.	
10.00	0.500	9	9	0	0	1.000	0.263	0.248	0.248	2181.	2181.	573.	541.	541.	
11.00	0.217	8	8	0	0	1.000	0.125	0.166	0.166	2590.	2590.	323.	429.	429.	
12.00	0.533	6	6	0	0	1.000	0.347	0.375	0.375	2874.	2874.	996.	1079.	1079.	
13.00	0.983	5	5	0	0	1.000	0.713	0.645	0.645	2923.	2923.	2084.	1887.	1887.	
14.00	1.000	4	4	0	0	1.000	0.775	0.748	0.748	2771.	2771.	2147.	2072.	2072.	
15.00	1.000	4	3	0	0	1.000	0.825	0.770	0.770	2393.	2393.	1974.	1843.	1843.	
16.00	1.000	3	3	0	0	1.000	0.850	0.793	0.793	1909.	1909.	1623.	1514.	1514.	
17.00	0.983	3	3	0	0	1.000	0.836	0.758	0.758	1305.	1305.	1091.	989.	989.	
18.00	0.233	7	8	0	0	1.000	0.169	0.330	0.330	617.	617.	104.	204.	204.	
19.00	0.0	8	10	0	0	1.000	0.0	0.113	0.113	185.	185.	0.	21.	21.	
20.00	0.0	10	7	0	0	1.000	0.0	0.046	0.046	12.	12.	0.	1.	1.	

DAILY TOTALS: 23343. 23343. 12546. 12253. 12253.

ALBANY, NY
JUN 24 1979
DAY NUMBER 175

SUNRISE = 4.39 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.38 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]			

5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	321.	321.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	928.	928.	0.	1.	1.	0.	*****			
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1565.	1565.	0.	1.	1.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2082.	2082.	0.	1.	1.	0.	*****			
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2448.	2448.	0.	2.	2.	4.	51106.4	-100.0	-57.2	-57.2
10.00	0.050	10	10	0	0	1.000	0.025	0.023	0.023	2690.	2690.	67.	62.	62.	12.	22315.1	460.8	420.0	420.0
11.00	0.783	9	9	0	0	1.000	0.411	0.376	0.376	2880.	2880.	1185.	1082.	1082.	297.	869.7	299.0	264.3	264.3
12.00	0.617	8	8	0	1	1.000	0.355	0.346	0.346	2681.	2681.	951.	926.	926.	418.	541.3	127.5	121.6	121.6
13.00	0.650	7	7	0	0	1.000	0.406	0.406	0.406	3018.	3018.	1227.	1224.	1224.	603.	400.6	103.4	103.0	103.0
14.00	0.100	10	10	0	0	1.000	0.058	0.113	0.113	2845.	2845.	164.	322.	322.	171.	1563.6	-4.3	88.1	88.1
15.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2684.	2684.	22.	22.	22.	20.	13320.5	11.9	10.0	10.0
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2439.	2439.	0.	2.	2.	1.	*****	-100.0	70.7	70.7
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2064.	2064.	0.	1.	1.	19.	10761.1	-100.0	-92.4	-92.4
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1534.	1534.	0.	1.	1.	0.	*****			
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	892.	892.	0.	1.	1.	0.	*****			
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	227.	227.	0.	0.	0.	2.	11231.2	-100.0	-92.1	-92.1

DAILY TOTALS: 3.296. 31296. 3616. 3649. 3649. 1547. 1923.0 133.7 135.9 135.9

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	21.	21.	0.	0.	0.	0.
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	186.	186.	0.	0.	0.	0.
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	580.	580.	0.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1118.	1118.	0.	1.	1.	1.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1680.	1680.	0.	1.	1.	1.
10.00	0.050	10	10	0	0	1.000	0.025	0.023	0.023	2174.	2174.	54.	50.	50.	50.
11.00	0.783	9	9	0	0	1.000	0.411	0.376	0.376	2574.	2574.	1059.	967.	967.	967.
12.00	0.617	8	8	0	1	1.000	0.355	0.346	0.346	2512.	2512.	891.	868.	868.	868.
13.00	0.650	7	7	0	0	1.000	0.406	0.406	0.406	2822.	2822.	1147.	1145.	1145.	1145.
14.00	0.100	10	10	0	0	1.000	0.058	0.113	0.113	2527.	2527.	145.	286.	286.	286.
15.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2145.	2145.	18.	18.	18.	18.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1645.	1645.	0.	1.	1.	1.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1080.	1080.	0.	1.	1.	1.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	546.	546.	0.	0.	0.	0.
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	166.	166.	0.	0.	0.	0.
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	11.	11.	0.	0.	0.	0.

DAILY TOTALS: 21787. 21787. 3315. 3338. 3338.

ALBANY, NY
JUN 25 1979
DAY NUMBER 176

SUNRISE = 4.39 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.38 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]					[PERCENT]			
5.00	0.110	5	4	0	0	1.000	0.088	0.275	0.110	601.	601.	53.	165.	66.	295.	103.7	-82.1	-44.1	-77.7
6.00	0.967	0	0	0	0	1.000	0.870	0.773	0.967	1799.	1799.	1566.	1390.	1739.	1938.	-7.1	-19.2	-28.3	-10.2
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2485.	2485.	2485.	2361.	2485.	2639.	-5.8	-5.8	-10.5	-5.8
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2936.	2936.	2936.	2789.	2936.	3014.	-2.6	-2.6	-7.5	-2.6
9.00	1.000	4	4	0	0	1.000	0.900	0.860	1.000	3001.	3001.	2700.	2581.	3001.	3173.	-5.4	-14.9	-18.7	-5.4
10.00	1.000	2	2	0	0	1.000	0.850	0.815	1.000	3279.	3279.	2787.	2673.	3279.	3357.	-2.3	-17.0	-20.4	-2.3
11.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	3448.	3448.	3189.	3043.	3448.	3448.	-0.0	-7.5	-11.7	-0.0
12.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	3547.	3547.	3459.	3290.	3547.	3480.	1.9	-0.6	-5.5	1.9
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3547.	3547.	3547.	3369.	3547.	3471.	2.2	2.2	-2.9	2.2
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3491.	3491.	3491.	3316.	3491.	3428.	1.8	1.8	-3.3	1.8
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3375.	3375.	3375.	3206.	3375.	3355.	0.6	0.6	-4.4	0.6
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3178.	3178.	3178.	3019.	3178.	3209.	-1.0	-1.0	-5.9	-1.0
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2865.	2865.	2865.	2722.	2865.	3008.	-4.7	-4.7	-9.5	-4.7
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2382.	2382.	2382.	2263.	2382.	2646.	-10.0	-10.0	-14.5	-10.0
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1695.	1695.	1695.	1611.	1695.	1871.	-9.4	-9.4	-13.9	-9.4
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	557.	557.	557.	529.	557.	308.	80.9	80.9	71.8	80.9

DAILY TOTALS: 42186. 42186. 40265. 38328. 41591. 42640. -1.1 -5.6 -10.1 -2.5

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]					[KJ/SQ.M]			
5.00	0.110	5	4	0	0	1.000	0.088	0.275	0.110	38.	38.	3.	11.	4.
6.00	0.967	0	0	0	0	1.000	0.870	0.773	0.967	353.	353.	307.	273.	342.
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	913.	913.	913.	867.	913.
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1570.	1570.	1570.	1492.	1570.
9.00	1.000	4	4	0	0	1.000	0.900	0.860	1.000	2054.	2054.	1849.	1767.	2054.
10.00	1.000	2	2	0	0	1.000	0.850	0.815	1.000	2648.	2648.	2251.	2159.	2648.
11.00	1.000	1	1	0	0	1.000	0.925	0.883	1.000	3080.	3080.	2849.	2719.	3080.
12.00	1.000	0	0	0	0	1.000	0.975	0.928	1.000	3324.	3324.	3240.	3083.	3324.
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3317.	3317.	3317.	3151.	3317.
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3100.	3100.	3100.	2945.	3100.
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2697.	2697.	2697.	2562.	2697.
16.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2143.	2143.	2143.	2036.	2143.
17.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1497.	1497.	1497.	1422.	1497.
18.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	844.	844.	844.	801.	844.
19.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	308.	308.	308.	293.	308.
20.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	27.	27.	27.	26.	27.

DAILY TOTALS: 27914. 27914. 26917. 25606. 27869.

ALBANY, NY
JUN 26 1979
DAY NUMBER 177

SUNRISE = 4.40 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.14 HOURS
COLL. RISE = 4.39 COLL. SET = 19.54 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.553	0	0	0	0	1.000	0.553	0.699	0.553	882.	882.	488.	616.	488.	454.	94.2	7.4	35.7	7.4
6.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	1884.	1884.	1884.	1789.	1884.	2002.	-5.9	-5.9	-10.6	-5.9
7.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2522.	2522.	2522.	2396.	2522.	2719.	-7.3	-7.3	-11.9	-7.3
8.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	2957.	2957.	2957.	2809.	2957.	3055.	-3.2	-3.2	-8.0	-3.2
9.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3235.	3235.	3235.	3073.	3235.	3270.	-1.1	-1.1	-6.0	-1.1
10.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3405.	3405.	3405.	3234.	3405.	3365.	1.2	1.2	-3.9	1.2
11.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3500.	3500.	3500.	3325.	3500.	3466.	1.0	1.0	-4.1	1.0
12.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3539.	3539.	3539.	3362.	3539.	3484.	1.6	1.6	-3.5	1.6
13.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3527.	3527.	3527.	3351.	3527.	3507.	0.6	0.6	-4.4	0.6
14.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3464.	3464.	3464.	3291.	3464.	3493.	-0.8	-0.8	-5.8	-0.8
15.00	1.000	0	0	0	0	1.000	1.000	0.950	1.000	3341.	3341.	3341.	3174.	3341.	3406.	-1.9	-1.9	-6.8	-1.9
16.00	1.000	2	0	0	0	1.000	1.000	0.905	1.000	3014.	3014.	3014.	2728.	3014.	3129.	-3.7	-3.7	-12.8	-3.7
17.00	1.000	3	1	0	0	1.000	0.975	0.838	1.000	2598.	2598.	2533.	2176.	2598.	2956.	-12.1	-14.3	-26.4	-12.1
18.00	1.000	2	0	0	0	1.000	0.975	0.838	1.000	2143.	2143.	2089.	1795.	2143.	2517.	-14.9	-17.0	-28.7	-14.9
19.00	1.000	4	0	0	0	1.000	1.000	0.815	1.000	1314.	1314.	1314.	1071.	1314.	1579.	-16.8	-16.8	-32.2	-16.8
20.00	0.250	2	0	0	0	1.000	0.250	0.428	0.250	432.	432.	108.	185.	108.	184.	134.9	-41.2	0.4	-41.2
DAILY TOTALS:										41757.	41757.	40920.	38375	41038.	42586.	-1.9	-3.9	-9.9	-3.6

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX						
		T	C	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4	
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						

5.00	0.553	0	C	0	0	1.000	0.553	0.699	0.553	55.	55.	30.	38.	30.		
6.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	365.	365.	365.	346.	365.		
7.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	924.	924.	924.	878.	924.		
8.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	1579.	1579.	1579.	1500.	1579.		
9.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	2213.	2213.	2213.	2103.	2213.		
10.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	2747.	2747.	2747.	2610.	2747.		
11.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	3126.	3126.	3126.	2969.	3126.		
12.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	3315.	3315.	3315.	3149.	3315.		
13.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	3299.	3299.	3299.	3134.	3299.		
14.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	3077.	3077.	3077.	2923.	3077.		
15.00	1.000	0	C	0	0	1.000	1.000	0.950	1.000	2671.	2671.	2671.	2537.	2671.		
16.00	1.000	2	C	0	0	1.000	1.000	0.905	1.000	2034.	2034.	2034.	1841.	2034.		
17.00	1.000	3	1	0	C	1.000	0.975	0.838	1.000	1359.	1359.	1325.	1139.	1359.		
18.00	1.000	2	C	0	0	1.000	0.975	0.838	1.000	760.	760.	741.	637.	760.		
19.00	1.000	4	C	0	0	1.000	1.000	0.815	1.000	243.	243.	243.	198.	243.		
20.00	0.250	2	C	0	0	1.000	0.250	0.428	0.250	21.	21.	5.	9.	5.		
DAILY TOTALS:										27787.	27787.	27694.	26010.	27747.		

ALBANY, NY
JUN 27 1979
DAY NUMBER 178

SUNRISE = 4.40 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.13 HOURS
COLL. RISE = 4.40 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					[PERCENT]				
5.00	0.0	5	1	0	0	1.000	0.0	0.225	0.0	575.	575.	0.	129.	0.	145.	296.2	-100.0	-10.8	-100.0
6.00	0.983	3	1	0	0	1.000	0.934	0.713	0.983	1514.	1514.	1414.	1079.	1489.	807.	87.6	75.3	33.7	84.5
7.00	1.000	1	1	0	0	1.000	0.950	0.860	1.000	2320.	2320.	2204.	1995.	2320.	2229.	4.1	-1.1	-10.5	4.1
8.00	1.000	5	2	0	0	1.000	0.925	0.815	1.000	2539.	2539.	2348.	2069.	2539.	2414.	5.2	-2.7	-14.3	5.2
9.00	1.000	8	4	0	0	1.000	0.850	0.658	0.850	2676.	2676.	2275.	1760.	2275.	1889.	41.7	20.4	-6.8	20.4
10.00	1.000	9	4	0	0	1.000	0.800	0.568	0.650	2824.	2824.	2260.	1604.	1837.	1171.	141.2	93.0	36.9	56.8
11.00	0.850	8	4	0	0	1.000	0.680	0.450	0.553	2989.	2989.	2032.	1346.	1652.	2839.	5.3	-28.4	-52.6	-41.8
12.00	1.000	8	4	5	0	1.000	0.775	0.665	0.675	3042.	3042.	2357.	2024.	2054.	2306.	31.9	2.2	-12.2	-10.9
13.00	1.000	6	2	4	0	1.000	0.805	0.770	0.755	3120.	3120.	2511.	2403.	2356.	1644.	89.8	52.8	46.2	43.3
14.00	1.000	8	3	5	0	1.000	0.830	0.770	0.755	2954.	2954.	2452.	2275.	2230.	2322.	27.2	5.6	-2.0	-3.9
15.00	1.000	8	2	0	0	1.000	0.850	0.665	0.675	2788.	2788.	2369.	1854.	1882.	1407.	98.1	68.4	31.8	33.8
16.00	1.000	10	3	0	0	1.000	0.875	0.545	0.600	2429.	2429.	2125.	1324.	1458.	2270.	7.0	-6.4	-41.7	-35.8
17.00	1.000	8	3	0	0	1.000	0.850	0.545	0.600	2138.	2138.	1817.	1166.	1283.	2115.	1.1	-14.1	-44.9	-39.3
18.00	0.567	10	3	0	0	1.000	0.482	0.300	0.340	1494.	1494.	720.	448.	508.	1524.	-2.0	-52.8	-70.6	-66.7
19.00	0.217	4	3	0	0	1.000	0.184	0.233	0.173	1150.	1150.	212.	268.	199.	757.	52.0	-72.0	-64.6	-73.7
20.00	0.0	4	2	0	0	1.000	0.0	0.270	0.0	332.	332.	0.	90.	0.	1.	33059.1	-100.0	8858.8	-100.0

DAILY TOTALS: 34881. 34881. 27096. 21833. 24082. 25840. 35.0 4.9 -15.5 -6.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	5	1	0	0	1.000	0.0	0.225	0.0	36.	36.	0.	8.	0.	
6.00	0.983	3	1	0	0	1.000	0.934	0.713	0.983	295.	295.	275.	210.	290.	
7.00	1.000	1	1	0	0	1.000	0.950	0.860	1.000	850.	850.	807.	731.	850.	
8.00	1.000	5	2	0	0	1.000	0.925	0.815	1.000	1353.	1353.	1251.	1103.	1353.	
9.00	1.000	8	4	0	0	1.000	0.850	0.658	0.850	1829.	1829.	1555.	1203.	1555.	
10.00	1.000	9	4	0	0	1.000	0.800	0.568	0.650	2277.	2277.	1822.	1293.	1481.	
11.00	0.850	8	4	0	0	1.000	0.680	0.450	0.553	2668.	2668.	1814.	1201.	1474.	
12.00	1.000	8	4	5	0	1.000	0.775	0.665	0.675	2849.	2849.	2208.	1895.	1923.	
13.00	1.000	6	2	4	0	1.000	0.805	0.770	0.755	2917.	2917.	2348.	2246.	2203.	
14.00	1.000	8	3	5	0	1.000	0.830	0.770	0.755	2624.	2624.	2178.	2021.	1982.	
15.00	1.000	8	2	0	0	1.000	0.850	0.665	0.675	2229.	2229.	1895.	1483.	1505.	
16.00	1.000	10	3	0	0	1.000	0.875	0.545	0.600	1641.	1641.	1436.	895.	985.	
17.00	1.000	8	3	0	0	1.000	0.850	0.545	0.600	1120.	1120.	952.	611.	672.	
18.00	0.567	10	3	0	0	1.000	0.482	0.300	0.340	535.	535.	258.	161.	182.	
19.00	0.217	4	3	0	0	1.000	0.184	0.233	0.173	210.	210.	39.	49.	36.	
20.00	0.0	4	2	0	0	1.000	0.0	0.270	0.0	17.	17.	0.	5.	0.	

