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CONC/11: A COMPUTER PROGRAM FOR CALCULATING
THE PERFORMANCE OF DISH-TYPE SOLAR THERMAL
COLLECTORS AND POWER SYSTEMS

By
L. D. Jaffe

February 15, 1984

Work Performed Under Contract No. AM04-80AL13137

Jet Propulsion Laboratory
Pasadena, California

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CONC/11: A Computer Program for Calculating the Performance of Dish-Type Solar Thermal Collectors and Power Systems

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Pasadena, California

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ABSTRACT

CONC/11 is a computer program designed for calculating the performance of dish-type solar thermal collectors and power systems. It is intended to aid the system or collector designer in evaluating the performance to be expected with possible design alternatives. From design or test data on the characteristics of the various subsystems, CONC/11 calculates the efficiencies of the collector and the overall power system as functions of the receiver temperature for a specified insolation. If desired, CONC/11 will also determine the receiver aperture and the receiver temperature that will provide the highest efficiencies at a given insolation. The program handles both simple and compound concentrators. CONC/11 is written in Athena Extended Fortran (similar to Fortran 77) to operate primarily in an interactive mode on a Sperry 1100/81 computer. It could also be used on many small computers.

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SECTION I

INTRODUCTION

CONC/11 is a computer program designed for calculation of the performance of dish-type solar thermal collectors and power systems. It is intended to aid the system or collector designer in evaluating the performance to be expected with possible design alternatives.

The solar thermal power system covered by CONC/11 consists conceptually of one or more dish-type solar collectors, power conversion subsystems, and power processing subsystems. Each collector is composed of a concentrator and a receiver (usually a cavity receiver), and serves to concentrate sunlight and convert its energy to heat in a working fluid. The power conversion subsystem (PCS) converts this heat to mechanical or electrical energy by means of a heat engine and (for electrical energy) an electrical generator. If the desired system output is heat, the power conversion subsystem is omitted. The power processing subsystem (PPS) transports the electrical or mechanical power from the PCS or the heat from the receiver to the system output and performs any associated power processing.

From design or test data on the characteristics of the various subsystems, CONC/11 calculates the collector efficiency and the overall power system efficiency as functions of the receiver temperature for a specified insolation. If desired, CONC/11 will also determine the receiver aperture and the receiver temperature that will provide the highest efficiencies at a given insolation.

CONC/11 does not calculate performance for conditions of varying insolation, such as those encountered over a year of service. However, it can be used as a tool for such calculations, as explained in Section IV.

CONC/11 handles designs in which the sunlight is reflected or refracted once (a simple concentrator) or twice (a compound concentrator, consisting of a primary and a secondary).

SECTION II

OPERATING ENVIRONMENT

CONC/11 was written to operate on a Sperry Univac 1100/81 computer, such as those used in the JPL Central Computing Facility. It could be run on any computer provided with the necessary software, an in-core memory of 16,000 words of at least 16 bits, and access to some form of mass storage. For input, either a card reader or an interactive terminal may be used. The input terminal needs a keyboard plus either a printer, a monitor, or a TV screen for prompting. CONC/11 was designed to send output to a printer with at least 126 characters per line. Printers with shorter line lengths could presumably handle the output by folding lines, which would result in some loss of readability.

CONC/11 is written in Athena Extended Fortran. This version of Fortran allows use of the IF....THEN....ELSEIF....ELSE.... structure. It is very similar to Fortran 77. CONC/11 also uses some routines from the libraries JPL\$ and CLIB\$, specifically the routines ASSIGN and CSF8 to assign a file from within a Fortran program, and the routine SLUP to perform a table lookup. Section VI of this report provides instructions for finding and using CONC/11.

SECTION III

PROGRAM STRUCTURE

A. INPUT

All inputs for CONC/11 are prompted. Inputs must be provided, and output is generated, for one set of input data at a time (a data set). Multiple data sets may be submitted sequentially during a single run of CONC/11.

CONC/11 utilizes two kinds of inputs, variables and arrays. Default values are provided for all variables at the beginning of a run. Values used for one data set are saved within the program and become the default values for the next data set. (One exception is noted below.) All variable values that differ from the default are entered by a single Fortran NAMELIST input statement, each in the form

VARIABLE = value

Input variables are themselves of two kinds: (1) real variables defining system characteristics numerically and (2) logical variables selecting certain system and program options. Some of these options pertain to the system design, some to the way array inputs will be provided, and some to the format of the program output as explained below. Input variables, their meaning and units, and their default values are tabulated in the CONC/11 dictionary (Appendix A) and also in Block 1 of the program listing (Appendix D).

Two arrays may be entered as part of each data set. One of these input arrays defines receiver temperatures for the data set; the other is optional and defines a set of efficiencies pertaining to the PCS, as is further explained below. There are initially no default values for these arrays. The first data set, therefore, must include a list of receiver temperatures. These temperatures must be entered, when prompted, in the form of 3 integers representing DO-loop parameters:

Temperature 1, Temperature 2, Temperature 3

where

Temperature 1 is the lowest receiver temperature (degrees Celsius) to be used,

Temperature 2 is a "not-to-be-exceeded" receiver temperature, and

Temperature 3 is the increment of receiver temperature to be used between successively higher temperatures.

The array of efficiencies pertaining to the PCS is prompted and accepted for the first data set if so indicated by the setting of appropriate logical variables. This array is entered, if needed, as a free-field list of real

variables,

Efficiency 1, Efficiency 2, Efficiency 3,....

where each efficiency in the sequence corresponds to a receiver temperature defined by the receiver temperature array.

CONC/11 saves internally the arrays of receiver temperatures and of efficiencies pertaining to the PCS and uses them as default values for all data sets after the first. To enter a new array for a new data set, the logical variable, NWTORF (NeW Temperature OR eEfficiency), must first be set .TRUE. for that data set. (The default value of NWTORF is set equal to .FALSE. for all data sets after the first.) When this is done, the program will prompt for an array of receiver temperatures, which must be entered. If the selected options require use of an array to define PCS efficiencies, that array will also be prompted for and must be entered.

Quantities to be Input

The CONC/11 dictionary (Appendix A) lists the quantities to be input, indicates whether they are required or optional, and gives the type of corresponding variable, the units, and the default value. Further information can be obtained from Block 1 of the program listing (Appendix D).