DAILY TOTALS: 23448. 23448. 18837. 15114. 16491.

ALBANY, NY
JUN 28 1979
DAY NUMBER 179

SUNRISE = 4.41 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.12 HOURS
COLL. RISE = 4.40 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	236.	236.	0.	0.	0.	14.	1586.8	-100.0	-99.1	-99.1
6.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	746.	746.	0.	0.	0.	26.	2767.9	-100.0	-98.3	-98.3
7.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	1348.	1348.	0.	1.	1.	15.	8885.0	-100.0	-94.3	-94.3
8.00	0.667	10	5	0	0	1.000	0.433	0.300	0.300	1865.	1865.	808.	561.	561.	471.	296.0	71.7	19.0	19.0
9.00	0.833	10	10	0	0	1.000	0.521	0.376	0.376	2241.	2241.	1167.	841.	841.	499.	349.1	134.0	68.6	68.6
10.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	2491.	2491.	1247.	1247.	1247.	339.	634.9	267.7	268.0	268.0
11.00	1.000	10	6	0	0	1.000	0.600	0.501	0.501	2643.	2643.	1586.	1323.	1323.	1081.	144.5	46.8	22.4	22.4
12.00	1.000	10	6	6	0	1.000	0.670	0.590	0.590	2713.	2713.	1818.	1602.	1602.	1390.	95.2	30.8	15.3	15.3
13.00	0.867	5	2	3	0	1.000	0.654	0.638	0.638	2960.	2960.	1937.	1888.	1888.	1684.	75.8	15.0	12.1	12.1
14.00	0.0	7	7	4	0	1.000	0.0	0.285	0.285	2809.	2809.	0.	801.	801.	709.	296.2	-100.0	13.0	13.0
15.00	0.0	10	10	0	0	1.000	0.0	0.128	0.128	2493.	2493.	0.	319.	319.	1.	*****	-100.0	031837.3	331837.3
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2221.	2221.	0.	2.	2.	0.	*****	*****	*****	*****
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1835.	1835.	0.	1.	1.	0.	*****	*****	*****	*****
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1308.	1308.	0.	1.	1.	0.	*****	*****	*****	*****
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	705.	705.	0.	0.	0.	1.	70439.1	-100.0	-50.6	-50.6
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	162.	162.	0.	0.	0.	1.	16098.5	-100.0	-88.7	-88.7

DAILY TOTALS: 28778. 28778. 8564. 8589. 8589. 6231. 361.9 37.4 37.8 37.8

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
[HOUR]	[ADIM.]	T	O	C	FH	TALP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	10	8	0	0	1.000	0.0	0.001	0.001	15.	15.	0.	0.	0.	0.
6.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	147.	147.	0.	0.	0.	0.
7.00	0.0	10	9	0	0	1.000	0.0	0.001	0.001	496.	496.	0.	0.	0.	0.
8.00	0.667	10	5	0	0	1.000	0.433	0.300	0.300	996.	996.	432.	299.	299.	299.
9.00	0.833	10	10	0	0	1.000	0.521	0.376	0.376	1532.	1532.	798.	575.	575.	575.
10.00	1.000	10	10	0	0	1.000	0.500	0.501	0.501	2008.	2008.	1005.	1005.	1005.	1005.
11.00	1.000	10	6	0	0	1.000	0.600	0.501	0.501	2358.	2358.	1415.	1180.	1180.	1180.
12.00	1.000	10	6	6	0	1.000	0.670	0.590	0.590	2540.	2540.	1702.	1500.	1500.	1500.
13.00	0.867	5	2	3	0	1.000	0.654	0.638	0.638	2767.	2767.	1811.	1765.	1765.	1765.
14.00	0.0	7	7	4	0	1.000	0.0	0.285	0.285	2496.	2496.	0.	712.	712.	712.
15.00	0.0	10	10	0	0	1.000	0.0	0.128	0.128	1995.	1995.	0.	256.	256.	256.
16.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1501.	1501.	0.	1.	1.	1.
17.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	963.	963.	0.	1.	1.	1.
18.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	469.	469.	0.	0.	0.	0.
19.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	133.	133.	0.	0.	0.	0.
20.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	8.	8.	0.	0.	0.	0.

DAILY TOTALS: 20424. 20424. 7162. 7295. 7295.

ALBANY, NY
JUN 29 1979
DAY NUMBER 180

SUNRISE = 4.42 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.12 HOURS
COLL. RISE = 4.42 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3		TAUP4	TAUP1	TAUP2	TAUP3
		[TENTHS]				[ADIM.]				[KJ/SQ.M]						[PERCENT]			
5.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	162.	162.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	565.	565.	0.	0.	0.	1.	56407.2	-100.0	-60.4	-60.4
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1107.	1107.	0.	1.	1.	9999.	*****			
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	1604.	1604.	0.	1.	1.	2.	80080.9	-100.0	-43.9	-43.9
9.00	0.150	10	10	0	1	1.000	0.075	0.068	0.068	1976.	1976.	148.	135.	135.	3.	65779.0	4844.4	4392.9	4392.9
10.00	1.000	9	9	0	0	1.000	0.525	0.523	0.523	2611.	2611.	1371.	1366.	1366.	96.	2619.3	1328.5	1322.6	1322.6
11.00	1.000	8	4	0	0	1.000	0.675	0.568	0.568	2833.	2833.	1912.	1609.	1609.	1349.	110.0	41.8	19.3	19.3
12.00	1.000	8	4	0	0	1.000	0.800	0.590	0.590	2897.	2897.	2317.	1710.	1710.	2028.	42.8	14.3	-15.7	-15.7
13.00	0.583	5	5	2	0	1.000	0.446	0.450	0.450	3036.	3036.	1355.	1367.	1367.	1990.	52.6	-31.9	-31.3	-31.3
14.00	1.000	5	4	2	0	1.000	0.755	0.785	0.785	2975.	2975.	2246.	2337.	2337.	2582.	15.2	-13.0	-9.5	-9.5
15.00	1.000	5	4	2	0	1.000	0.780	0.785	0.785	2826.	2826.	2204.	2219.	2219.	2483.	13.8	-11.2	-10.6	-10.6
16.00	1.000	7	6	0	0	1.000	0.740	0.710	0.710	2465.	2465.	1824.	1751.	1751.	2084.	18.3	-12.5	-16.0	-16.0
17.00	1.000	7	6	0	0	1.000	0.700	0.635	0.635	2073.	2073.	1451.	1317.	1317.	1210.	71.3	19.9	8.9	8.9
18.00	0.183	10	7	0	0	1.000	0.124	0.150	0.150	1368.	1368.	169.	206.	206.	1008.	35.7	-83.2	-79.6	-79.6
19.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	735.	735.	0.	0.	0.	94.	682.3	-100.0	-99.6	-99.6
20.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	170.	170.	0.	0.	0.	0.	*****			
DAILY TOTALS:										28295.	28295.	15000.	14018.	14018.	14930.	*****			

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX					
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO	CLD	TAUP1	TAUP2	TAUP3	TAUP4
[HOUR]	[ADIM.]	[TENTHS]				[ADIM.]				[KJ/SQ.M]					

5.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	10.	10.	0.	0.	0.	0.
6.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	112.	112.	0.	0.	0.	0.
7.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	407.	407.	0.	0.	0.	0.
8.00	0.0	10	10	0	1	1.000	0.0	0.001	0.001	955.	955.	0.	1.	1.	1.
9.00	0.150	10	10	0	1	1.000	0.075	0.068	0.068	1350.	1350.	101.	92.	92.	92.
10.00	1.000	9	9	0	0	1.000	0.525	0.523	0.523	2104.	2104.	1105.	1101.	1101.	1101.
11.00	1.000	8	4	0	0	1.000	0.675	0.568	0.568	2526.	2526.	1705.	1435.	1435.	1435.
12.00	1.000	8	4	0	0	1.000	0.800	0.590	0.590	2711.	2711.	2169.	1600.	1600.	1600.
13.00	0.583	5	5	2	0	1.000	0.446	0.450	0.450	2837.	2837.	1266.	1278.	1278.	1278.
14.00	1.000	5	4	2	0	1.000	0.755	0.785	0.785	2643.	2643.	1995.	2075.	2075.	2075.
15.00	1.000	5	4	2	0	1.000	0.780	0.785	0.785	2260.	2260.	1763.	1775.	1775.	1775.
16.00	1.000	7	6	0	0	1.000	0.740	0.710	0.710	1667.	1667.	1233.	1184.	1184.	1184.
17.00	1.000	7	6	0	0	1.000	0.700	0.635	0.635	1087.	1087.	761.	691.	691.	691.
18.00	0.183	10	7	0	0	1.000	0.124	0.150	0.150	491.	491.	61.	74.	74.	74.
19.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	138.	138.	0.	0.	0.	0.
20.00	0.0	10	7	0	0	1.000	0.0	0.000	0.000	9.	9.	0.	0.	0.	0.
DAILY TOTALS:										20801.	20801.	12160.	11305.	11305.	11305.

ALBANY, NY
JUN 30 1979
DAY NUMBER 181

SUNRISE = 4.42 SUNSET = 19.53 (STD. TIME)
GEOMETRIC DAY LENGTH = 15.11 HOURS
COLL. RISE = 4.42 COLL. SET = 19.55 (STD. TIME)

(MICROCLIMATIC OPTION)

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

TIME [HOUR]	S/D [ADIM.]	SKYCOVER [TENTHS]				TRANSMISSION [ADIM.]				COMPUTED DIRECT ENERGY FLUX [KJ/SQ.M]					EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR [PERCENT]			
		T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	210.	210.	0.	0.	0.	0.	*****			
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	687.	687.	0.	0.	0.	0.	*****			
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1276.	1276.	0.	1.	1.	0.	*****			
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1791.	1791.	0.	1.	1.	2.	89466.1	-100.0	-37.3	-37.3
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2169.	2169.	0.	2.	2.	0.	*****			
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2423.	2423.	0.	2.	2.	2.	*****	-100.0	-15.2	-15.2
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2576.	2576.	0.	2.	2.	6.	42826.9	-100.0	-70.0	-70.0
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2648.	2648.	0.	2.	2.	0.	*****			
13.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2645.	2645.	22.	22.	22.	110.	2304.5	-79.9	-80.3	-80.3
14.00	0.133	10	10	0	0	1.000	0.037	0.061	0.061	2569.	2569.	171.	156.	155.	460.	458.4	-62.7	-66.1	-66.1
15.00	0.650	9	9	0	0	1.000	0.341	0.316	0.316	2461.	2461.	840.	777.	777.	1142.	115.5	-26.4	-32.0	-32.0
16.00	0.450	8	8	0	0	1.000	0.259	0.271	0.271	2262.	2262.	586.	612.	612.	459.	392.8	27.6	33.4	33.4
17.00	0.967	7	7	0	0	1.000	0.604	0.548	0.548	1943.	1943.	1174.	1065.	1065.	1463.	32.8	-19.8	-27.2	-27.2
18.00	0.200	7	7	0	0	1.000	0.130	0.225	0.225	1418.	1418.	184.	320.	320.	114.	1143.7	61.7	180.4	180.4
19.00	0.0	9	8	0	0	1.000	0.0	0.091	0.091	705.	705.	0.	64.	64.	71.	893.0	-100.0	-10.1	-10.1
20.00	0.0	10	10	0	0	1.000	0.0	0.023	0.023	147.	147.	0.	3.	3.	2.	7256.4	-100.0	70.2	70.2
DAILY TOTALS:										27928.	27928.	2978.	3028.	3028.	3831.	629.0	-22.3	-21.0	-21.0

DIRECT ENERGY FLUX ON A SOLAR COLLECTOR SURFACE

TIME	S/D	SKYCOVER				TRANSMISSION				COMPUTED DIRECT ENERGY FLUX				
[HOUR]	[ADIM.]	T	O	C	FH	TAUP1	TAUP2	TAUP3	TAUP4	NO CLD	TAUP1	TAUP2	TAUP3	TAUP4
		[TENTHS]				[ADIM.]				[KJ/SQ.M]				
5.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	13.	13.	0.	0.	0.
6.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	135.	135.	0.	0.	0.
7.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	467.	467.	0.	0.	0.
8.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	953.	953.	0.	1.	1.
9.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1479.	1479.	0.	1.	1.
10.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	1949.	1949.	0.	1.	1.
11.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2295.	2295.	0.	2.	2.
12.00	0.0	10	10	0	0	1.000	0.0	0.001	0.001	2477.	2477.	0.	2.	2.
13.00	0.017	10	10	0	0	1.000	0.008	0.008	0.008	2472.	2472.	21.	20.	20.
14.00	0.133	10	10	0	0	1.000	0.067	0.061	0.061	2282.	2282.	152.	138.	138.
15.00	0.650	9	9	0	0	1.000	0.341	0.316	0.316	1958.	1968.	672.	621.	621.
16.00	0.450	8	8	0	0	1.000	0.259	0.271	0.271	1529.	1529.	396.	414.	414.
17.00	0.967	7	7	0	0	1.000	0.604	0.548	0.548	1019.	1019.	616.	559.	559.
18.00	0.200	7	7	0	0	1.000	0.130	0.225	0.225	507.	507.	66.	114.	114.
19.00	0.0	9	8	0	0	1.000	0.0	0.091	0.091	134.	134.	0.	12.	12.
20.00	0.0	10	10	0	0	1.000	0.0	0.023	0.023	8.	8.	0.	0.	0.
DAILY TOTALS:										19635.	19685.	1922.	1886.	1886.

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

1979 YEARLY TOTALS (FOR DAYS SELECTED)

(MICROCLIMATIC OPTION)

COMPUTED	DIRECT	ENERGY	FLUX
TAUP1	TAUP2	TAUP3	TAUP4
[KJ/SQ.M]			

958964.	569544.	537263.	563862.
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EXPTAL.
EN. FLUX
[KJ/SQ.M]

558812.