B. OPTIONS

CONC/11 will accept inputs in many alternative forms and provides a number of options concerning the system characteristics to be entered, the calculations to be done by the program, and the format of the output. Appendix B describes these options.

Depending upon the input options selected, some of the input variables are ignored by the program and need not be specified. To clarify the output, such variables are generally set equal to zero in the output (except that portion of the output which merely echoes the input). However, the default or input values of these variables are saved internally in the program and used as default values for the next data set.

C. OUTPUT

1. Standard Output

If there are no input errors, the output for each data set takes one or two pages and consists of three parts: an echo of the input, a listing of the values used for the input variables, and an output table.

a. Echo of Input. This consists of:

- (1) The set number
- (2) An echo of the input NAMELIST, showing any new values for input variables
- (3) An echo of the list defining receiver temperatures if a new list has been input

If an array of efficiencies pertaining to the PCS is input, it is not echoed. The efficiencies used for the data set can be determined by examining the output table.

b. List of Values Used for Input Variables. This is a NAMELIST listing of the values used by the program for all input variables, whether provided by a new input, by default, or generated within the program. Values that are ignored by the program are generally set equal to zero. Values that vary with the receiver temperature are set equal to zero in this list; the values used are given in the output table.

c. Output Table. This table consists of one, or in some cases two, lines for each receiver temperature. The quantities listed depend upon the options chosen. (See Appendix B, Section D, "Options Pertaining to Output.") The following quantities are always given:

Receiver temperature, in °C and °F

Collector efficiency

Power conversion subsystem efficiency

System efficiency

The ratio, (system efficiency at this receiver temperature)/(highest system efficiency at any receiver temperature listed)

If the program optimizes the receiver aperture (option OPTMZE), the output table also gives

Geometric concentration ratio

Intercept factor

If calculations are made for a secondary concentrator (option SECONC), the collector and system efficiencies and the fraction of maximum system efficiency are given both with and without the secondary, as is the delta for each due to use of the secondary.

If the program optimizes the receiver aperture, and if a secondary concentrator is used (options OPTMZE and SECONC), the geometric concentration ratio and intercept factor of the primary are given both with and without use of the secondary. A second line for each receiver temperature gives the overall geometric concentration ratio and the overall intercept factor for the compound concentrator. In addition, if the program maximizes the secondary concentration ratio (option MAXSEC), this value is printed on the second line. Output of the second line may be suppressed if desired (option SUP2).

2. Extract of Output

If an extract of the output is requested (option XTRACT), a separate extract is provided, in addition to the standard output. For each data set, this extract consists of the echo of input and an abbreviated output table. This table includes only the lines for the lowest and highest receiver temperatures and for the receiver temperature at which system efficiencies are highest. Table headings are omitted.

D. ERROR HANDLING

If an input format error is detected in a data set, an error message is placed in the output and the run is aborted after results for all preceding data sets are sent to output.

If the input values are found to be optically impossible or outside of the range of input that the program can handle, an error message is output and the program generally skips further processing of that data set. In a few cases, a warning is sent to output and processing of the data set continues.

If the efficiency or temperature given for power conditioning is thermodynamically impossible, the program provides an error message and skips further processing for the temperature concerned until acceptable values are input.

If the list of temperatures indicates that the accompanying array of efficiencies is too long for the allocated storage, a warning is generated and the array is truncated. If more efficiencies are input than correspond to the temperature list, the efficiency array is truncated. If too few efficiency values are provided, a read error will result.

If conflicting options are selected, the program chooses one and provides a message so stating.

If an extract is requested, but the Exec is unable to catalog or assign a file for this purpose, CONC/11 omits the extract and so states.

SECTION IV

EQUATIONS USED

The equations used are similar to those presented and discussed in Reference 1. The reader may find it useful to read Section II of that reference, where equations are given in algebraic form, before going through the rest of this section, in which Fortran notation is used.

The key output quantities are defined as:

$$\text{Collector efficiency} = \frac{\text{thermal power output of receiver}}{(\text{direct normal insolation}) \times (\text{concentrator aperture area})}$$

$$\text{System efficiency} = \frac{\text{net power output of system, deducting parasitics}}{(\text{direct normal insolation}) \times (\text{concentrator aperture area})}$$

Definitions of other solar engineering terms are given in Reference 1. All of the quantities used in the following equations are defined in Appendix A.

A. COLLECTOR

1. Collector Efficiency

The equation used for collector efficiency is

$$A(1) = (\text{INS} \cdot \text{RH01} \cdot \text{BS1} \cdot \text{PHI} \cdot \text{ALPHA} - (1/\text{C1})(\text{EPS} \cdot \text{BOLTZ} \cdot (\text{TRK}^{**4} - \text{TAK}^{**4}) + \text{HC} \cdot (\text{TRK} - \text{TAK})) - \text{ARATIO} \cdot \text{HK} \cdot (\text{TRK} - \text{TAK})) / \text{INS} \quad (1)$$

Equation (1) assumes that the concentrator is pointed close to the sun line. It assumes that the only energy entering the receiver is sunlight from the concentrator and that receiver input may be expressed as this energy times an effective absorptance for the receiver aperture area. Equation (1) also assumes that the cavity temperature may be taken as uniform and that receiver losses may be expressed using an effective emittance for the aperture area, an effective convection coefficient for the aperture area, and an effective conductive coefficient for the wall area of the cavity -- all of these being independent of temperature, concentrator pointing, and wind velocity. These assumptions are usually adequate for preliminary system design.

Equation (1) is taken from Reference 1. It is a slightly modified form of a relation given earlier in Reference 2.

When a secondary concentrator is used, Equation (1) is modified by replacing RH01 by RH01 * RH02, BS1 by BS1 * BS2, PHI1 by PHI1S * PHI2, and C1 by C1S * C2 (Ref. 1). It may be necessary to adjust BS1 to take into account any shadowing of the primary by the secondary.

2. Intercept Factor and Concentration Ratio

The user of CONC/11 sometimes will have available all of the quantities on the right-hand side of Equation (1) and will be able to provide them as input. Often, however, the intercept factor or the geometric concentration ratio obtainable will not be known, and it will be necessary for the program to calculate them. CONC/11 obtains these quantities as follows:

For the variance of the angular distribution of sunlight leaving a local area of the (primary) mirror or lens (taken to be Gaussian), CONC/11 uses:

$$\text{DELTSQ} = (2.0 * \text{SLOPER} / 1000.0) ** 2 + (\text{SPECUL} / 1000.0) ** 2 + (\text{SOLSD} / 1000.0) ** 2 \quad (2)$$

For twice the square of the standard deviation of the flux distribution in the focal plane (taken to be Gaussian) in units of concentrator radius, the program uses:

$$\begin{aligned} \text{SIG2DF} = & 2.0 * \text{DELTSQ} * (1.0 / (\text{RMAR} * ((\text{TAN}(\text{RMAR} / 2.0)) ** 2))) * \\ & ((-1.0 / (3.0 * (\text{S} ** 3) * \text{C})) + (2.0 / (3.0 * (\text{S} ** 3))) + (2.0 / \text{S}) \\ & - (\text{C} / (3.0 * (\text{S} ** 3))) - (2.0 * \text{C} / \text{S}) + ((4.0 * \text{S}) / (3.0 * \text{C}))) \\ & - \text{ALOG}(\text{TAN}(\text{P4} + \text{RMAR} / 2.0)) + \text{ALOG}(\text{TAN}(\text{P4} - \text{RMAR} / 2.0))) \end{aligned} \quad (3a)$$

if the overall contour of the concentrator is a paraboloidal mirror, and

$$\text{SIG2DF} = 2.0 * \text{DELTSQ} * (1.0 + 2.0 * (\text{C} ** 2)) / (3.0 * \text{RMAR} * \text{C} * \text{S}) \quad (3b)$$

if the overall contour is planar. Here

$$\begin{aligned} \text{S} &= \text{SIN}(\text{RMAR}) \\ \text{C} &= \text{COS}(\text{RMAR}) \\ \text{T} &= \text{TAN}(\text{RMAR}) \end{aligned}$$

For the maximum intercept factor or geometric concentration ratio that is optically possible, CONC/11 uses:

$$\text{PHI1} = 1.0 - \text{EXP}(-1.0 / (\text{C1} * \text{SIG2DF})) \quad (4a)$$

or equivalently:

$$\text{C1} = 1.0 / (\text{SIG2DF} * (-\text{ALOG}(1.0 - \text{PHI1}))) \quad (4b)$$

Equation (4b) breaks down if $\text{PHI1} = 1.0$, which is not possible for a finite receiver aperture size because a Gaussian flux distribution extends to infinity. If given $\text{PHI1} = 0$ as an input, the program uses:

$$\text{C1} = 1.0 / (\text{SIG2DF} * \text{VF}) \quad (4c)$$

as an approximation, where the parameter VF has been set = 6.

When a secondary concentrator is used, PH11 and C1 in Equations (4a) and (4c) are replaced by PH1S and C1S, and the maximum C2 that is optically possible is given by the smaller of the quantities:

$$1.0/(((\sin(\text{RMAR}+\text{DELT}))^2)*\text{PHI2}) \quad (5a)$$

and

$$(1.0/\text{C1S}*((\sin(\text{DELT}))^2)*\text{PHI2}))*\text{VF}/(-\text{ALOG}(1.0-\text{PHI1S})) \quad (5b)$$

if PH1S $\neq$ 1.0, or

$$1.0/(\text{C1S}*((\sin(\text{DELT}))^2)*\text{PHI2}) \quad (5c)$$

if PH1S = 1.0. Here, DELT = SQRT(DELT SQ).

Equations (3a) and (3b) require as input the rim angle of the concentrator. If the rim angle is not known to the user, CONC/11 will calculate it from the focal ratio, if given. The basic relationships are:

$$F = (1.0+\cos(\text{RMAR}))/ (4.0+\sin(\text{RMAR})) \quad (6a)$$

if the overall contour of the concentrator is that of a paraboloidal reflector, and

$$F = 1.0/(2.0*\tan(\text{RMAR})) \quad (6b)$$

if the overall contour is planar.

To solve Equation (6a) for RMAR, CONC/11 uses a table lookup; solution of Equation (6b) is done explicitly:

$$\text{RMAR} = \text{ATAN2}(1.0, (2.0*F)) \quad (6c)$$

Equations (4) and (5) are used to calculate intercept factors and geometric concentration ratios, as appropriate, when the options MAXPHI, MAXC, or MAXSEC are selected. In other cases they are used as a basis for warning messages stating that quantities input for these variables are greater than is optically possible.

If the option OPTMZE is selected, CONC/11 calculates the intercept factor and geometric concentration ratio that will provide maximum collector efficiency for a simple concentrator, using the equations:

$$\text{PHI1} = 1.0 - (\text{SIG2DF}*\text{EPS}*\text{BOLTZ}*(\text{TRK}^4 - \text{TAK}^4) + \text{HC}(\text{TRK} - \text{TAK})) / (\text{INS}*\text{RH01}*\text{BS1}*\text{ALPHA}) \quad (7a)$$

$$\text{C1} = 1.0 / ((\text{SIG2DF}*\text{ALOG}(\text{INS}*\text{RH01}*\text{BS1}*\text{ALPHA}) / (\text{SIG2DF}*\text{EPS}*\text{BOLTZ}*(\text{TRK}^4 - \text{TAK}^4) + \text{HC}(\text{TRK} - \text{TAK})))) \quad (7b)$$

If OPTMZE is selected with a secondary concentrator, the equations used are:

$$PHI1S = 1.0 - (SIG2DF * EPS * BOLTZ * (TRK^{**4} - TAK^{**4}) + HC(TRK - TAK)) / (INS * RHO1 * RHO2 * BS1 * BS2 * ALPHA * PHI2 * C2) \quad (7c)$$

$$C1S = 1.0 / SIG2DF * ALOG(INS * RHO1 * RHO2 * BS1 * BS2 * ALPHA * PH2 * C2 / (SIG2DF * EPS * BOLTZ * (TRK^{**4} - TAK^{**4}) + HC(TRK - TAK))) \quad (7d)$$

In Equations (7c) and (7d), C2 is calculated by expression (5a) if option MAXSEC has been selected; otherwise, CONC/11 uses the value of C2 provided by input or default.