RELATIVE ERROR			
TAUP1	TAUP2	TAUP3	TAUP4
[PERCENT]			

71.6	1.9	-3.9	0.9
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DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

MONTHLY TOTALS (FOR DAYS SELECTED)

(MICROCLIMATIC OPTION)

		COMPUTED DIRECT ENERGY FLUX				EXPTAL. EN. FLUX [KJ/SQ.M]	RELATIVE ERROR			
		TAUP1	TAUP2	TAUP3	TAUP4		TAUP1	TAUP2	TAUP3	TAUP4
		[KJ/SQ.M]					[PERCENT]			
		-----					-----			
JAN	1979	0.	0.	0.	0.	0.	*****			
FEB	1979	0.	0.	0.	0.	0.	*****			
MAR	1979	0.	0.	0.	0.	0.	*****			
APR	1979	0.	0.	0.	0.	0.	*****			
MAY	1979	0.	0.	0.	0.	0.	*****			
JUN	1979	958964.	569544.	537263.	563862.	558812.	71.6	1.9	-3.9	0.9
JUL	1979	0.	0.	0.	0.	0.	*****			
AUG	1979	0.	0.	0.	0.	0.	*****			
SEP	1979	0.	0.	0.	0.	0.	*****			
OCT	1979	0.	0.	0.	0.	0.	*****			
NOV	1979	0.	0.	0.	0.	0.	*****			
DEC	1979	0.	0.	0.	0.	0.	*****			

DIRECT ENERGY FLUX ON A SUN-TRACKING COLLECTOR

(MICROCLIMATIC OPTION)

COMPUTED TAUP1	DIRECT TAUP2	ENERGY TAUP3	FLUX TAUP4	EXPTAL. EN. FLUX	RELATIVE ERROR TAUP1 TAUP2 TAUP3 TAUP4
	[KJ/SQ.M]			[KJ/SQ.M]	[PERCENT]

JUN 1 1979	DAY NUMBER 152	35473.	31184.	27667.	30571.	33615.	5.5	-7.2	-17.7	-9.1
JUN 2 1979	DAY NUMBER 153	5145.	2425.	3108.	3108.	1734.	*****			
JUN 3 1979	DAY NUMBER 154	30510.	1356.	1082.	1082.	1990.	1433.2	-31.9	-45.6	-45.6
JUN 4 1979	DAY NUMBER 155	33250.	20162.	16024.	16024.	18443.	80.3	9.3	-13.1	-13.1
JUN 5 1979	DAY NUMBER 156	32910.	21723.	22634.	22634.	21502.	53.1	1.0	5.3	5.3
JUN 6 1979	DAY NUMBER 157	34722.	29799.	28845.	31043.	36014.	-3.6	-17.3	-19.9	-13.8
JUN 7 1979	DAY NUMBER 158	29687.	20894.	19426.	19426.	13979.	112.4	49.5	39.0	39.0
JUN 8 1979	DAY NUMBER 159	22006.	8326.	5874.	5874.	6743.	226.4	23.5	-12.9	-12.9
JUN 9 1979	DAY NUMBER 160	22516.	0.	134.	134.	792.	*****			
JUN 10 1979	DAY NUMBER 161	23551.	4645.	5533.	5533.	4846.	386.0	-4.1	14.2	14.2
JUN 11 1979	DAY NUMBER 162	27583.	0.	19.	19.	29.	*****			
JUN 12 1979	DAY NUMBER 163	37291.	16541.	16969.	16969.	19489.	91.3	-15.1	-12.9	-12.9
JUN 13 1979	DAY NUMBER 164	39540.	27477.	27052.	27052.	29934.	32.1	-8.2	-9.6	-9.6
JUN 14 1979	DAY NUMBER 165	39274.	36704.	34546.	38008.	38066.	3.2	-3.6	-9.2	-0.2
JUN 15 1979	DAY NUMBER 166	35173.	26362.	25313.	25313.	17127.	105.4	53.9	47.8	47.8
JUN 16 1979	DAY NUMBER 167	33945.	27872.	27090.	27090.	21152.	60.5	31.8	28.1	28.1
JUN 17 1979	DAY NUMBER 168	26168.	10308.	10080.	10060.	10539.	148.3	-2.2	-4.4	-4.4
JUN 18 1979	DAY NUMBER 169	30960.	8020.	7781.	7781.	5090.	508.3	57.6	52.9	52.9
JUN 19 1979	DAY NUMBER 170	40471.	34973.	33845.	37713.	39811.	1.7	-12.2	-15.0	-5.3
JUN 20 1979	DAY NUMBER 171	41238.	40694.	38875.	41037.	40698.	1.3	-0.0	-4.5	0.8

DIRECT ENERGY FLJX ON A SUN-TRACKING COLLECTOR

(MICROCLIMATIC OPTION)

		COMPUTED	DIRECT ENERGY FLUX				EXPTAL.	RELATIVE ERROR			
		TAUP1	TAUP2	TAUP3	TAUP4		EN. FLUX	TAUP1	TAUP2	TAUP3	TAUP4
		[KJ/SQ.M]					[KJ/SQ.M]	[PERCENT]			
		-----					-----	-----			
JUN	21 1979	DAY NUMBER 172	38922.	37304.	34012.	37840.	36628.	6.3	1.8	-7.1	3.3
JUN	22 1979	DAY NUMBER 173	29784.	7190.	6491.	6491.	61E6.	383.8	16.8	5.4	5.4
JUN	23 1979	DAY NUMBER 174	33733.	17155.	17054.	17054.	168E0.	100.4	1.9	1.3	1.3
JUN	24 1979	DAY NUMBER 175	31296.	3616.	3649.	3649.	1547.	1923.0	133.7	135.9	135.9
JUN	25 1979	DAY NUMBER 176	42186.	40265.	38328.	41591.	42640.	-1.1	-5.6	-10.1	-2.5
JUN	26 1979	DAY NUMBER 177	41757.	40920.	38375.	41038.	425E6.	-1.9	-3.9	-9.9	-3.6
JUN	27 1979	DAY NUMBER 178	34881.	27096.	21833.	24082.	25840.	35.0	4.9	-15.5	-6.8
JUN	28 1979	DAY NUMBER 179	28778.	8564.	8589.	8589.	62E1.	361.9	37.4	37.8	37.8
JUN	29 1979	DAY NUMBER 130	28295.	15000.	14018.	14018.	149E0.	*****			
JUN	30 1979	DAY NUMBER 131	27928.	2978.	3028.	3028.	38E1.	629.0	-22.3	-21.0	-21.0

BREAKDOWN OF ERRORS AND SYNOPTIC TABLE

ALBANY, NY

LATITUDE 42.70 DEG. LONGITUDE 73.83 DEG.

SYNOPTIC TABLE

DIRECT ENERGY FLUX ON A HORIZONTAL SURFACE

SUMMARY OF DAILY RELATIVE ERRORS

(MICROCLIMATIC OPTION)

		TAUP1		NO. OF DAYS AND RELATIVE ERROR TAUP2 [ADIM] TAUP3 TAUP4			
		-----		-----			
MAXIMUM	REL. ERROR	1923.0		133.7		135.9	135.9
MINIMUM	REL. ERROR	-3.6		-31.9		-45.6	-45.6
AVERAGE	REL. ERROR	26 257.0	26 11.1	26 5.4	26 8.1		
AVERAGE POS.	REL. ERROR	23 290.8	13 32.6	10 36.8	12 31.0		
AVERAGE NEG.	REL. ERROR	3 -2.2	13 -10.3	16 -14.3	14 -11.5		

DIRECT ENERGY FLUX ON A SUN-TRACKING SURFACE

BREAKDOWN OF ERRORS

(MICROCLIMATIC OPTION)

ERROR LESS THAN [ADIM]	NUMBER OF DAYS AND PERCENT OF TOTAL DAYS							
	TAUP1		TAUP2		TAUP3		TAUP4	
			[DAYS]					
5. %	6	20.0 %	9	30.0 %	3	10.0 %	7	23.3 %
10. %	8	26.7 %	13	43.3 %	9	30.0 %	13	43.3 %
15. %	8	26.7 %	14	46.7 %	15	50.0 %	18	60.0 %
20. %	8	26.7 %	17	56.7 %	18	60.0 %	18	60.0 %
30. %	8	26.7 %	19	63.3 %	20	66.7 %	20	66.7 %
40. %	10	33.3 %	22	73.3 %	22	73.3 %	22	73.3 %
50. %	10	33.3 %	23	76.7 %	24	80.0 %	24	80.0 %
100. %	14	46.7 %	25	83.3 %	25	83.3 %	25	83.3 %

The results of the computation of the direct component of the global energy flux have been reported on the previous pages as obtained by the analytic model implemented in the CIRR2 interactive program, run on a microclimatic approximation.

As expected, the monthly precision is higher than the daily, which is higher than the hourly precision. For the two months considered, there is a one percent monthly precision; approximately two-thirds of the daily data are within a 15 percent precision, most of the remaining days being highly overcast and therefore with little, if any, direct radiation. The average of the relative error is extremely low, and the standard deviation of the daily values for those two months is also low. The first simplified version of this model, run for European locations, did not appear to have a sensible dependence on the month of the year (for the same location) nor, more generally, from location to location.

If days with no clouds during the entire insolation period are considered, the daily and hourly match of experimental and computed values is extremely satisfactory, as may be seen from the previous tabulations. In order to better visualize this, the hourly direct energy fluxes--the hourly interval is used because experimental data were available mainly on an hourly basis or, otherwise, have been adjusted to hourly information

through interpolations and/or randomization as indicated in Section 8.6--both experimental and computed, are plotted versus time. All the days on which the factor S/D (hours of sunshine per hour) were equal to one during the entire day are substantially represented by days such as February 3, February 6, February 11, February 28, June 14, June 20 and June 25. Their plottages are reported below,

Even on those days on which S/D equals one during the entire day, the clouds' presence tends to affect the precision of the model. June 6 and June 21 are good examples of this trend: they both have S/D equal to one over the whole day, but the former has cloud cover fluctuations (η fluctuations) ranging from 10 to 80 percent (even though the clouds never intercept the beam) and the latter has a cloud cover consistently less than 30 percent. The precision of the latter is higher than the precision of the former. This happens also during the same day: on June 26, S/D equals one the entire day, but the cloud cover is zero during the morning and different from zero in the afternoon. The three plottages follow and confirm the fact that it is the lack of information on the clouds presence is the main problem and not how the clouds are taken into consideration by the model.

It appears reasonable to state that, on a daily basis, the analytical model represents very well the interaction in the total absence of clouds. On an hourly basis, though, the model is affected by the lack of information on meteorological conditions (state parameters of the system). Some systematicity on the error introduced by the clouds, mainly at high sky cover (S/D always being one), may be noticed (e.g., the influence of the clouds on the increase of humidity content of the atmosphere). Once more, nothing has been done to decrease this "systematic" error, both for lack of relevant amount of data in different climatological conditions and in order to allow an analysis of the "physical" model. The first reason is particularly relevant, due to the fact that no real information related to statistical fluctuations is available.

It is plausible to state that the amount of precipitable water, also, is a critical measurement. The limits of its availability (twice a day) and reliability affect the precision of the model, even though linear interpolation of its daily values is performed. This is evidenced by days such as February 17, where both the cloud cover and S/D equal one during the entire day. It may be seen that the precision of computation tends to drop, mainly around noon, which corresponds to the time between the two precipitable water hours' measurements (performed at 00.00 and 12.00 GMT).

The sum of the two effects, i.e., the lack of information on the humidity content and the effect that the clouds have on the humidity content is clearly shown by February 14, when the cloud cover is inferior to 30 percent in the morning, is superior to 30 percent in the afternoon but S/D is reported to equal one during the entire day. The plottage for that day follows.

All discussion of the clouds thus far pertains only to those days on which the S/D factor was consistently near one during the entire day or on a portion of the day. The effect of the clouds on the amount of precipitable water obviously will be enhanced on those days on which S/D equals zero the entire day (or in those portions of the day in which S/D consistently equals zero). But in those periods, the direct component of the global energy flux will also consistently equal zero. Therefore it may be expected that the worst problem will be found, as it has been shown, when there is a stochastic presence of clouds not on the beam's path that will then nullify the effect of the interpolation between the two daily available measurements of amount of precipitable water.

Typical days on which S/D equals zero the entire day and the sky cover is 100 percent during the entire day are February 27 or June 11, days on which the direct component (as opposed to the global energy flux) equals zero.

DIRECT ENERGY FLUX

□ $\int$ EO (EXPER.)
△ $\int$ EO (COMP.)

FEB. 27, 1979
DAY NUMBER 58

DIRECT ENERGY FLUX

□ $\int E_0$ (EXPER.)
△ $\int E_0$ (COMP.)

JUNE 11, 1979
DAY NUMBER 162

For days on which S/D equals substantially zero the entire day--and therefore, following the definition itself of S/D, the beam component of the radiation should equal zero--and the cloud cover is 100 percent during the entire day but with more transparent (low albedo) clouds, the CIRR2 still predicts, with a reasonable precision, the direct flux as it may be seen from the plottage of June 28, reported below. The lower albedo of the clouds on this day may be noticed either from the tabulations or by comparing this day with Feb. 11 or June 25, although they all have $S/D = 0$; $\eta_1 = 100$ percent.

DIRECT ENERGY FLUX

□ $\int E_0$ (EXPER.)
△ $\int E_0$ (COMP.)

JUNE 28, 1979
DAY NUMBER 179

Those days on which S/D equals zero only part of the day, always with a higher percent of cloud cover, are represented by February 1 or June 18, on both of which S/D tends to be zero from late morning until later afternoon. Nevertheless the tau prime function (TAUP4) again takes into proper account the partial transparency of the (low) cloud layer present on the sky dome on the beam's path. These plottages follow.

DIRECT ENERGY FLUX

□ $\int E_0$ (EXPER.)
△ $\int E_0$ (COMP.)

FEB. 1, 1979
DAY NUMBER 32

DIRECT ENERGY FLUX

□ JEO (EXPER.)
△ JEO (COMP.)

JUNE 18, 1979
DAY NUMBER 169

Finally a word should be said about the precision of the experimental data used. It would not make much sense to criticize the experimental data used to check an analytical model behavior. However, this analytic model is nothing else than a series of correlations between a (sufficient) number of state parameters of the system under consideration (the atmosphere) and the attenuation of the radiative energy flux; the correlations were built through an analysis of the physical characteristics of the interaction, sometimes with the help of extensive numerical techniques. Even if we were to assume that the correlation is highly imprecise (which it is not, as the results of the CIRR2 runs have shown), it would be very unlikely that, all state parameters staying constant for a period of the day, the direct energy flux would vary by a factor of two from hour to hour. Unfortunately, this is what sometimes happens, as it may be immediately seen by cross-examining the previous plottages and the correspondent tabulated values of the experimental meteorological data.

No further attempt to interpret those results will be made.

It appears now that the analytical model as a whole permits an extremely good approximation on a monthly and daily basis, largely within the limits of error of the energy fluxes measurements, and is slightly affected by a lack of frequency

of the meteorological input data (mainly amount of precipitable water mainly on those days in which the global flux equals the diffusion component of the radiation). It is worth mentioning a lack of precision of the S/D measurement: it has been pointed out how the S/D values should perfectly take into account the clouds' presence for the direct component computation purposes; it has been shown how this was not the case and how the tau prime function instead performs the task. On all those days in which the diffusion component is particularly reduced, the precision of computation is particularly satisfactory also on an hourly basis.

A statistical analysis of the results follows.

9.1 STATISTICAL ANALYSES OF THE CIRR2 RESULTS

9.1.1 Introduction

Before the CIRR2 code may be intelligently used in any application, an analysis of the error inherent in the outputs from the model must be made, and these errors taken into consideration. This chapter will accomplish that analysis, describing in detail what analyses have been performed on the model, and discussing these results as they may apply to different applications.