Equation (2) assumes that the slope error and specularity spread of the mirror or lens and the angular spread of the incoming sunlight are all very small compared to the rim angle of the concentrator. This should be true for all practical concentrators. Equation (2) also assumes that the concentrator slope errors and specularity and the angular distribution of incoming sunlight are all normally distributed (Gaussian). This is a reasonable first approximation for slope errors, although circumferential slope errors may have a different standard deviation than tangential. The specularity spread of reflection from a glass mirror appears to be close to Gaussian, but if reflection is from a metal or polymeric mirror, the sum of two normal distributions may be needed for a good description (Ref. 3). For solar radiation, a Gaussian angular distribution is a rather crude approximation, although its accuracy depends on atmospheric conditions (Ref. 4). Unless the concentrator is unusually accurate, however, $(SOLSD/1000.0)^{**2}$ is considerably smaller than DELTSQ, and the inexactness of the solar representation has little effect upon the flux distribution in the focal plane (Ref. 4). Equation (2) neglects concentrator pointing errors and the spectral dispersion produced by a lens concentrator. If desired, either or both may be taken into account by providing as input for SPECUL the square root of the sum of the variances in angle due to specularity spread, pointing error, and dispersion.

Equation (3) is taken from Reference 5. As pointed out earlier (Ref. 6), the flux distribution in the focal plane may be taken as Gaussian. Reference 1 gives justification for the choice of Equation (3).

Equations (4a) and (4b) were derived in Reference 1. Equation (4c) is believed to be a reasonable approximation; the choice of VF = 6 was based on a cut-off reasonably far out on the tail of the Gaussian distribution (about 2.5 standard deviations).

Equation (5a) was derived from consideration of the theoretical performance of an ideal concentrator irradiated over an angle RMAR+DELTA (Refs. 7,8) and modified by the intercept factor PHI2. This modification is equivalent to assuming that the flux density is uniform, out to a finite radius, in the focal plane of the secondary. This is a good approximation for secondaries with good performance (Ref. 7). Equations (5b) and (5c) are derived in the same way from the theoretical performance of an ideal compound concentrator irradiated over an angle DELT and with primary characteristics given by Equation (4).

Equation (6) is straightforward geometry. Equation (7a) was derived by substituting Equation (4a) in Equation (1), differentiating, setting the differential $d(A(1))/d(TRK) = 0$, and solving for PH11. Equation (7b) was then derived by substituting this value of PH11 in Equation (4b). Equations (7c) and (7d) are derived in an analogous way, using factors appropriate to a compound concentrator.

B. SYSTEM EFFICIENCY

The system efficiency is calculated as

$$A(5) = A(1) * PCSE * PPE \quad (8)$$

The power processing efficiency (PPE) is an input or default value. The power conversion subsystem efficiency (PCSE) is obtained in one of several ways, depending upon the options selected and the zero or nonzero values input for the pertinent variables. Thus, PCSE may be given as an array of input values, one for each receiver temperature, or may be calculated as

$$PCSE = PCEFCT * ((TIK - TOK) / TIK) \quad (9a)$$

where PCEFCT, the PCS effectiveness as a fraction of Carnot efficiency, is an input or default value. Alternatively, PCSE may be taken as

$$PCSE = ENGE * GEARE * GENE \quad (9b)$$

Here GEARE and GENE are input values, and the engine efficiency, ENGE, is either given as an array of input values, one for each receiver temperature, or may be calculated as

$$ENGE = ENEFCT * ((TIK - TOK) / TIK) \quad (10a)$$

where the engine effectiveness, ENGE, is an input value. Alternatively, ENGE may be taken as

$$ENGE = CYCE * MECHE * AUXE \quad (10b)$$

where MECHE and AUXE are input values, and the thermodynamic cycle efficiency, CYCE, is either given as an array of input values or calculated as

$$CYCE = CYCECT * ((TIK - TOK) / TIK) \quad (11)$$

with the cycle effectiveness, CYCECT, being an input value.

The input temperature, TIK, is calculated as

$$TIK = TRK - DTRE \quad (12)$$

where the receiver temperature, TRK, is given by an input list and an internal conversion from Celsius to Kelvin, and DTRE and TOK are input or default values (with Celsius to Kelvin conversion).

Derivation of these equations is obvious.

CONC/11 determines the temperature at which system efficiency is greatest by calculating this efficiency at many receiver temperatures, which are defined by an input list, and noting at which temperature the system efficiency is highest. This is done for a fixed insolation. If it is desired to calculate yearly performance at a selected site (for which insolation data are available), or to optimize receiver temperature or aperture to provide maximum output over a year at such a site, the output for a given design may be calculated for each insolation level and the results weighted and summed to give total output for a year. By computing this total output for various receiver temperatures or apertures, the optimum based on yearly output may be determined.

SECTION V

FUNCTIONAL BLOCK DIAGRAMS

CONC/11 consists of a main program and two subroutines: NAMLRD, which carries out the NAMELIST read-in and echoing of the input variables, and OPT, which carries out the optical calculations and checks associated input values. OPT has three entries, CKNOPT, CKOPT, and OPTAP. CONC/11 also uses subroutines and functions from the MATH library and, as described in Section II, from the libraries JPL\$ and CLIB\$.

Figure 5-1 provides an overall block diagram of CONC/11. Figures 5-2, 5-3, and 5-4 give greater detail for Blocks 2.2, 2.3, and 2.4. Figures 5-5 and 5-6 are block diagrams for the subroutines NAMLRD and OPT.

Figure 5-1. Overall Block Diagram of CONC/11

Figure 5-2. Diagram of Block 2.2

Figure 5-3. Diagram of Block 2.3

Figure 5-4. Diagram of Block 2.4

Figure 5-5. Block Diagram of Subroutine NAMLRD

Figure 5-6. Block Diagram of Subroutine OPT

SECTION VI

USER INSTRUCTIONS

Source and absolute CONC/11 programs are stored in JPL MASSTOR as elements of the file JAFFE*SOLAR1. To use these programs, arrange access to the MASSTOR file and transfer it to a JPL Sperry Univac 1100 file by initiating a run on the 1100 and then commanding

```
@SRD
RESTORE programfile FROM JAFFE*SOLAR1
STOP
```

(If MASSTOR is discontinued, files stored on it are to be saved. A backup tape identified as JAFFE1 is held by the author.)