One would expect to observe a relatively good match when analyzing the results on a yearly basis. This is because on a time scale so large, positive and negative errors tend to cancel each other out and a very low annual relative error may be observed. A true test of a model is if that model can predict insolation values correctly on a smaller time scale, say monthly, daily, or even hourly.

An example of when this last test is important is when the output of the insolation model is to be used as the input to a program modeling a unit whose efficiency is time dependent. An example of this sort of unit might be a solar thermal collector: when presented with strong solar radiation, such as might be observed around noon, the efficiency of the unit is fairly high. In the mornings and evenings, however, when insolation is low, the efficiency of a collector drops significantly. Thus it is seen that a good hourly match between the predicted and actual values of solar insolation is necessary.

For the analysis of the CIRR2 atmospheric model, meteorological and insolation data were collected for two United States cities with very different and widely varying climates: Albany, NY and Albuquerque, NM. The insolation data from Albany were collected at the Albany State University; the

meteorological data file was constructed from records supplied from the Albany County Airport. The Albuquerque, NM data file was obtained from a SOLMET tape.

Albany was selected as a site for testing of the CIRR2 model primarily because of the variability of its climate. The rapid shifts on cloud cover, amounts of precipitable water, etc. in both the short term (i.e., hour-to-hour and day-to-day) and the long term (i.e., month-to-month) allow for a demonstration of the model's ability to adjust to rapidly varying daily climatic conditions, as well as widely varying monthly climatic differences.

Albuquerque was selected as a second site for testing the model due to the inherent differences in climate: accurate predictions for Albuquerque as well as Albany will show that the model works for a wide range of United States climates.

Upon first glance, the data presented from both cities will seem somewhat incomplete. This problem may be attributed to two factors. First, in the case of both Albany and Albuquerque, only a subset of the data for an entire year was available. In the case of Albany, the supplied data included the months of February and June through December. It is believed that these data are satisfactory because an adequately

large subset of the year is analyzed: early and late winter, all of summer, and all of autumn. In this subset of the year, a sufficiently wide range of climatic values are presented to adequately represent the varying climatic conditions on Albany.

The same sort of problem occurs in Albuquerque. On the supplied SOLMET tape, only the months of February through September 1979 were supplied. This is because this was the only time during which accurate readings of observed direct solar insolation were taken at Albuquerque. Other sets of data (from other locations) all had to be rejected because of a lack of experimental readings of the direct energy flux; the subset of 1979 that was acquired was the best that was available at the time that the statistical analyses were to be performed.

An additional problem became apparent with the Albuquerque data, upon preliminary analyses of the results of runs of the CIRR2 program. A good correlation between the experimental values of direct energy flux (on a collector surface normal to the beam) was observed for all months in Albany and the majority of the months of data available for Albuquerque. The exception was the majority of the months of March, April, and May in Albuquerque, where extremely large errors were observed, and only for the direct energy flux computation. A check of the experimental values of direct energy flux for these days

show that the data are simply inconsistent, both with respect to the reported meteorological parameters and with respect to itself, i.e., other days within the same month with nearly identical meteorological conditions. For example, note the days March 8 and 9. According to the SOLMET tape's recorded meteorological conditions, the weather on March 8 was very good: very clear (never more than 10 percent of the celestial dome covered by clouds), and very sunny (these clouds never intercepted the direct beam, as evidenced by the fact that the hours of sunshine per hour parameter equals unit all day). Yet on this very clear day, the observed experimental direct energy flux is only 2333 kJ/sq.m. This is unusual in itself--the model (which predicts accurately for most other months of the year both in Albany and Albuquerque) predicted over 35,000 kJ. Further, the next day, a day in which there were significantly more clouds all day, the experimental daily value of direct energy flux is almost twice the amount, just under 4000 kJ. These inconsistencies continue throughout the months of March and April. In May, it would seem that the sensor for the direct component of the beam malfunctioned: on May 11, the experimental direct energy flux mysteriously goes to zero and remains at zero until the twenty-third of May. At this point, presumably, the instrument was repaired and direct readings were processed onto the tape. Because of these inconsistencies in March and April, and the large segment of

missing data in May, these months were not considered in the error analysis.

All experimental data not specifically excluded by the paragraph above were processed using the CIRR2 model, and error analyses performed. The results of these various analyses are presented below.

9.1.2 Total annual relative error

For the analysis of total annual relative error, the experimental and computed values of the various components of the energy flux were summed for all hours in which there was an experimental value of energy flux, and the relative difference between the computed and experimental (the relative error) computed using the formula

$$\text{Error (percent)} = 100.00 \quad (H_{\text{comp}} - H_{\text{exper}})/H_{\text{exper}}$$

where H is the sum of the hourly values of energy flux for a particular component of the beam. The only hours which were specifically excluded were those hours in which the experimental value of energy flux was coded as 9999, i.e., missing data. The results of this error analysis are presented in Table 9.1.

9.1.3 Total monthly relative error

The same analysis as was done for the total annual relative error computation was performed for the model's results on a monthly basis. The results of this analysis are presented in Table 9.2 (for Albany) and Table 9.3 (for Albuquerque).

9.1.4 Daily relative error

The above described error analysis was also performed on a daily basis, i.e., computing the relative difference between daily values of computed and experimental energy flux. Rather than reporting in tabular form the results of this analysis for each of the many days considered, a breakdown-of-errors table and synoptic table have been constructed for each city and component of the beam (global, direct, diffuse) that were considered.

The breakdown-of-errors table reports, for each component of the beam, the number of days for which the daily relative error was a certain amount. For example, looking at Table 9.4 (the table for Albany), under the global heading, we see that 73 days had a relative error of 5 percent or less in the global computation, and that 72 days is 30.2 of the total number of days for which computations were made for Albany. The results

of this analysis for Albuquerque are presented in Table 9.5.

The synoptic tables contain more general information about daily relative errors. Specifically, they report the highest positive daily relative error, the highest (in magnitude) negative daily relative error, the average of all the daily relative errors, the average of all positive daily relative errors, and the average of all negative daily relative errors. The synoptic tables for Albany and Albuquerque are presented in Tables 9.6 and 9.7, respectively.

9.1.5 Hourly measures of error

It was mentioned above that a demonstration of the accuracy/usefulness of the CIRR2 code must include demonstrations of the accuracy on a long time scale as well as a small time scale. One way of demonstrating a good correlation between the model and experimental values would be to list the results of the computation hour by hour, along with a computation of hourly relative error. This, however, would be even more tedious than a listing of the daily relative errors, as discussed above. Therefore, a means of capturing the hourly error was devised and is reported here.

To observe the hourly error, and capture the magnitude of

its severity, the following analysis was performed: for each hour in which there were experimental values of energy flux (i.e., only those hours coded with 9999 were not considered), the absolute error was computed using the formula

$$\text{Error} = H_{\text{comp}} - H_{\text{exper}}$$

where H is the hourly value of integrated energy flux, either experimental or computed. The mean and standard deviation of all the hourly absolute errors were then computed, along with the mean hourly experimental value of energy flux, and the results reported in Tables 9.8 and 9.9 (for Albany and Albuquerque, respectively). An explanation of the interpretation of these results follows.

Looking at Table 9.8, notice that the mean absolute error for the Albany global computation is -35.83, and the standard deviation is 221.61. If we assume that absolute errors are normally distributed about the mean (an assumption which has been observed to be true for large numbers of hourly computations), then it may be inferred that 60 percent of the hourly errors fell between -257 and +187. This is because for any normally distributed random variable (hourly absolute errors are considered here to be random variables), 60 percent of the occurrences of error will lie within one standard

deviation of either side of the mean. Using the value of mean experimental hourly global energy flux from the table, it can then be seen that the 60 percent of the hourly errors lie between -27 percent relative error and +19 percent relative error.

9.1.6 Summary

It should be noted that when results of a solar insolation model are accurate to within 5 percent, then the theoretical limit of the accuracy of the model has been obtained: the limit of the accuracy of the instruments which measure energy flux is only ± 5 percent.

The correlation between the hourly values of experimental and computed global energy flux is very high, and the error term consistently very low. This accuracy improves even more when errors are considered on a daily, monthly, or yearly basis. This is because as more hours' data are considered, more positive and negative errors cancel one another out.

The direct energy flux computation is also accurate, but not as good as the global. This is due to the (unexpected and absurd) inaccuracy inherent in the S/D observation, as mentioned in earlier chapters. The inherent inaccuracy of the

cloud data also contributes heavily to errors in the computation of the direct portion of the beam.

The least accurate computations are those of the diffuse component of the beam. This is more apparent because of the small magnitude of the total amount of diffuse energy flux: since the amount is smaller, the total relative error is larger, and the computation seems more inaccurate. Another problem with the diffuse portion of the beam is that it is extremely hard to measure--in effect it is measured as the global flux with the direct portion blocked out. But this may not always work, e.g., if the measuring instrument is even slightly off center.

This component of the beam is also the least used of the three (global, direct, diffuse) because it is such a small component. Further, most solar energy conversion systems require as much energy as possible to run efficiently, and therefore the global and direct components of the beam are of much more interest. The diffuse component is simply too small to be statistically interesting.

Table 9.1

TOTAL ANNUAL RELATIVE ERROR COMPUTATION

	<u>Albany, NY</u>	<u>Albuquerque, NM</u>
Total global radiation observed [kJ/m ²]	3,004,444	3,552,207
Total global radiation computed [kJ/m ²]	2,891,566	3,236,319
Rel. error [percent]	-3.8	-8.9
Total direct radiation observed [kJ/m ²]	2,917,254	4,079,592
Total direct radiation computed [kJ/m ²]	2,946,893	4,277,413
Rel. error [percent]	2.4	4.8
Total diffuse radiation observed	--	793,012
Total diffuse radiation computed	--	597,442
Rel. error [percent]	--	-24.7

Table 9.2
MONTHLY RELATIVE ERRORS, ALBANY

<u>Month</u>	<u>Relative error</u>		
	<u>Global</u>	<u>Direct</u>	<u>Diffuse</u>
Feb.	-1.2	0.1	--
June	-2.3	0.9	--
July	-2.4	14.1	--
Aug.	-3.2	7.3	--
Sept.	-8.5	-9.2	--
Oct.	-0.9	11.8	--
Nov.	-6.2	-12.9	--
Dec.	-8.6	10.4	--

Table 9.3
MONTHLY RELATIVE ERRORS, ALBUQUERQUE

<u>Month</u>	<u>Relative error</u>		
	<u>Global</u>	<u>Direct</u>	<u>Diffuse</u>
Feb.	-22.2	-6.8	-3.3
June	-2.1	9.0	-46.8
July	-6.0	4.8	-25.9
Aug.	-8.6	2.3	-9.3
Sept.	-14.4	10.8	-20.0

Table 9.4
DAILY RELATIVE ERRORS, ALBANY

<u>Error*</u>	<u>Global</u>		<u>Direct</u>		<u>Diffuse</u>
	No. of Days	Pct. of Total	No. of Days	Pct. of Total	
5 percent	73	30.2	33	15.7	--
10 percent	133	55.0	81	33.5	--
15 percent	170	70.2	101	41.7	--
20 percent	189	78.1	116	47.9	--
30 percent	209	86.4	144	59.5	--
40 percent	216	89.3	163	67.4	--
50 percent	219	90.5	174	71.9	--
100 percent	226	93.4	183	75.6	--

*Absolute value of relative error $\leq$ X percent

Table 9.5
DAILY RELATIVE ERROR, ALBUQUERQUE

<u>Error*</u>	<u>Global</u>		<u>Direct</u>		<u>Diffuse</u>	
	No. of Days	Pct. of Total	No. of Days	Pct. of Total	No. of Days	Pct. of Total
5 percent	38	25.3	51	34.0	20	13.3
10 percent	79	52.7	88	58.7	37	24.7
15 percent	107	71.3	111	74.0	50	33.3
20 percent	124	82.7	121	80.7	60	40.0
30 percent	143	95.3	131	87.3	70	46.7
40 percent	146	97.3	136	90.7	86	57.3
50 percent	147	98.0	136	90.7	97	64.7
100 percent	148	98.7	141	94.0	147	98.0

*Absolute value of relative error $\leq$ X percent

Table 9.6

DAILY RELATIVE ERROR, SYNOPTIC TABLE, ALBANY

	<u>Global</u>		<u>Direct</u>		<u>Diffuse</u>
	No. of Days	Error	No. of Days	Error	
Maximum Relative Error		135.5		184.2	-
Minimum Relative Error		-46.4		-100.0	-
Average Relative Error	230	0.7	188	3.5	-
Average Positive Relative Error	74	20.4	88	26.7	-
Average Negative Relative Error	156	-10.7	100	-17.0	-

Table 9.7

DAILY RELATIVE ERROR, SYNOPTIC TABLE, ALBUQUERQUE

	<u>Global</u>		<u>Direct</u>		<u>Diffuse</u>	
	No. of Days	Error	No. of Days	Error	No. of Days	Error
Maximum Relative Error		42.0		2034.5		107.4
Minimum Relative Error		-50.3		-100.0		-92.4
Average Relative Error	148	10.3	143	16.8	148	-25.4
Average Positive Relative Error	10	8.0	93	33.0	36	18.5
Average Negative Relative Error	138	-11.6	50	-13.3	112	-39.6

Table 9.8

HOURLY ABSOLUTE ERRORS, ALBANY

	<u>Global</u>	<u>Direct</u>	<u>Diffuse</u>
Mean Hourly Experimental Value of E_0	963.58	935.62	-
Mean Hourly Absolute Error	-35.83	22.55	-
Standard Deviation of Hourly Absolute Errors	221.61	402.93	-

Table 9.9
HOURLY ABSOLUTE ERRORS, ALBUQUERQUE

	<u>Global</u>	<u>Direct</u>	<u>Diffuse</u>
Mean Hourly Experimental Value of E_0	1,707.26	1,960.01	381.25
Mean Hourly Absolute Error	-46.18	119.69	-93.97
Standard Deviation of Hourly Absolute Errors	296.11	541.29	338.89

CHAPTER 10

CIRR2 MODEL COUPLING WITH A NON-STEADY-STATE THERMAL COLLECTOR MODEL, SIRR2

It has been repeatedly stated how the purpose of the CIRR2 model was not to compute solar irradiance per se (e.g. for meteorological purposes) but to define a tool able to assist in the design and in the performance evaluation of solar energy conversion systems (see Introduction to Vol. I and III). It has also been stated that such a tool was needed due to unreliability and "low frequency" of most solar measurements available. The purpose of this chapter is to assess this potential of the CIRR2 code and to show how a nonsteady state model of a solar collector has to be used, not only for proper design, but also for proper evaluation of the thermal/electrical energy output. The approach "the average insulation is, the average efficiency is, the average output is" will be shown to be a particularly misleading approximation.

First a non-steady state model of a solar thermal collector, low temperature flat plate monophasic thermovector fluid is summarized and analyzed; then the later model is

implemented on a code, here called SIRR2 and finally the CIRR2 code is coupled with the SIRR2 code to obtain a proper collector performance evaluation.

10.1 SIRR2 MODEL

The total useful energy available at the collector outlet in the form of low temperature heat, Q_u , may be obtained through the energy balance of the system:

$$Q_u = E_{in} - E_{losses} \quad (10.1)$$

The energy balance in Eq. 10.1 may be rewritten in explicit form [69]:

$$Q_u = A_c F_R [E_o(\sigma\tau) - U_L(T_{f,i} - T_a)] \quad [W] \quad (10.2)$$

where:

- A_c = collector area [m^2]
- F_R = factor of "thermal remotion"; takes into account the difference between the collector temperature, T and $T_{f,i}$.
- E_o = global solar energy flux on the collector [$W\ m^{-2}$]

- α = Collector absorptance
- τ = collector transmittance
- U_L = collector overall heat transfer coefficient
[W m⁻² °C⁻¹]
- $T_{f,i}$ = collector cooling fluid inlet temperature [°C]
- T_a = ambient temperature [°C]

All units, even when omitted, are SI system units

10.1.1 Collector transmission-absorption coefficient, $\tau\alpha$

Let θ_1 be the angle of incidence and θ_2 be the angle of refraction of the solar beam passing through the cover glass. The Fresnel relation for the reflection of the electromagnetic radiation from a medium 1 with index of refraction n_1 to a medium 2 with index of refraction n_2 furnishes the ratio of the beam energy density flux after and before the passage, ρ :

$$\rho = 1/2[\sin^2(\theta_1 - \theta_2)]/[\sin^2(\theta_2 + \theta_1)] + 1/2[\tan^2(\theta_2 - \theta_1)]/[\tan^2(\theta_2 + \theta_1)] \quad (10.3)$$

where:

$$\begin{aligned} \theta_1 &= \theta \text{ angle of CIRR2 code} \\ \theta_2 &= \arcsin((n_1/n_2) \sin(\theta_1)) \end{aligned} \quad (10.4)$$

The transmittance due to reflection τ_r for one cover is then:

$$\tau_r = (1-\rho)/(1+\rho) \quad (10.5)$$

The transmission factor due to absorption in the glass cover, τ_a , may be immediately computed through the extinction coefficient of the solar spectrum, K and the thickness of the glass cover, L :

$$\tau_a = \exp[-KL/\cos(\theta_2)] \quad (10.6)$$

where:

$$K = 0.161$$

$$L = 0.23$$

The total transmittance is then:

$$\tau = \tau_r \tau_a \quad (10.7)$$

For computation purposes in the SIRR2 code, τ is set to equal τ_r for all those intervals of time in which τ_a is not on the vicinity of .98.

The angular absorbance of the absorber plate is calculated estimating the diffuse reflectance, ρ_d , by using the specular reflection of the cover systems at an incidence angle of 60° .

Therefore:

$$\rho_d = 1 - (\theta_1 = 60^\circ) \quad (10.8)$$

$$\alpha = \alpha_{\text{absorber}} / [1 - (1 - \alpha_{\text{absorber}}) \rho_d] \quad (10.9)$$

where:

$$\alpha_{\text{absorber}} = .95$$

10.1.2 Collector overall heat transfer coefficient, U_L ,

10.1.2.1 Collector top heat transfer coefficient, U_T

U_T is the collector top loss coefficient, from the collector plate to the ambient. It is computed from the heat-transfer coefficients of the various sub-components in the system, from collector plate to ambient, i.e., through:

h_{p-c} = convection coefficient between plate and cover

$h_{r,p-c}$ = radiation coefficient between plate and cover

h_w = wind convection coefficient

$h_{r,c-s}$ = radiation coefficient between cover and sky

$$U_T = [(1/(h_{p-c} + h_{r,p-c})) + (1/(h_w + h_{r,c-s}))]^{-1} \text{ [Wm}^{-2}\text{°C}^{-1}\text{]} \quad (10.10)$$

where

$$h_{p-c} = h_{45}(1 - 0.0018(\bar{T} - 10)) \quad (10.11)$$

$$h_{45} = 1.14 (\Delta T^{.310} / (1 \cdot 10^2)^{.143}) \quad (10.12)$$

$$l = \text{plate to cover spacing} = 0.025 \text{ [m]}$$

$$h_{r,p-c} = [\sigma(T_p^2 + T_c^2)(T_p + T_c)] / [(1/\epsilon_p) + (1/\epsilon_c) - 1] \quad (10.13)$$

$$\sigma = \text{Stefan-Boltzman constant} = 5.6697 \cdot 10^{-8}$$

$$\epsilon_p = \text{plate emittance} = 0.95$$

$$\epsilon_c = \text{cover emittance} = 0.10$$

$$T_p = \text{plate temperature (see subsection 10.1.5)}$$

$$T_c = \text{cover temperature (see subsection 10.1.3)}$$

$$h_{r,c-s} = \epsilon_c \sigma (T_c^2 + T_s^2)(T_c + T_s) \quad (10.14)$$

$$T_s = \text{sky temperature} = 0.0552 T_{\text{air}}^{1.5} \quad (10.15)$$

$$T_{\text{air}} = \text{air temperature} = 10^\circ\text{C}$$

$$h_w = 5.7 + 3.8 V \quad (10.16)$$

$$V = \text{wind speed} = 5 \text{ m s}^{-1}$$

10.1.2.2 Collector bottom heat transfer coefficient, U_b

$$U_b = K/L \quad (10.17)$$

where:

K = thermal conductivity of bottom insulation = 0.045

L = bottom insulation thickness = 0.05

10.1.2.3 Collector edge heat transfer coefficient, U_e

$$U_e = \frac{K}{L} A_{\text{edge}} / A_c \quad (10.18)$$

where:

A_{edge} = collector edge area = 0.95

A_c = 1.6

The collector overall heat transfer coefficient therefore is:

$$U_L = U_T + U_b + U_e \quad (10.19)$$

10.1.3 Collector cover temperature, T_c

$$T_c = T_p - [U_t(T_p - T_a)] / [h_{p-c} + h_{r,p-c}] \quad (10.20)$$

This expression, intuitively apparent, is iteratively used as follows:

- guess T_c
- compute h 's

- compute T_c through eq. 10.20
- re-compute h 's
-

10.1.4 "Thermal remotion" factor, F_R

The F_R factor is computed as a function of mainly two other "efficiency" factors, F and F' . F is the standard fin efficiency for straight fins with rectangular profile: it indicates how much energy is transferred from the portion of plates on both sides of the pipes ("fin") to the flow tubes and, hence, to the fluid. The factor F' represents the ratio of the actual useful energy gain to the useful energy gain if the collector absorbing surface had been at local fluid temperature.

$$F = (\tanh[m(W-D)/2]) / [m(W-D)/2] \quad (10.21)$$

where:

$$m = [U_L / (K_p \delta)]^{1/2} \quad (10.22)$$

$$K_p = \text{plate thermal conductivity} = 210$$

$$\delta = \text{plate thickness} = 5 \cdot 10^{-4}$$

$$W = \text{distance between the axes of the pipes} = 0.1$$

$$D = \text{pipe diameter} = 0.02$$

$$F' = (U_L)^{-1} / [W((U_L(D+(W-D)F))^{-1} + (\pi D_i h_{f,i})^{-1})] \quad (10.23)$$

where:

D_i = pipe internal diameter = 0.016

$h_{f,i}$ = heat transfer coefficient between fluid and tube wall = 300 or 500

$$F_R = (G c_p / U_L)(1 - \exp[-(U_L F') / (G c_p)]) \quad (10.24)$$

where:

G = mass flow rate per unit collector surface = 0.01

c_p = specific heat of cooling fluid = 4,186

10.1.5 Mean fluid temperature, $T_{f,m}$

For the purpose of computing U_T , not only T_c but also T_p had to be initially guessed. The iteration over T_c has already been shown. A similar procedure is used for T_p through the $T_{f,m}$ definition, that follows:

$$T_{f,m} = T_{f,i} + (Q_U / A_c) / (U_L F_R) (1 - (F_R / F')) \quad (10.25)$$

10.2 SIRR2 MODEL ANALYSIS

It is not the purpose of this work to show how a thermal collector (of the type here described) design could be optimized and the purpose of the SIRR2 model is only to show how the CIRR2 code operates. However it is evident that it would not be hard to have SIRR2 optimize a collector geometry, given the material constants (or even letting some arbitrariness on the materials characteristics) and given (if any) operation constraints (e.g. minimum fluid outlet temperature). This type of optimization, though, often ends up by being quite unrealistic because of excess of precision. For the purposes of design it is much more advantageous to the engineer to use the following set of graphs that fully define the collector performance (generally, for fixed materials characteristics) in a parametric way with respect to the geometry of the collector parameters. This series of plottages, whose list follows, is here shown for the purpose of analysis of the SIRR2 code performance and shows that all magnitudes vary as expected, with the proper dependencies (more complex of what might seem at first insight) and trends.

1. U_L
 - 1.1 U_L dependency with respect to K/L
 - 1.2 U_L dependency with respect to A_{edge}/A_c

2. F
 - 2.1 F dependency with respect to $K_p \delta$
 - 2.2 F dependency with respect to $(W-D)$
 - 2.3 F dependency with respect to m

3. F'
 - 3.1 F' dependency with respect to bond conductivity,
 C_B
 - 3.2 F' dependency with respect to W , parametrically
with respect to $K\delta$ for $K\delta$ values from 0.005
 $W^\circ C^{-1}$ to $0.40 W^\circ C^{-1}$ and $h_{f,i} = 300$ and U_L
 $= 2$
 - 3.3 Same as 3.2, but $h_{f,i} = 500$
 - 3.4 Same as 3.2, but $U_L = 4$
 - 3.5 Same as 3.3, but $U_L = 4$
 - 3.6 Same as 3.2, but $U_L = 6$
 - 3.7 Same as 3.3, but $U_L = 6$

4. F_R
 - 4.1 F_R as a function of G

5. Q_u
 - 5.1 Q_u as a function of F_R

6. $\eta = Q_u/E_o$
 - 6.1 η as a function of G

7. $T_{f,o}$

7.1 $T_{f,o}$ as a function of collector length, for
various $T_{f,i}$.

10.3 CIRR2-SIRR2 MODELS COUPLING

The conclusions of this analysis will be extremely concise and entirely left to numbers.

For eight months of a year, the SIRR2 code will be run using as an input the experimental values first and the computed values (on a micro-climatic approximation) of the global energy flux on a collector area of 1.6 m^2 , in Albany, N.Y., and for two different inlet temperatures of the water, 20 and 30 degrees centigrade (Tables 10.1 and 10.2).

The same computation, but only for 5 months and only for one inlet temperature, 30°C will then be performed for Albuquerque, N.M. (Table 10.3)

Finally, for the eight and five months respectively in Albany and Albuquerque a calculation has been made using the average value of the experimental daily radiation for each month and a classical average collector efficiency (from D.O.E. reports and commercial literature) of .55, year round (Tables 10.4 and 10.5).

TABLE 10.1
CIRR2/SIRR2 COUPLING
ALBANY, N.Y.

1979

$T_{f,i} = 20^{\circ}\text{C}$

E_o COMPUTED VALUES

Month	E_o [KJ]	Q_u [KJ]	Collector Efficiency [percent]
Feb.	405,427	65,368	16.12
June	955,410	672,592	70.40
July	1,869,111	1,377,704	73.71
Aug.	743,651	550,079	73.97
Sep.	667,592	430,665	64.51
Oct.	368,166	164,178	44.59
Nov.	231,598	54,289	23.44
Dec.	210,862	19,883	9.43

E_o Total: 5,451,817 Q_u Total: 3,334,758 Efficiency: 61.17

E_o EXPERIMENTAL VALUES

Feb.	410,006	68,118	16.61
June	977,466	680,599	63.63
July	1,917,143	1,397,381	72.89
Aug.	766,612	560,364	73.10
Sep.	729,739	464,892	63.71
Oct.	371,603	168,700	45.40
Nov.	246,947	63,334	25.65
Dec.	230,570	25,900	11.23

E_o Total: 5,650,086 Q_u Total: 3,423,288 Efficiency: 60.69

TABLE 10.2

CIRR2/SIRR2 COUPLING

ALBANY, N.Y.

1979

$$T_{f,i} = 30^{\circ}\text{C}$$

 E_o COMPUTED VALUES

Month	E_o [KJ]	Q_u [KJ]	Collector Efficiency [percent]
Feb.	405,427	28,733	7.09
June	955,410	537,347	56.24
July	1,869,111	1,102,819	59.00
Aug.	743,651	422,860	56.86
Sep.	667,592	319,079	47.80
Oct.	368,166	98,918	26.87
Nov.	231,598	19,516	8.43
Dec.	210,862	2,868	1.36

E_o Total: 5,451,817 Q_u Total: 2,532,140 Efficiency: 46.45

 E_o EXPERIMENTAL VALUES

Feb.	410,006	30,406	7.42
June	977,466	547,522	56.01
July	1,917,143	1,122,460	58.55
Aug.	776,612	435,585	56.82
Sep.	723,739	350,375	48.01
Oct.	371,603	108,111	29.09
Nov.	246,947	25,767	10.43
Dec.	230,570	5,011	2.17

E_o Total: 5,650,086 Q_u Total: 2,625,237 Efficiency: 46.46

TABLE 10.3
CIRR2/SIRR2 COUPLING
ALBUQUERQUE, N.M.
1979

$T_{f,i} = 30^{\circ}\text{C}$

E_o COMPUTED VALUES

Month	E_o [KJ]	Q_u [KJ]	Collector Efficiency [percent]
Feb.	615,627	191,059	31.11
June	1,376,710	903,519	65.63
July	1,341,739	925,683	68.99
Aug.	1,214,159	783,356	64.52
Sep.	902,065	579,662	59.025

E_o Total: 5,530,300 Q_u Total: 3,383,729 Efficiency: 61.185

E_o EXPERIMENTAL VALUES

Feb.	666,108	205,616	30.87
June	1,396,265	909,243	65.12
July	1,397,221	954,908	68.34
Aug.	1,253,185	802,914	64.07
Sep.	1,032,970	596,900	57.785
E_o Total:	5,745,749	Q_u Total: 3,469,581	Efficiency: 60.385

TABLE 10.4
COLLECTOR PERFORMANCE
USING MONTHLY AVERAGE RADIATION VALUES
AND FIXED COLLECTOR EFFICIENCY

ALBANY, N.Y.

Month	E_o [KJ]	Q_u [KJ]	Collector Efficiency [percent]	Collector Efficiency CIRR2/SIRR2 $T_{f,i}=20^\circ\text{C}$ $T_{f,i}=30^\circ\text{C}$ [percent]	
Feb.	337,522	185,037	55	16	7
June	879,514	483,733	55	70	56
July	877,005	482,353	55	74	59
Aug.	789,310	434,121	55	74	57
Sep.	637,536	350,645	55	65	48
Oct.	460,040	253,022	55	45	27
Nov.	249,024	136,963	55	23	8
Dec.	208,334	110,184	55	9	1

E_o Total: 4,430,285 Q_u Total: 2,436,657 Efficiency: 55

FROM CIRR2/SIRR2

E_o Total	Q_o Total	Efficiency	
5,451,817	3,334,758	61	($T_{f,i} = 20^\circ\text{C}$)
5,451,817	2,532,140	46	($T_{f,i} = 30^\circ\text{C}$)

TABLE 10.5
COLLECTOR PERFORMANCE
USING MONTHLY AVERAGE RADIATION VALUES
AND FIXED COLLECTOR EFFICIENCY

ALBUQUERQUE. N.M.

Month	E_o [KJ]	Q_u [KJ]	Collector Efficiency [percent]	Collector Efficiency CIRR2/SIRR2 $T_{f,i}=30^\circ\text{C}$ [percent]
Feb.	682,304	375,267	55	31
June	1,459,344	802,639	55	66
July	1,400,853	770,469	55	69
Aug.	1,289,104	709,007	55	65
Sep.	1,074,096	590,753	55	59

E_o Total: 5,905,701 Q_u Total: 3,248,136 Efficiency: 55

FROM CIRR2/SIRR2

E_o Total	Q_o Total	Efficiency	
5,530,300	3,383,729	61	$(T_{f,i} = 30^\circ\text{C})$

A better understanding of why the collector behaves in such a way, i.e., of using the non-steady data operation mode of the collector, has such an influence on its performance, is gained examining step-by-step computations of SIRR2 (using CIRR2 as an input) and is explained by the fact that a solar collector practically works all the time in a transient mode, due to continuous meteorological and irradiance variations with time.