The rest of these instructions pertain to execution on the Sperry Univac 1100. Similar methods can be used on other computers. The program is run on the Sperry 1100 by the command

```
@XQT programfile.CONC/11
```

To become familiar with the program, it is best to run it first in demand mode, from an interactive terminal set up to display and print transmissions from the 1100. This will permit display of prompts for all input, which should be entered with the keyboard. The input needed is described in Section III.A. above. Input and output will be displayed and printed. Multiple sets of input data are expected; after output is provided for one set, input is solicited for the next set. To end CONC/11 execution, enter

```
@EOF
```

when prompted for input values (NAMELIST). CONC/11 may be reinvoked as often as desired, and new sets of values entered.

When the user becomes familiar with CONC/11 and perhaps wishes to avoid inclusion of prompt and input messages in the output printout or to reduce time at the terminal, he may catalog and assign a file for output, then breakpoint to this file immediately before executing CONC/11:

```
@BK1 outputfile
@XQT programfile.CONC/11
```

After completing a CONC/11 execution, the data file should be sent to a printer by

```
@BK2 siteid, bldg/box
```

Care should be taken not to overwrite the output file by breakpointing successive CONC/11 executions. Either use the form

@BK1

without a file name, which creates a unique file each time it is invoked, or specify a different output file (or file cycle) for each execution.

A disadvantage of this method of execution is that the prompts displayed are limited to a carat. Therefore, it is necessary to keep track of the inputs that will be required. Accordingly, this mode is not recommended unless only very few sets are input per CONC/11 execution.

If the output is to be breakpointed, it is better to create a file containing the input for a CONC/11 execution and check this file. After output is breakpointed, CONC/11 is executed by

```
@XQT programfile.CONC/11
@ADD inputfile
```

Alternatively, once the user is familiar with the program, he may choose to execute it in batch mode, either from cards or from 1100 files, using the

```
@ADD inputfile
```

as mentioned above.

With any of these methods of execution, if option XTRACT is selected, an extract of the output (described in Section III.C.2. above) is placed in a file named XTRACT, which is cataloged and assigned by CONC/11. A new file cycle is cataloged at each CONC/11 execution to prevent overwriting. The XTRACT file should be printed out by commanding

```
@BLK,S XTRACT, bldg/box, printer
```

This command should be repeated once for each execution of CONC/11. Multiple executions may precede any printout of XTRACT. If this is done, printouts will be in the reverse order of the executions (e.g., latest XTRACT output printed first).

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APPENDIX A
CONC/11 DICTIONARY

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<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
A	Array	7	Real	-	-		
	A(1): Collector efficiency, without secondary A(2): Collector efficiency, with secondary A(3): Collector efficiency increase due to secondary A(4): Power conversion subsystem efficiency A(5): System efficiency, without secondary A(6): System efficiency, with secondary A(7): System efficiency increase due to secondary						
AA	Array	9,NT	Real	-	-		X
	Output array of efficiencies						
ALOG	Function	-	Real	-	-		
	Natural logarithm. (In Math Library.)						
ALPHA	Variable	-	Real	1.0	-	X	
	Receiver effective absorptance						
AMAX1	Function	-	Real	-	-		
	Largest of 2 arguments. (Intrinsic function.)						
AMIN1	Function	-	Real	-	-		
	Smallest of 2 arguments. (Intrinsic function.)						
ARATIO	Variable	-	Real	0.025	-	X	
	Ratio, (Receiver cavity wall area)/(Concentrator area)						
ASG100	Variable	-	Logical	-	-		
	Flag to indicate assignment of extract file XTRACT. (File 100 internally in Fortran.)						
ASSIGN	Subroutine	-	-	-	-		
	Sends @CAT and @ASG commands to Exec. (In library LIB*CLIB\$.)						
ATAN2	Function	-	Real	-	-		
	Arctangent of ratio of 2 arguments. (In Math Library.)						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
AUXE	Variable	-	Real	0.0	-	X	
	Efficiency factor to account for power used by auxiliaries						
A5MAX	Variable	-	Real	-	-		
	Highest system efficiency, without secondary						
A6MAX	Variable	-	Real	-	-		
	Highest system efficiency, with secondary						
BOLTZ	Variable	-	Real	5.67032E-8	W/m ² K ⁴		
	Boltzman constant						
BOUND	Variable	-	Real	1.0E-7	-		
	Bound for equality comparisons of real numbers and to prevent division by zero						
BS1	Variable	-	Real	1.0	-	X	
	Blocking and shadowing factor of primary concentrator						
BS2	Variable	-	Real	1.0	-	X	
	Blocking and shadowing factor of secondary concentrator						
C	Procedure	-		-	-		
	Cosine of rim angle of (primary) concentrator						
CARNOT	Variable	-	Real	-	-		
	Carnot efficiency						
CINV	Variable	-	Real	-	-		
	Inverse of C1						
CINVS	Variable	-	Real	-	-		
	Inverse of C1S						
CKNOPT	Entry	-	-	-	-		
	Checks input of collector characteristics. Calculates angular distribution of sunlight leaving local area of mirror or lens. Used when receiver aperture optimization is not selected. (In subroutine OPT.)						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
CKOPT	Entry	-	-	-	-		
	Corresponds to preceding item. Used when receiver aperture optimization is selected. (In subroutine OPT.)						
COS	Function	-	Real	-	-		
	Cosine. (In Math Library.)						
CSF8	Function	-	Integer	-	-		
	Sends @USE command to Exec. (In library LIB*CLIB\$.)						
CYCE	Variable	-	Real	-	-		
	Thermodynamic cycle efficiency of engine						
CYCECT	Variable	-	Real	0.0	-		X
	Cycle effectiveness (fraction of Carnot efficiency)						
C1	Variable	-	Real	1000.0	-		X
	Geometric concentration ratio, without secondary						
C1MAX	Variable	-	Real	-	-		
	Maximum C1 that is optically possible						
C1S	Variable	-	Real	1000.0	-		X
	Primary geometric concentration ratio, with secondary						
C1SMAX	Variable	-	Real	-	-		
	Maximum C1S that is optically possible						
C2	Variable	-	Real	1.0	-		X
	Secondary geometric concentration ratio						
C2HOLD	Variable	-	Real	-	-		
	Temporary store of C2						
C2MAX	Variable	-	Real	-	-		
	Maximum C2 that is optically possible						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
DELT	Variable	-	Real	-	radian		
	Variance of Gaussian angular distribution of sunlight leaving a local area of (primary) mirror or lens						
DELTSQ	Variable	-	Real	-	(radian) ²		
	Standard deviation of Gaussian angular distribution of sunlight leaving a local area of (primary) mirror or lens						
DTRE	Variable	-	Real	25.0	°C	X	
	Temperature drop from receiver to engine						
DUMMY	Variable	-	Real	-	-		
	Dummy argument in call of subroutine SLUP						
EFF	Array	NT	Real	-	-		X
	Power conversion, engine, or cycle efficiencies corresponding to receiver temperatures designated by ITRC list						
ENEFACT	Variable	-	Real	0.0	-		X
	Power conversion effectiveness (fraction of Carnot efficiency)						
ENGE	Variable	-	Real	-	-		
	Engine efficiency						
EPS	Variable	-	Real	1.0	-		X
	Receiver effective emittance (for aperture area)						
EXP	Function	-	Real	-	-		
	Exponential. (In Math Library.)						
F	Variable	-	Real	0.6	-		X
	Focal ratio of (primary) concentrator						
FRAY	Array	90	Real	(DATA)	-		
	Focal ratios corresponding to RMARAY						
GEARE	Variable	-	Real	0.0	-		X
	Gear efficiency						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
GENE	Variable	-	Real	0.0	-	X	
	Generator efficiency						
HC	Variable	-	Real	0.0	W/m ² °C	X	
	Effective convection coefficient (for receiver aperture)						
HK	Variable	-	Real	0.0	W/m ² °C	X	
	Effective conduction coefficient (for receiver cavity wall)						
I	Variable	-	Integer	-	degree		
	Index of DO loop to generate RMARAY						
ICYCEF	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to input engine cycle efficiency vs. temperature						
IDUMM	Variable	-	Integer	-	-		
	Dummy argument in call of subroutine ASSIGN						
IENGEF	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to input engine efficiency vs. temperature						
INREAD	Array	14	Integer	-	-		
	Read/Write buffer						
INS	Variable	-	Real	800.0	W/m ²	X	
	Insolation						
IPCSEF	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to input PCS efficiency vs. temperature						
IRFLG	Variable	-	Logical	-	-		
	Flag to indicate if RMARAY has been generated						
ISTAT	Variable	-	Integer	-	-		
	Indicates status of execution of function CSF8						
ITRC	Variable	-	Integer	-	°C		
	Receiver temperature. (Index of DO loop.)						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
ITRC1	Variable	-	Integer	-	°C	X	
	Initial parameter of DO loop for receiver temperatures						
ITRC2	Variable	-	Integer	-	°C	X	
	Terminal parameter of DO loop for receiver temperatures						
ITRC3	Variable	-	Integer	-	°C	X	
	Incrementation parameter of DO loop for receiver temperatures						
J	Variable	-	Integer	-	-		
	Index of DO loop						
JJ	Variable	-	Integer	-	-		
	Number of records in input NAMELIST						
K	Variable	-	Integer	-	-		
	Index of DO loop						
L	Variable	-	Integer	-	-		
	Position of character in word of input NAMELIST. (Index of DO loop.)						
M	Variable	-	Integer				
	Data set number. (Index of DO loop.)						
MAXC	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to maximize (primary) geometric concentration ratio						
MAXPHI	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to maximize (primary) intercept factor						
MAXSEC	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to use maximum possible secondary concentration						
MECHE	Variable	-	Real	0.0	-	X	
	Mechanical efficiency of engine						
MIN	Function	-	Integer	-	-		
	Smaller of 2 arguments. (Intrinsic function.)						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u> <u>Input</u> <u>Output</u>
MNT	Variable	-	Integer	-	-	X
	Number of efficiencies, pertaining to PCS, to be read and number of receiver temperatures to be written					
MORDEC	Variable	-	Logical	.FALSE.	-	X
	.TRUE. to print more decimal places for efficiencies. (5 instead of 3.)					
NAMLRD	Subroutine	-		-	-	
	Reads in values of input variables					
NLIST	Namelist name	-		-	-	
	List of variables for NAMLIST					
NSET	Variable	-	Integer	-	-	
	Number of data sets entered					
NT	Parameter	-	-	50	-	
	Maximum number of receiver temperatures per data set					
NTCNT	Variable	-	Integer	-	-	
	Count of receiver temperatures					
NTRC	Variable	-	Integer	-	-	
	Number of receiver temperatures					
NWTORF	Variable	-	Logical	-	-	X
	.TRUE. to read new receiver temperatures or new efficiencies pertaining to PCS. (Default value: .TRUE. for first data set; .FALSE. for all others.)					
OPT	Subroutine	-	-	-	-	
	Calculates or checks optical characteristics					
OPTAA	Array	5,NT	Real	-	-	X
	Intercept factors for specified receiver temperatures and concentration ratios.					
	OPTAA (1,NTCNT): C1 for various receiver temperatures					
	OPTAA (2,NTCNT): CIS if SECONC =, TRUE, else PH1					
	OPTAA (3,NTCNT): PH1					
	OPTAA (4,NTCNT): PH1S					
	OPTAA (5,NTCNT): C2					

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for Input Output</u>
OPTAP	Entry	-		-	-	
	Optimizes receiver aperture. (In subroutine OPT.)					
OPTMZE	Variable	-	Logical	.FALSE.	-	X
	.TRUE. to optimize receiver aperture					
PARAB	Variable	-	Logical	.TRUE.	-	X
	.TRUE. : overall contour of (primary) mirror approximately paraboloidal					
	.FALSE.: overall contour of (primary) mirror or lens approximately planar.					
PCEFACT	Variable	-	Real	0.5	-	X
	Power conversion effectiveness (fraction of Carnot efficiency)					
PHI1	Variable	-	Real	0.95	-	X
	Intercept factor (with no secondary concentrator)					
PHI1FC	Variable	-	Real	-	-	
	Function of PHI1 used to determine maximum possible geometric concentration ratio (no secondary)					
PHI1S	Variable	-	Real	(0.0)	-	X
	Intercept factor for primary concentrator (used with secondary)					
PHI1SF	Variable	-	Real	-	-	
	Function of PHI1S used to determine maximum possible primary geometric concentration ratio, with secondary					
PHI2	Variable	-	Real	1.0	-	X
	Intercept factor for secondary concentrator					
PI	Variable	-	Real	3.141592	-	
	π					
PPE	Variable	-	Real	0.95	-	X
	Power processing efficiency					
P4	Variable	-	Real	$\pi/4.0$	-	
	$\pi/4$					