The following outputs correspond to one day of collector operation in Albuquerque, N.M.; all the design parameters defined in Section 10.1 are computed on an hourly basis; the two iterations, also performed every hour, needed for the T_p and T_c computation, are also reported. The fact that all of those parameters show hourly variations is of particular interest and the reason itself of this work (e.g., note the variation of the cover transmission factor, close to zero on the first and last hours of insolation, due to its dependency with respect to the angle of incidence). Finally, the CIRR2 design chart is also reported.

SIRRAGGIA2

A. G. RUSSO

THERMAL FLUID MONOPHASIC FLAT PLATE SOLAR COLLECTOR
ONE COVER, H CONVECTION, PLATE COVER 45 DEGREES

LOCATION: ALBUQUERQUE, NM 35.05 NORTH 105.62 WEST ALT: 1619.0 METERS

DATE: 9/29/78

TP	TC	DT																
13.90000	12.02545	0.0																
13.90000	12.06410	1.87455																
TIME	ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFO	ETA	RE	
-->	6. 0.958	0.155	****	6.5	12.0	*****	*****	*****	*****	*****	*****	6.	30.0	*****	*****	*****	*****	
	11.96583		14.04277		0.0													
	11.96583		14.07581		0.0													
TIME	ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFO	ETA	RE	
-->	7. 0.958	0.573	****	6.5	18.7	*****	*****	*****	*****	*****	*****	352.	30.0	*****	*****	*****	*****	
	18.72383		18.36395		0.0													
	18.72383		18.36719		0.35988													
	31.92392		21.05461		13.55673													
	31.92392		21.02226		10.86931													
TIME	ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFO	ETA	RE	
-->	8. 0.958	0.765	5.8	7.3	31.6	21.0	0.981	0.916	0.842	457.	127.	1462.	30.0	31.0	31.5	0.313	20.	
	31.63382		21.85043		0.0													
	31.63382		22.30855		9.78339													
	31.63382		22.30267		9.32527													
	35.17247		23.10312		12.86980													
	35.17247		23.09291		12.06935													
TIME	ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFO	ETA	RE	
-->	9. 0.958	0.836	6.0	8.0	35.1	23.1	0.980	0.915	0.840	1434.	398.	2701.	30.0	33.1	34.8	0.531	20.	
	35.12488		23.86562		0.0													
	35.12488		24.42636		11.25926													
	35.12488		24.41924		10.69852													
	38.14110		25.11739		13.72186													

	TIME	ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	E0IN	TFI	TFM	TFO	ETA	RE
		38.14110		25.10860		13.02371												
-->	10.	0.958	0.863	6.1	8.1	38.1	25.1	0.980	0.914	0.838	2266.	630.	3738.	30.0	34.8	37.6	0.606	21.
		38.09901		26.63641		0.0												
		38.09901		27.22174		11.46260												
		38.09901		27.21445		10.87727												
		40.43797		27.76096		13.22353												
		40.43797		27.75417		12.67702												
		38.09901		26.63641		0.0												
		38.09901		27.22174		11.46260												
		38.09901		27.21445		10.87727												
		40.43797		27.76096		13.22353												
		40.43797		27.75417		12.67702												
-->	11.	0.958	0.872	6.2	8.2	40.4	27.8	0.980	0.913	0.837	2911.	809.	4482.	30.0	36.2	39.8	0.650	21.
		40.40582		28.70821		0.40582												
		40.40582		29.08000		11.69762												
		40.40582		29.07539		11.32582												
		41.60815		29.35826		12.53276												
-->	12.	0.958	0.872	6.2	8.2	41.6	29.4	0.980	0.913	0.836	3243.	901.	4861.	30.0	36.9	40.9	0.667	21.
		41.59071		30.44756		1.59071												
		41.59071		30.68118		11.14316												
-->	13.	0.958	0.866	6.2	8.2	41.7	30.7	0.980	0.913	0.836	3276.	910.	4845.	30.0	37.0	41.1	0.676	21.
		41.71001		31.77129		1.71001												
		41.71001		31.95938		9.93872												
		40.61992		31.70613		8.66054												
-->	14.	0.953	0.846	6.1	8.1	40.6	31.7	0.980	0.914	0.838	2976.	827.	4418.	30.0	36.4	40.0	0.674	21.
		40.63412		31.96729		0.63412												
		40.63412		32.18594		8.66684												
		38.21032		31.64000		6.02487												
		38.21032		31.64680		6.57082												
-->	15.	0.953	0.787	5.9	7.9	38.2	31.6	0.980	0.915	0.840	2305.	640.	3635.	30.0	34.9	37.8	0.634	21.
		38.23343		31.34486		0.0												
		38.23343		31.65527		6.88857												
		34.67442		30.88802		3.01915												

31.05391	30.18636	0.87738														
TIME ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFD	ETA	RE
--> 17. 0.958	0.266	5.2	7.2	31.1	30.2	0.982	0.922	0.853	298.	83.	1371.	30.0	30.6	31.0	0.217	20.
31.06299	26.88757	0.0														
31.06299	27.03975	4.17542														
TIME ALPHA	TAU	UT	UL	TP	TC	F	F'	FR	QU	QUD	EOIN	TFI	TFM	TFD	ETA	RE
--> 18. 0.958	0.089	****	6.5	27.2	*****	*****	*****	*****	*****	*****	294.	30.0	*****	*****	*****	*****

EO INPUT:	34746.	QU SUMMED:	20482.	ETA FOR THE DAY:	0.58948
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CIRR2 DESIGN GRAPH

APPENDIX A3

COMPUTATION OF THE AMOUNT OF PRECIPITABLE WATER AND OF THE EQUIVALENT HEIGHT OF THE ATMOSPHERE

It will be assumed that the gases that constitute the atmosphere behave as perfect gases. Thus, for each:*

$$p_i v_i = R_i T \quad (i = 1, 2, \dots, n) \quad (\text{A3.1})$$

where:

p_i = partial pressure [N m^{-2}]

T = temperature [K]

v_i = specific volume [$\text{m}^3 \text{kg}^{-1}$]

R_i = specific gas content of the i -th gas [$\text{m}^2 \text{s}^{-2} \text{deg}^{-1}$].

The R_i gas constant is related to the molar gas constant, R , and the molecular weight of the i -th gas, M_i , by the relation:

$$R_i = \frac{R}{M_i} \quad (\text{A3.2})$$

*Equation of a perfect gas.

According to Dalton's Law:*

$$P_D = \sum_{i=1}^n p_i \quad (A3.3)$$

If v is the specific volume of dry air (i.e., the volume of one kilogram of air) and if m_i is the mass of the i -th gas in one kilogram of dry air, then:

$$v_i = \frac{v}{m_i} \quad (A3.4)$$

Substituting in eq. A3.1, summing, and from eq. A3.3:

$$v \sum_{i=1}^n p_i = v P_D = T \sum_{i=1}^n m_i R_i \quad (A3.5)$$

Define R_D as:

$$R_D = \sum_{i=1}^n m_i R_i \quad (A3.6)$$

From eqs. A3.5, A3.3, and A3.6, the following may be written:

*". . . the pressure of the mixture equals the sum of the partial pressures."

$$P_D v = R_D T \quad (A3.7)$$

Equation A3.7 is formally known as the equation of state of dry air. From eq. A3.2, the gas constant of dry air may be computed when the composition of the atmosphere is known. Thus:

$$R_D = 287 \quad [m^2 \text{ sec}^{-2} \text{ deg}^{-1}]$$

Moist air is a mechanical mixture of dry air and water vapor. Although the atmospheric temperatures are lower than the critical temperatures of water vapor, it will be assumed that the physical properties of water vapor approximate those of a perfect gas. Thus the equation of state of water vapor can be written as:

$$p_w v_w = R_w T \quad (A3.8)$$

where:

p_w = partial pressure $[N \text{ m}^{-2}]$

v_w = specif. volume $[m^3 \text{ Kg}^{-1}]$

R_w = "water" vapor constant $[m^2 \text{ sec}^{-2} \text{ deg}^{-1}]$.

From eq. A3.2, R_w may be computed:

$$R_w = 461 \quad [m^2 \text{ sec}^{-2} \text{ deg}^{-1}].$$

The dry air and the water vapor are uniformly distributed within the entire volume, v , of the moist air; the specific volumes of dry air, v_D , and water vapor, v_w , are:

$$v_D = v/(1 - S) \quad (A3.9)$$

$$v_w = v/\alpha \quad (A3.10)$$

where:

v = volume of kilograms of water and $(1 - \alpha)$ kilograms of dry air.

The equation of state of the dry fraction of the moist air may be written as:

$$(P_M - p_w) v = R T \quad (A3.11)$$

where:

P_M = total pressure of moist air $[N\ m^{-2}]$

p_w = partial pressure of water vapor $[N\ m^{-2}]$.

From eq. A3.2, the following may be derived:

$$R_w/R_D = 1.608 \quad [\text{adimensional}] \quad (A3.12)$$

By substituting eqs. A3.9, A3.10 and A3.12 into eqs. A3.8 and A3.11:

$$p_w \frac{v}{\alpha} = 1.608 R_D T \quad (\text{A3.13})$$

$$(P_M - p_w) v / (1 - \alpha) = R_D T \quad (\text{A3.14})$$

Adding eqs. A3.13 and A3.14 gives:

$$P_M v = T R_D (1 + 0.608 \alpha) \quad (\text{A3.15})$$

Equation A3.15 is known as the equation of state of moist air. It may be rewritten as:*

$$P_M v = R_M T \quad (\text{A3.16})$$

where:

$$R_M = R_D (1 + 0.608 \alpha). \quad (\text{A3.17})$$

It should be stressed that R_M is a function of the air humidity, α .

*If the factor $(1 + 0.608 \alpha)$ is considered to affect the temperature term, the concept of virtual temperature, T_v , is introduced ($T_v = T(1 + 0.608 \alpha)$) and the equation of the state of moist air may be written in terms of the dry air gas constituent. This is often done in meteorological applications.

Defining the mixing ratio as the ratio of the mass of water vapor per unit volume to the mass of dry air per unit volume, its numerical value will equal the amount of water vapor per unit mass of dry air.

From this definition and from equations A3.8 and A3.11, the relation between the mixing ratio, MR, and the air humidity, α , may be simply derived:

$$MR = \frac{\alpha}{1 - \alpha} \quad (A3.18)$$

The difference between the mixing ratio and α is very small.

Recalling eq. A3.11 (equation of state of the dry fraction of moist air) and eq. A3.8 (equation of state of water vapor), the mixing ratio may be expressed as follows:

$$MR = (R_D/R_W)(p_W/(P - p_W)) \quad (A3.19)$$

Therefore, the equation of state of moist air (eq. A3.17) may be rewritten as:

$$R_M = R_D (1 + 0.608 MR) \quad (A3.20)$$

1. Precipitable water computation

With all these concepts established, computation of the amount of precipitable water may be attempted.

It will be assumed that dry-bulb temperature and pressure are known. The amount of humidity will be considered through the dew-point "temperature," although other parameters, such as relative humidity, might be used.

The partial pressure of the water vapor in the gas mixture may be computed, using the following numerical solution of the Clausius-Clapeyron equation:*

$$\begin{aligned} \log_{10} p_w = & 10.79586(1 - T_{SK}/T_{DP}) + 5.02808 \log_{10}(T_{SK}/T_{DP}) \quad (A3.21) \\ & + 1.50474 \cdot 10^{-4} [1 - 10^{-8.29692(T_{DP}/T_{SK} - 1)}]^{10} \\ & + 0.42873 \cdot 10^{-3} [10^{4.76955(1 - T_{SK}/T_{DP})} - 1] \\ & - 2.2195983 \end{aligned}$$

*From the Smithsonian Institution, Washington, D.C.

where:

p_w = partial pressure of water vapor [atm]

T_{SK} = 283.16 [K]

T_{DP} = station dew-point "temperature" [K].

Note that eq. A3.21 furnishes p_w in atmospheres; its conversion into S.I. units will be implicitly assumed from now on.

Recalling eq. A3.8, the water vapor density may be computed as:

$$\rho_w = p_w / (R_w T_{DBK}) \quad (A3.22)$$

where:

ρ_w = water vapor density [Kg m^{-3}]

T_{DBK} = station dry-bulb temperature [K].

Recalling the concept of "equivalent height of the atmosphere," the amount of precipitable water may be computed from the following relation:

$$w = \rho_w H_w \quad (A3.23)$$

where:

w = amount of precipitable water [mm]

H_w = "water vapor scale height" of the atmosphere [m]

ρ_w = water vapor density [Kg m^{-3}].

A dimensional analysis will help to understand eq. A3.23. Recalling that 1 kg of water $\approx$ 1 liter of water = 1 dm^3 of water, the dimensional analysis of eq. A3.23 would be:

$$[\text{Kg m m}^{-3}] = [\text{Kg m}^{-2}] \approx [\text{dm}^3 \text{ m}^{-2}] = [10^6 \text{ mm}^3 10^6 \text{ mm}^{-2}] = \text{mm}$$

The "water vapor scale height" of the atmosphere (or the equivalent height of the atmosphere generally adopted in those applications) is two kilometers. Seasonally optimized values for different "Standard Meteorological Areas" have previously been computed.

Due to complete ignorance of the even low atmospheric movements here assumed, the precision of this calculation is low; final results may be obtained with an error range of 40 percent. The consequent error of the E_0 computation may be immediately derived from the sensitivity analysis plottages, reported in Chapter 5.

The results of the amount of precipitable water computation for a location at which temperatures, pressure, and experimental precipitable water daily values are available, follow:

AMOUNT OF PRECIPITABLE WATER AND EQUIVALENT HEIGHT OF THE ATMOSPHERE COMPUTATION

ALBANY, NY (USA)

LAT. 42.70 DEG. NORTH LONG. 73.83 DEG. WEST ALT. 79.30 [M]

INPUT DATA:

TDB = DRY BULB TEMPERATURE [K]
TDP = DEW POINT [K]
P = ATMOSPHERIC PRESSURE [N/SQ.M]
RW = WATER VAPOR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
RD = DRY AIR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
G = ACCELERATION OF GRAVITY [M/SEC. SQ.]
HW = WATER VAPOR EQUIVALENT HEIGHT [M]
HSA = EQUIVALENT HEIGHT OF THE STANDARD ATMOSPHERE [M]

OUTPUT DATA:

PW = WATER VAPOR PARTIAL PRESSURE [N/SQ.M]
WM = AMOUNT OF PRECIPITABLE WATER [MM]
RWM = WATER VAPOR DENSITY [KG/CUB.M]
MR = MIXING RATIO [ADIM.]
RMA = MOIST AIR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
ROMA = MOIST AIR DENSITY [KG/CUB.M]
H = EQUIVALENT HEIGHT OF THE ATMOSPHERE [M]

AMOUNT OF PRECIPITABLE WATER COMPUTATION:

THE EXPERIMENTAL VALUES OF THE AMOUNT OF PRECIPITABLE WATER DISPLAYED ARE OBTAINED BY LINEAR INTERPOLATION OF THE TWO DAILY MEASUREMENTS

PRECIPITABLE WATER COMPUTATION

FEB. 1, 1979

DAY NUMBER 32

RV = 461.0 [SQ.M/SEC.SQ. M]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

MERID. TIME	TDB	TDP	PW	ROW	WW COMPUTED	WW EXPER.	RELATIVE ERROR (%)	SOLAR TIME
8.00	262.2	256.2	162.0	0.001	3.25	4.42	-26.57	7.86
9.00	262.2	257.2	176.1	0.001	3.53	4.52	-21.93	8.86
10.00	263.2	257.2	176.1	0.001	3.52	4.64	-24.24	9.86
11.00	264.2	257.2	176.1	0.001	3.50	4.73	-25.96	10.86
12.00	265.2	257.2	176.1	0.001	3.49	4.85	-28.07	11.86
13.00	265.2	257.2	176.1	0.001	3.49	4.94	-29.38	12.86
14.00	265.2	257.2	176.1	0.001	3.49	5.06	-31.05	13.86
15.00	265.2	257.2	176.1	0.001	3.49	5.15	-32.26	14.86
16.00	265.2	258.2	191.3	0.002	3.79	5.27	-28.08	15.86
17.00	265.2	258.2	191.3	0.002	3.79	5.38	-29.55	16.86
18.00	265.2	258.2	191.3	0.002	3.79	5.49	-30.96	17.86

DAILY AVERAGE COMPUTED WW = 3.56
DAILY EXPERIMENTAL WW = 4.95
DAILY RELATIVE ERROR (%) = -28.16

PRECIPITABLE WATER COMPUTATION

FEB. 2, 1979

DAY NUMBER 33

RW = 461.0 [SQ.M/SEC.SQ. K]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

MEAS ID. TIME	TDB	TDP	PW	RDW	WW COMPUTED	WW EXPER.	RELATIVE ERROR (%)	SOLAR TIME
8.00	262.2	256.2	162.0	0.001	3.25	4.93	-34.16	7.85
9.00	262.2	256.2	162.0	0.001	3.25	5.03	-35.47	8.85
10.00	263.2	257.2	176.1	0.001	3.52	5.14	-31.61	9.85
11.00	264.2	257.2	176.1	0.001	3.50	5.25	-33.29	10.85
12.00	266.2	258.2	191.3	0.002	3.78	5.35	-29.42	11.85
13.00	266.2	259.2	207.7	0.002	4.10	5.46	-24.92	12.85
14.00	266.2	259.2	207.7	0.002	4.10	5.56	-26.27	13.85
15.00	267.2	260.2	225.3	0.002	4.43	5.67	-21.86	14.85
16.00	267.2	260.2	225.3	0.002	4.43	5.77	-23.22	15.85
17.00	266.2	260.2	225.3	0.002	4.45	5.88	-24.37	16.85
18.00	265.2	260.2	225.3	0.002	4.46	5.99	-25.48	17.85

DAILY AVERAGE COMPUTED WW = 3.93
DAILY EXPERIMENTAL WW = 5.46
DAILY RELATIVE ERROR (%) = -27.94

PRECIPITABLE WATER COMPUTATION

FEB. 11, 1979

DAY NUMBER 42

RW = 461.0 [SQ.M/SEC.SQ. K]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

MERID. TIME	TDB	TDP	PH	ROW	WW COMPUTED	WW EXPER.	RELATIVE ERROR (%)	SOLAR TIME
8.00	250.2	240.2	38.2	0.000	0.80	1.02	-21.33	7.84
9.00	251.2	241.2	42.1	0.000	0.88	1.02	-13.70	8.84
10.00	253.2	241.2	42.1	0.000	0.87	1.02	-14.38	9.84
11.00	254.2	242.2	46.3	0.000	0.96	1.02	-6.15	10.84
12.00	255.2	243.2	50.9	0.000	1.05	1.02	2.78	11.84
13.00	256.2	243.2	50.9	0.000	1.04	1.02	2.38	12.84
14.00	257.2	243.2	50.9	0.000	1.04	1.02	1.98	13.84
15.00	258.2	244.2	55.9	0.000	1.14	1.02	11.59	14.84
16.00	258.2	244.2	55.9	0.000	1.14	1.02	11.59	15.84
17.00	257.2	243.2	50.9	0.000	1.04	1.02	1.98	16.84
18.00	256.2	242.2	46.3	0.000	0.95	1.02	-6.89	17.84

DAILY AVERAGE COMPUTED WW = 0.99
DAILY EXPERIMENTAL WW = 1.02
DAILY RELATIVE ERROR (%) = -2.74

PRECIPITABLE WATER COMPUTATION

FEB. 12, 1979

DAY NUMBER 43

RW = 461.0 [SQ.M/SEC.SQ. K]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

REG ID. TIME	TDB	TDP	PW	ROW	WM COMPUTED	WM EXPER.	RELATIVE ERROR (%)	SOLAR TIME
8.00	251.2	246.2	67.3	0.001	1.41	2.06	-31.64	7.84
9.00	252.2	246.2	67.3	0.001	1.40	2.11	-33.53	8.84
10.00	254.2	246.2	67.3	0.001	1.39	2.15	-35.28	9.84
11.00	256.2	248.2	80.7	0.001	1.66	2.19	-24.38	10.84
12.00	258.2	248.2	80.7	0.001	1.64	2.23	-26.31	11.84
13.00	259.2	248.2	80.7	0.001	1.64	2.28	-28.20	12.84
14.00	260.2	248.2	80.7	0.001	1.63	2.32	-29.71	13.84
15.00	260.2	248.2	80.7	0.001	1.63	2.36	-30.90	14.84
16.00	260.2	247.2	73.8	0.001	1.49	2.40	-37.94	15.84
17.00	260.2	248.2	80.7	0.001	1.63	2.46	-33.71	16.84
18.00	260.2	247.2	73.8	0.001	1.49	2.50	-40.42	17.84

DAILY AVERAGE COMPUTED WM = 1.55
DAILY EXPERIMENTAL WM = 2.28
DAILY RELATIVE ERROR (%) = -32.13

PRECIPITABLE WATER COMPUTATION

FEB. 21, 1979

DAY NUMBER 52

RW = 461.0 [SQ.M/SEC.SQ. K]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

MERID. TIME	TDB	TDP	PM	ROW	WW COMPUTED	WW EXPER.	RELATIVE ERROR (%)	SOLAR TIME
7.00	269.2	265.2	335.0	0.003	6.54	3.56	83.70	6.85
8.00	269.2	266.2	362.0	0.003	7.07	4.47	58.07	7.85
9.00	271.2	267.2	390.8	0.003	7.57	5.38	40.76	8.85
10.00	273.2	268.2	421.7	0.003	8.11	6.28	29.16	9.85
11.00	274.2	269.2	454.8	0.004	8.71	7.19	21.21	10.85
12.00	276.2	269.2	454.8	0.004	8.65	8.10	6.81	11.85
13.00	276.2	269.2	454.8	0.004	8.65	9.02	-4.08	12.85
14.00	276.2	271.2	527.8	0.004	10.04	9.93	1.12	13.85
15.00	275.2	272.2	568.1	0.004	10.85	10.84	0.07	14.85
16.00	274.2	273.2	611.1	0.005	11.71	11.75	-0.33	15.85
17.00	275.2	273.2	611.1	0.005	11.67	12.65	-7.76	16.85
18.00	275.2	273.2	611.1	0.005	11.67	13.55	-13.95	17.85

DAILY AVERAGE COMPUTED WW = 9.27
DAILY EXPERIMENTAL WW = 8.56
DAILY RELATIVE ERROR (%) = 8.29

PRECIPITABLE WATER COMPUTATION

FEB. 22, 1979

DAY NUMBER 53

BW = 461.0 [SQ.M/SEC.SQ. K]
G = 9.806 [M/SEC.SQ.]

TS = 273.16 [K]
HW = 2422.04 [M]

MERID. TIME	TDB	TDP	PW	ROW	WW COMPUTED	WW EXPER.	RELATIVE ERROR (%)	SOLAR TIME
7.00	276.2	271.2	527.8	0.004	10.04	10.67	-5.89	6.85
8.00	276.2	271.2	527.8	0.004	10.04	10.35	-2.98	7.85
9.00	276.2	270.2	490.1	0.004	9.32	10.02	-6.95	8.85
10.00	276.2	270.2	490.1	0.004	9.32	9.72	-4.08	9.85
11.00	276.2	270.2	490.1	0.004	9.32	9.39	-0.70	10.85
12.00	276.2	271.2	527.8	0.004	10.04	9.07	10.71	11.85
13.00	276.2	271.2	527.8	0.004	10.04	8.76	14.63	12.85
14.00	276.2	271.2	527.8	0.004	10.04	8.44	18.98	13.85
15.00	276.2	271.2	527.8	0.004	10.04	8.13	23.51	14.85
16.00	276.2	271.2	527.8	0.004	10.04	7.81	28.57	15.85
17.00	276.2	271.2	527.8	0.004	10.04	7.48	34.25	16.85
18.00	275.2	271.2	527.8	0.004	10.08	7.18	40.36	17.85

DAILY AVERAGE COMPUTED WW = 9.87
DAILY EXPERIMENTAL WW = 8.92
DAILY RELATIVE ERROR (%) = 10.62

2. Equivalent height computation

The equivalent height of the atmosphere has been given in Chapter 2. There it was shown how it is possible, for a location at a zero elevation, to avoid its computation for the determination of the density integral, A_0 .

However, H may be computed as follows.

- i. the mixing ratio is computed from eq. A3.19;
- ii. the moist air constant is computed from eq. A3.20;
- iii. the moist air density computation may now be performed from eq. A3.15 (the equation of state of moist air).

Therefore, H may be computed from eq. 4.7:

$$H = P(0)/[\rho(0) g]$$

where:

- H = equivalent height of the atmosphere [m]
 $P(0)$ = sea-level atmospheric pressure [N m^{-2}]
 $\rho(0)$ = moist air sea-level density [Kg m^{-3}]
 g = acceleration of gravity [m s^{-2}].

The results of the equivalent height computation, for a location at which temperatures and pressures are known, are:

AMOUNT OF PRECIPITABLE WATER AND EQUIVALENT HEIGHT OF THE ATMOSPHERE COMPUTATION

ALBANY, NY (USA)

LAT. 42.70 DEG. NORTH LONG. 73.83 DEG. WEST ALT. 79.30 [M]

INPUT DATA:

TDB = DRY BULB TEMPERATURE [K]
TDP = DEW POINT [K]
P = ATMOSPHERIC PRESSURE [N/SQ.M]
RW = WATER VAPOR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
RD = DRY AIR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
G = ACCELERATION OF GRAVITY [N/SEC.SQ.]
HW = WATER VAPOR EQUIVALENT HEIGHT [M]
HSA = EQUIVALENT HEIGHT OF THE STANDARD ATMOSPHERE [M]

OUTPUT DATA:

PW = WATER VAPOR PARTIAL PRESSURE [N/SQ.M]
WW = AMOUNT OF PRECIPITABLE WATER [MM]
ROW = WATER VAPOR DENSITY [KG/CUB.M]
MR = MIXING RATIO [ADIM.]
RMA = MOIST AIR 'GAS CONSTANT' [SQ.M/SEC.SQ. K]
ROMA = MOIST AIR DENSITY [KG/CUB.M]
H = EQUIVALENT HEIGHT OF THE ATMOSPHERE [M]

EQUIVALENT HEIGHT OF THE ATMOSPHERE COMPUTATION:

THE 1971 STANDARD ATMOSPHERE HAS THE FOLLOWING PROPERTIES:

PRESSURE = 101325. [N/SQ.M]
DENSITY = 1.225 [KG/CUB.M]

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 1, 1979

DAY NUMBER 32

RM = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.16 [K]

MERID. TIME	TDB	TDP	P	PW	ROW	MP	RMA	RONA	H	HSA	REL. DIFF. (%)	SOLAR TIME
8.00	262.2	256.2	98883.	161.96	0.001	0.001	287.18	1.31	7677.60	8433.81	8.97	7.86
9.00	262.2	257.2	98950.	176.08	0.001	0.001	287.19	1.31	7678.01	8433.81	8.96	8.86
10.00	263.2	257.2	98984.	176.08	0.001	0.001	287.19	1.31	7707.30	8433.81	8.61	9.86
11.00	264.2	257.2	99018.	176.08	0.001	0.001	287.19	1.31	7736.59	8433.81	8.27	10.86
12.00	265.2	257.2	98984.	176.08	0.001	0.001	287.19	1.30	7765.87	8433.81	7.92	11.86
13.00	265.2	257.2	98984.	176.08	0.001	0.001	287.19	1.30	7765.87	8433.81	7.92	12.86
14.00	265.2	257.2	99018.	176.08	0.001	0.001	287.19	1.30	7765.87	8433.81	7.92	13.86
15.00	265.2	257.2	99120.	176.08	0.001	0.001	287.19	1.30	7765.86	8433.81	7.92	14.86
16.00	265.2	258.2	99221.	191.29	0.002	0.001	287.21	1.30	7766.31	8433.81	7.91	15.86
17.00	265.2	258.2	99323.	191.29	0.002	0.001	287.21	1.30	7766.30	8433.81	7.91	16.86
18.00	265.2	258.2	99341.	191.29	0.002	0.001	287.21	1.31	7766.30	8433.81	7.91	17.86

DAILY AVERAGE COMPUTED H = 7741.98
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -8.20

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 2, 1979

DAY NUMBER 33

RW = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.15 [K]

MERID. TIME	TDB	TDP	P	PW	ROW	HR	RHA	ROMA	H	HSA	REL. DIFF. (%)	SOLAR TIME
8.00	262.2	256.2	100203.	161.96	0.001	0.001	287.18	1.33	7677.54	8433.81	8.97	7.85
9.00	262.2	256.2	100254.	161.96	0.001	0.001	287.18	1.33	7677.53	8433.81	8.97	8.85
10.00	263.2	257.2	100305.	176.08	0.001	0.001	287.19	1.33	7707.23	8433.81	8.62	9.85
11.00	264.2	257.2	100254.	176.08	0.001	0.001	287.19	1.32	7736.52	8433.81	8.27	10.85
12.00	266.2	258.2	100203.	191.29	0.002	0.001	287.21	1.31	7795.55	8433.81	7.57	11.85
13.00	266.2	259.2	100186.	207.67	0.002	0.001	287.23	1.31	7796.03	8433.81	7.56	12.85
14.00	266.2	259.2	100169.	207.67	0.002	0.001	287.23	1.31	7796.02	8433.81	7.56	13.85
15.00	267.2	260.2	100169.	225.29	0.002	0.001	287.24	1.31	7825.84	8433.81	7.21	14.85
16.00	267.2	260.2	100254.	225.29	0.002	0.001	287.24	1.31	7825.83	8433.81	7.21	15.85
17.00	266.2	260.2	100322.	225.29	0.002	0.001	287.24	1.31	7796.55	8433.81	7.56	16.85
18.00	265.2	260.2	100390.	225.29	0.002	0.001	287.24	1.32	7767.25	8433.81	7.90	17.85

DAILY AVERAGE COMPUTED H = 7763.79
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -7.94

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 11, 1979

DAY NUMBER 42

PM = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.16 [K]

MERID. TIME	TDB	TDP	P	PW	FOV	MR	RMA	ROMA	H	HSA	REL. DIFF. (%)	SOLAR TIME
8.00	250.2	240.2	101998.	38.21	0.000	0.000	287.04	1.42	7322.65	8433.81	13.18	7.84
9.00	251.2	241.2	102032.	42.08	0.000	0.000	287.04	1.42	7352.03	8433.81	12.83	8.84
10.00	253.2	241.2	102032.	42.08	0.000	0.000	287.04	1.40	7410.58	8433.81	12.13	9.84
11.00	254.2	242.2	102032.	46.31	0.000	0.000	287.05	1.40	7439.97	8433.81	11.78	10.84
12.00	255.2	243.2	102032.	50.91	0.000	0.000	287.05	1.39	7469.37	8433.81	11.44	11.84
13.00	256.2	243.2	101964.	50.91	0.000	0.000	287.05	1.39	7498.64	8433.81	11.09	12.84
14.00	257.2	243.2	101896.	50.91	0.000	0.000	287.05	1.33	7527.92	8433.81	10.74	13.84
15.00	258.2	244.2	101863.	55.93	0.000	0.000	287.06	1.37	7557.34	8433.81	10.39	14.84
16.00	258.2	244.2	101863.	55.93	0.000	0.000	287.06	1.37	7557.34	8433.81	10.39	15.84
17.00	257.2	243.2	101880.	50.91	0.000	0.000	287.05	1.38	7527.92	8433.81	10.74	16.84
18.00	256.2	242.2	101913.	46.31	0.000	0.000	287.05	1.39	7498.52	8433.81	11.09	17.84