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
RH01	Variable	-	Real	0.9	-	X	
	Effective reflectance or transmittance of (primary) concentrator						
RH02	Variable	-	Real	0.9	-	X	
	Effective reflectance or transmittance of secondary concentrator						
RMA	Variable	-	Real	(0.0)	degree	X	
	Rim angle of (primary) concentrator						
RMAR	Variable	-	Real	-	radian		
	Rim angle of (primary) concentrator						
RMARAY	Array	90	Real	-	degree		
	Rim angles corresponding to FRAY						
S	Procedure	-	-	-	-		
	Sine of rim angle of (primary) concentrator						
SECONC	Variable	-	Logical	.FALSE.			
	.TRUE. to calculate performance with secondary concentrator, as well as without						
SIG2DF	Variable	-	Real	-	-		
	Variance of flux distribution in focal plane, in units of (concentrator radius) ²						
SIN	Function	-	Real	-	-		
	Sine. (In Math Library.)						
							X
SLOPER	Variable	-	Real	2.0	mrاد	X	
	Slope error of (primary) reflector						
SLUP	Subroutine	-		-	-		
	Table lookup and interpolation. (In Library LIB*JPL\$.)						
SOLSD	Variable	-	Real	2.3	mrاد	X	
	Standard deviation of angular spread of incoming sunlight						

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for Input Output</u>
SPECUL	Variable	-	Real	0.5	mrad	X
	Specularity spread of (primary) concentrator					
SQRT	Function	-	Real	-	-	X
	Square root. (In Math library.)					
SUP2	Variable	-	Logical	.FALSE.	-	
	.TRUE. to suppress 2nd line of output for each receiver temperature					
T	Procedure	-		-	-	
	Tangent of rim angle of (primary) concentrator					
TAC	Variable	-	Real	20.0	°C	X
	Ambient temperature					
TAK	Variable	-	Real	-	K	
	Ambient temperature					
TAN	Function	-	Real	-	-	
	Tangent. (In Math library.)					
TIK	Variable	-	Real	-	K	
	Engine inlet temperature					
TOC	Variable	-	Real	50.0	°C	X
	Outlet temperature of engine thermodynamic cycle					
TOK	Variable	-	Real	-	K	
	Outlet temperature of engine thermodynamic cycle					
TRK	Variable	-	Real	-	K	
	Receiver (cavity) temperature					
TRMA	Variable	-	Real	-	W/m ²	
	Term pertaining to power into receiver (no secondary concentrator)					
TRMAS	Variable	-	Real	-	W/m ²	
	Term pertaining to power into receiver with secondary concentrator					

<u>Name</u>	<u>Usage</u>	<u>Dimen- sions</u>	<u>Type</u>	<u>Default Value</u>	<u>Units</u>	<u>Used for</u>	
						<u>Input</u>	<u>Output</u>
TRMB	Variable	-	Real	-	W/m ²		
	Term pertaining to radiation and convection loss from receiver						
TRMC	Variable	-	Real	-	W/m ²		
	Term pertaining to conduction loss from receiver						
TT	Array	2, NT	Real	-	-	X	
	Receiver temperatures						
	TT (1, NT)				°C		
	TT (2, NT)				°F		
VF	Variable	-	Real	6.0	-		
	Variance ratio limiting maximum concentration when PHI = 1.0						
XFLAG	Variable	-	Logical	-	-		
	.TRUE. to identify line of output tables to be included in extract						
XTRACT	Variable	-	Logical	.FALSE.	-	X	
	.TRUE. to provide extract of output in file XTRACT						
XTRON	Variable	-	Logical	-	-		
	Flag to indicate if XTRACT has just been .TRUE.						
Y	Array	32	Real	-	-		
	Input values of real variables, held for next data set						
Z	Array	32	Real	-	-		
	Real variables used for input						
98	File	-	Temporary	-	-	X	-
	Holds input temporarily for NAMELIST read						
100	File	-	Cataloged	-	-	-	X
	Extract of output. (Named 'XTRACT' by Exec.)						

APPENDIX B

OPTIONS

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OPTIONS

A. OPTIONS PERTAINING TO COLLECTOR CHARACTERISTICS

1. Secondary Concentrator

If SECONC (SEcondary CONCentrator) is set .TRUE., the output will show performance with a secondary concentrator, as well as without. If SECONC is .FALSE., the output will be for a simple concentrator only (no secondary). The initial default value is .FALSE.

2. Receiver Aperture Optimization

If OPTMZE is set .TRUE., CONC/11 will calculate the receiver aperture size that provides maximum collector efficiency. It will calculate and output the corresponding geometric concentration ratio, intercept factor, and efficiencies. If SECONC is also .TRUE., the program will optimize the receiver aperture and output the quantities named, both with and without a secondary concentrator. The initial default value of OPTMZE is .FALSE.

Optimization of receiver temperature to provide maximum system efficiency is always done by CONC/11 when data pertaining to PCS and PPS efficiencies are input, and need not be explicitly requested.

3. Maximization of Geometric Concentration Ratio

Maximization of geometric concentration ratio at a given intercept factor is requested by setting MAXC (MAXimum Concentration) equal to .TRUE. This should not be done if OPTMZE is true (in which case MAXC will be ignored). If SECONC and MAXC are both true (and OPTMZE is not), the program maximizes the geometric concentration ratio of the primary both with and without the secondary. The initial default value of MAXC is .FALSE.

4. Maximization of Intercept Factor

Maximization of intercept factor at a given concentration ratio is requested by setting MAXPHI (MAXimum intercept factor) equal to .TRUE. This should not be done if OPTMZE or MAXC is .TRUE. (in which case MAXPHI will be ignored). If SECONC and MAXPHI are both .TRUE., the program maximizes the intercept factor of the primary both with and without the secondary. The initial default value of MAXPHI is .FALSE.