DAILY AVERAGE COMPUTED H = 7469.25
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -11.44

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 12, 1979

DAY NUMBER 43

RM = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.16 [K]

MERID. TIME	TDD	TDP	P	PM	ROW	MR	RMA	ROMA	H	HSA	RXL. DIFF. (%)	SOLAR TIME
8.00	251.2	246.2	101896.	67.31	0.001	0.000	287.07	1.41	7352.72	8433.81	12.82	7.84
9.00	252.2	246.2	101829.	67.31	0.001	0.000	287.07	1.41	7382.00	8433.81	12.47	8.84
10.00	254.2	246.2	101761.	67.31	0.001	0.000	287.07	1.39	7440.55	8433.81	11.78	9.84
11.00	256.2	248.2	101693.	80.75	0.001	0.000	287.09	1.38	7499.48	8433.81	11.08	10.84
12.00	258.2	248.2	101558.	80.75	0.001	0.000	287.09	1.37	7558.04	8433.81	10.38	11.84
13.00	259.2	248.2	101456.	80.75	0.001	0.000	287.09	1.36	7587.32	8433.81	10.04	12.84
14.00	260.2	248.2	101321.	80.75	0.001	0.000	287.09	1.36	7616.60	8433.81	9.69	13.84
15.00	260.2	248.2	101219.	80.75	0.001	0.000	287.09	1.36	7616.60	8433.81	9.69	14.84
16.00	260.2	247.2	101185.	73.76	0.001	0.000	287.00	1.35	7616.39	8433.81	9.69	15.84
17.00	260.2	248.2	101202.	80.75	0.001	0.000	287.09	1.35	7616.60	8433.81	9.69	16.84
18.00	260.2	247.2	101202.	73.76	0.001	0.000	287.08	1.36	7616.39	8433.81	9.69	17.84

DAILY AVERAGE COMPUTED H = 7536.60
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -10.64

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 21, 1979

DAY NUMBER 52

RW = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.16 [K]

MERID. TIME	TDB	TDP	P	PW	ROW	MR	RMA	ROMA	H	HSA	REL. DIFF. (%)	SOLAR TIME
7.00	269.2	265.2	101338.	335.03	0.003	0.002	287.36	1.31	7887.60	8433.81	6.48	6.85
8.00	269.2	266.2	101308.	361.97	0.003	0.002	287.39	1.31	7888.40	8433.81	6.47	7.85
9.00	271.2	267.2	101287.	390.83	0.003	0.002	287.42	1.30	7947.88	8433.81	5.76	8.85
10.00	273.2	268.2	101168.	421.72	0.003	0.003	287.45	1.29	8007.45	8433.81	5.06	9.85
11.00	274.2	269.2	101033.	454.77	0.004	0.003	287.49	1.28	8037.78	8433.81	4.70	10.85
12.00	276.2	269.2	100881.	454.77	0.004	0.003	287.49	1.27	8096.43	8433.81	4.00	11.85
13.00	276.2	269.2	100694.	454.77	0.004	0.003	287.49	1.27	8096.46	8433.81	4.00	12.85
14.00	276.2	271.2	100593.	527.82	0.004	0.003	287.57	1.27	8098.72	8433.81	3.97	13.85
15.00	275.2	272.2	100593.	568.12	0.004	0.004	287.62	1.27	8070.63	8433.81	4.31	14.85
16.00	274.2	273.2	100440.	611.11	0.005	0.004	287.66	1.27	8042.64	8433.81	4.64	15.85
17.00	275.2	273.2	100356.	611.11	0.005	0.004	287.67	1.27	8071.99	8433.81	4.29	16.85
18.00	275.2	273.2	100288.	611.11	0.005	0.004	287.67	1.27	8072.00	8433.81	4.29	17.85

DAILY AVERAGE COMPUTED H = 8026.49
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -4.53

EQUIVALENT HEIGHT OF THE ATMOSPHERE

FEB. 22, 1979

DAY NUMBER 53

RW = 461.0 [SQ.M/SEC.SQ. K]

TS = 273.16 [K]

REFID. TIME	TDB	TDP	P	PW	ROW	MR	RMA	ROMA	H	HSA	REL. DIFF. (%)	SOLAR TIME
7.00	276.2	271.2	101101.	527.82	0.004	0.003	287.57	1.27	8098.64	8433.81	3.97	6.85
8.00	276.2	271.2	101304.	527.82	0.004	0.003	287.57	1.28	8098.60	8433.81	3.97	7.85
9.00	276.2	270.2	101456.	490.09	0.004	0.003	287.53	1.28	8097.44	8433.81	3.99	8.85
10.00	276.2	270.2	101270.	490.09	0.004	0.003	287.53	1.28	8097.46	8433.81	3.99	9.95
11.00	276.2	270.2	101592.	490.09	0.004	0.003	287.53	1.28	8097.41	8433.81	3.99	10.85
12.00	276.2	271.2	101642.	527.82	0.004	0.003	287.57	1.28	8098.55	8433.81	3.98	11.85
13.00	276.2	271.2	101558.	527.82	0.004	0.003	287.57	1.28	8098.57	8433.81	3.97	12.85
14.00	276.2	271.2	101659.	527.82	0.004	0.003	287.57	1.28	8098.55	8433.81	3.98	13.85
15.00	276.2	271.2	101693.	527.82	0.004	0.003	287.57	1.28	8098.55	8433.81	3.98	14.85
16.00	276.2	271.2	101642.	527.82	0.004	0.003	287.57	1.28	8098.55	8433.81	3.98	15.85
17.00	276.2	271.2	101744.	527.82	0.004	0.003	287.57	1.28	8098.53	8433.81	3.98	16.85
18.00	275.2	271.2	101829.	527.82	0.004	0.003	287.57	1.29	8069.20	8433.81	4.32	17.85

DAILY AVERAGE COMPUTED H = 8095.83
 STANDARD ATMOSPHERE H = 8433.81
 DAILY RELATIVE DIFF. (%) = -4.01

CONVERSION TABLE (in alphabetical order)

<u>To convert from</u>	<u>to</u>	<u>multiply by</u> (power of 10)	
<u>Acceleration:</u>			
foot/sec ²	meter/sec ²	3.048	-1
inch/sec ²	meter/sec ²	2.540	-1
meter/sec ²	foot/sec ²	3.281	0
meter/sec ²	inch/sec ²	3.937	1

Area:

sq. foot	sq. meter	9.290	-2
sq. inch	sq. meter	6.452	-4
sq. mile	sq. meter	2.590	6
sq. yard	sq. meter	8.361	-1
sq. meter	sq. inch	1.550	3
sq. meter	sq. foot	1.076	1
sq. meter	sq. yard	1.196	0
sq. meter	sq. mile	3.861	-7

Energy:

BTU	joule	1.056	3
calorie	joule	4.185	0
kilocalorie	joule	4.185	3
kilowatt hour	joule	3.600	6
joule	BTU	9.470	-4
joule	calorie	2.390	-1
joule	kilocalorie	2.390	-4
Joule	Kilowatt hour	2.778	-7

Energy/Area Time:

BTU/foot ² sec	W/m ²	1.135	4
BTU/foot ² min	W/m ²	1.891	2
BTU/foot ² hr	W/m ²	3.152	0

CONVERSION TABLE (in alphabetical order) (continued)

<u>To convert from</u>	<u>to</u>	<u>multiply by</u>	(power of 10)
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Energy/Area Time: (continued)

BTU/inch ² sec	W/m ²	1.634	6
calories/cm ² min	W/m ²	6.973	2
W/cm ²	W/m ²	1.000	4
W/m ²	BTU/foot ² sec	8.811	-5
W/m ²	BTU/foot ² min	5.288	-3
W/m ²	BTU/foot ² hr	3.173	-1
W/m ²	BTU/inch ² sec	6.120	-7
W/m ²	calories/cm ² min	1.434	-3
W/m ²	W/cm ²	1.000	-4

Force:

dyne	Newton	1.000	-5
kilogram force	Newton	9.807	0
pound force	Newton	4.448	0
Newton	dyne	1.000	5
Newton	kilogram force	1.020	-1
Newton	pound force	2.248	-1

Length:

inch	centimeter	2.540	0
foot	meter	3.048	-1
yard	meter	9.144	-1
mile	meter	1.609	3
meter	mile	6.214	-4
meter	foot	3.281	0
centimeter	inch	3.937	-1
millimeter	inch	3.937	-2

CONVERSION TABLE (in alphabetical order) (continued)

<u>To convert from</u>	<u>to</u>	<u>multiply by</u>	<u>(power of 10)</u>
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Power:

BTU/sec	watt	1.054	3
BTU/min	watt	1.757	1
calories/sec	watt	4.184	0
calories/min	watt	6.973	-2
horsepower	watt	7.460	2
watt	BTU/sec	9.488	-4
watt	BTU/min	5.692	-2
watt	calories/sec	2.390	-1
watt	calories/min	1.434	1

Pressure:

atmosphere	N/sq. meter	1.013	5
bar	N/sq. meter	1.000	5
inch of mercury (60°F)	N/sq. meter	3.377	3
inch of water (60°F)	N/sq. meter	2.488	2
millibar	N/sq. meter	1.000	2
mm of mercury (0°C)	N/sq. meter	1.333	2
Pascal	N/sq. meter	1.000	0
torr (0°C)	N/sq. meter	1.333	2
N/sq. meter	atmospheres	9.872	-6
N/sq. meter	bar	1.000	-5
N/sq. meter	inches of mercury (60°F)	2.961	-4
N/sq. meter	inches of water (60°F)	4.019	-3
N/sq. meter	millibars	1.000	-2
N/sq. meter	mm of mercury (0°C)	7.502	-3
N/sq. meter	torr (0°C)	7.502	-3

CONVERSION TABLE (in alphabetical order) (continued)

To convert from to multiply by

Temperature:

Fahrenheit	Celsius	$t_c = (5/9)(t_f - 32)$
Fahrenheit	Kelvin	$t_k = (5/9)(t_f + 459.67)$
Celsius	Fahrenheit	$t_f = (9/5)(t_c) + 32$
Celsius	Kelvin	$t_k = t_c + 273.15$
Rankine	Kelvin	$t_k = 5/9 t_r$
Kelvin	Rankine	$t_r = 9/5 t_k$

NOMENCLATURE

- A = parameter on the delination computation; in Appendix A0 and Chapter 00, area
- A_0 = density integral of the atmosphere
- A_0 = relative atmospheric mass
- B = radiance in Appendix A0 (Subsection 0.0) or brilliance (Subsection 2.0)
- C_b = bond conductivity
- D = geometrical day length; in Chapter 00, pipe diameter
- E = energy flux density; in Chapter 2, East; in Appendix A0 (Subsection 0.2), luminescence
- E_S = extraterrestrial solar energy flux density for average Sun-Earth distance
- E_S = extraterrestrial solar energy flux density for daily computed Sun-Earth distance
- E_0 = solar energy flux density (or its time integral) on the ground
- F = collector fin efficiency
- F' = collector efficiency when absorbing surface is at local fluid temperature, all other efficiencies being 0
- F_0 = irradiance (integrated energy flux)
- F_0' = irradiance in the hypothesized absence of atmosphere
- F_R = collector "thermal remotion" factor
- G = mass flow rate per unit collector area
- H = equivalent height
- I = energy as electromagnetic radiation
- K = absorbance function of the atmosphere
- K_T = integral absorbance function of the atmosphere without clouds

K_T = integral absorbance function of the atmosphere with clouds thickness
 M = number of days in the month
 M_i = molecular weight of gas i
 MR = moist ratio
 N = progressive number of the days of the year, first of January $N = 1$
 P = pressure
 R = radius; in Appendix A1 radiative energy intensity (Subsection 1.1) or light intensity (Subsection 1.2); Appendix A3 molar gas content
 R_i = gas constant of gas i
 R_D = gas constant of dry air
 R_W = gas constant of water vapor
 S = minutes of sunshine
 S/D = minutes of sunshine for interval time (hour or day)
 T = G.M.T. (Greenwich Mean Time); in Chapter 1 and Appendixes absolute temperature; in Chapter 10, temperature in $^{\circ}C$
 T = average collector temperature
 T_{DBK} = dry-bulb temperature
 T_{DP} = dew-point
 U = overall heat transfer coefficient
 V = sensitivity factor (associated with the visibility curve)
 W = energy emission (electromagnetic waves) in Chapter 1; pipe distance in Chapter 10; otherwise, West
 W_p = light flux (photometric units)
 W_r = radiative flux (radiometric units)
 Z = elevation Z

a = albedo
 c = $1 - S/D$ is the extensive factor of the cloud presence; in Appendix A1, velocity of the electromagnetic radiation; in Chapter 10, specific heat
 e = Earth orbit parameter
 f = fluid
 g = acceleration of gravity
 h = altitude of the Sun; in Appendix A1, Planck's constant; in Chapter 10, heat transfer coefficient
 h_r = relative humidity
 m = mass
 n = refraction index
 p = "local" factor of the K_T expression; in eq. 2.1, Earth orbit parameter and in eqs. 4.27, 4.28, and 4.29, transparency coefficient of the atmosphere; in Appendix A3, partial pressure
 p_1 = intensive factor of depletion due to permanent components of the atmosphere
 p_2 = intensive factor of depletion due to precipitable water
 p_3 = intensive factor of depletion due to precipitable water
 p_4 = intensive factor of depletion due to "local" factors
 r = number of rainy days in a month
 s = generic beam direction abscissa
 t = solar time
 t_f = sunset time (solar time)
 t_i = sunrise time (solar time)
 w = amount of precipitable water; in Appendix A1, radiative flux
 w = total water vapor content in the atmosphere in the vertical direction

x = generic abscissa
 y = collector abscissa, in the direction of flow
 z = zenith (vertical) axis abscissa
 z_0 = elevation z_0

Greek

α = angle of the "position triangle"; in Appendix A1, absorptivity
 β = angle of the "position triangle" (azimuth computation)
 γ = angle of the "position triangle" (hourly angle)
 γ' = hourly angle value at sunrise (or sunset)
 Δ = difference between final and initial values of a variable or parameter
 δ = declination; in Chapter 10, plate thickness
 δ_0 = daily averaged declination
 ϵ = emissivity coefficient
 ζ = angle between the Earth axis and the normal to the plane of the ecliptic; in Chapter 2 (Subsection 2.5) inclination angle of an inclined surface
 η_1 = total cloud cover
 η_2 = total opaque cloud cover
 θ = zenith angle
 λ = wavelength; in astronomical computations, longitude
 ξ = anomaly of the Earth in its orbit
 π = 3.1415927
 ρ = density; in Chapters 1 and 2, daily average value of the Sun-Earth distance; in Appendix A1, reflectivity coefficient

- ρ = average between aphelion and perihelion of Sun-Earth distance
- σ = Stefan-Boltzmann's constant
- τ = transmission coefficient
- ϕ = latitude
- Φ = function symbol
- ψ = azimuth
- ψ' = orientation angle of an inclined surface ("azimuth" of the normal)
- ω = solid angle

Superscripts

- $^{\circ}$ = degrees
- $'$ = minutes

Subscripts

- b = collector bottom
- c = collector cover; convective
- D = dry air
- e = collector edge
- E = Earth
- f = fluid
- i = incident; in Appendixes, i -th gas; in Chapter 10, internal or inlet
- l = local
- m = meridian; in Chapter 10, mean

M = moist air
max = maximum
o = outlet
p = collector plate
r = radiative
S = Sun
t = collector top
W = water vapor
Z = elevation Z
0 = zero

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