Note: If OPTMZE, MAXC, and MAXPHI are all .FALSE. (the initial default value), the program will use the input or default values of the geometric concentration ratio and the intercept factor (with and without a secondary concentrator if SECONC is .TRUE.)

5. Maximization of Geometric Concentration Ratio of Secondary

If both MAXSEC and SECONC are .TRUE., the program will calculate and use the maximum secondary concentration ratio compatible with the characteristics of the primary and with the secondary intercept factor. The initial default value of MAXSEC is .FALSE.

6. Shape of Concentrator

If PARAB is .TRUE., the overall contour of the (primary) concentrator is taken to be paraboloidal. If PARAB is .FALSE., the overall contour is taken to be flat. The initial default value is .TRUE.

B. OPTIONS PERTAINING TO POWER CONVERSION CHARACTERISTICS

Power conversion characteristics may be input either as an effectiveness (that is, a constant fraction of Carnot efficiency) or as an array of efficiency values, corresponding to the receiver temperatures. Also, the effectiveness or the array of efficiencies can be given either for the power conversion subsystem as a whole, for the engine only, or for the thermodynamic cycle only.

If IPCSEF (Input PCS Efficiencies), IENGFEF (Input ENGINE Efficiencies), or ICYCEFEF (Input CYCLE Efficiencies) is set .TRUE., the program expects input of a corresponding array of efficiencies. Not more than one of these variables should be set .TRUE. If two or three are set .TRUE., the program will interpret the efficiency array as pertaining to IPCSEF or IENGFEF, in that order of preference.

If IPCSEF, IENGFEF, and ICYCEFEF are all .FALSE. (the initial default value), the program will use the input or default value of PCEFEF (PCS EFFeCTiveness) if it is greater than zero. If PCEFEF is zero (or less), the program will use ENEFEF (ENGINE EFFeCTiveness) if it is greater than zero. Otherwise, the program will use CYCEFEF (CYCLE EFFeCTiveness).

Notes: If only the collector is of interest, this may be designated by IPCSEF, IENGFEF, and ICYCEFEF all .FALSE. (their initial default value) and PCEFEF, ENEFEF, and CYCEFEF all zero. The initial default values of ENEFEF and CYCEFEF are zero, but that of PCEFEF is not. Thus, if the initial default values are still in use for a data set, it is only necessary to input PCEFEF = 0.0.

C. OPTION PERTAINING TO INPUT

To enter either new receiver temperatures or a new table of efficiencies for power conversion, NWTORF (NeW Temperature OR efficiencies) must be set .TRUE. To enter a new table of efficiencies for power conversion, IPCSEF, IENGFEF, or ICYCEFEF must also be set .TRUE.

The last sentence does not apply to entering a new effectiveness for power conversion, which is done by entering the desired value of PCEFCT, ENEFCT, or CYCECT, with IPCSEF, IENGEF, and ICYCEF all set .FALSE. and with NWTORF either .TRUE. or .FALSE.

The default value of NWTORF is .TRUE. for the first data set and .FALSE. for all subsequent data sets. The default value of NWTORF is not determined by its value in the preceding data set.

D. OPTIONS PERTAINING TO OUTPUT

1. Extract of Output

Output of CONC/11 is one or two pages per data set; if many data sets are input, the output will be many pages. If .XTRACT. is set .TRUE., the program will also provide an extract of the output. This consists, for each data set, of an echo of the NAMELIST and receiver temperature inputs, plus outputs for the lowest and highest receiver temperatures and for the temperature that gives the highest system efficiency.

If .XTRACT. is .TRUE., CONC/11 catalogs and assigns a file named XTRACT and places the extract in this file. Each run of CONC/11 catalogs and assigns a new cycle of XTRACT.

The initial default value of XTRACT is .FALSE.

2. Partial Suppression of Output

When both SECONC and OPTMZE are .TRUE., the standard output for each receiver temperature is too long to fit on one line of output, and therefore is folded over to a second line. Appropriate headings are printed for this line; nevertheless, the folding makes the main output table harder to read and doubles its length. If SUP2 (SUPpress 2nd line) is set .TRUE., output of the second line is suppressed. The quantities otherwise printed on this line are the geometric concentration ratio and intercept factor of the compound concentrator and, if MAXSEC is .TRUE., the geometric concentration ratio of the secondary concentrator.

The initial default value of SUP2 is .FALSE.

3. More Decimal Places

In the standard output, efficiencies are given to three decimal places. If MORDEC (MORE DECimal places) is set .TRUE., efficiencies will be given to five decimal places.

The initial default value of MORDEC is .FALSE.

APPENDIX C

SAMPLE CASES

Case A	C-3
Case B	C-9
Case C	C-17
Case D	C-33

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CASE A

Only collector of interest. (Not power conversion.)

Two data sets.

CONC/11 assumed to be in file SOLAR.

Control, input, and output by interactive terminal.

➡Indicates input.

Notes on results:

For the selected input values, including an insolation of 800 W/m^2 , increasing the receiver temperature from 700 to 800°C lowers collector efficiency from 0.79 to 0.76. If the insolation is increased to 1000 W/m^2 , the corresponding efficiencies rise. The efficiency increase is greater at the higher receiver temperatures.

➔@RUN ABC,12345.DEF

➔@ASG,A SOLAR
READY

➔@XQT SOLAR.CONC/11

SET 1

ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

➔ \$NLIST PCEFCT=0.0, \$END

\$NLIST PCEFCT=0.0, \$END

ENTER RECEIVER TEMPERATURES (M1,M2,M3 INTEGER)

➔700,800,25

ITRC1, ITRC2, ITRC3 = 700, 800, 25

\$NLIST

INS = .80000000E+03

RHO1 = .90000000E+00

RHO2 = .00000000E+00

BS1 = .10000000E+01

BS2 = .00000000E+00

PHI1 = .95000000E+00

PHI1S = .00000000E+00

PHI2 = .00000000E+00

C1 = .10000000E+04

C1S = .10000000E+04

C2 = .00000000E+00

F = .60000000E+00

RMA = .45239635E+02

SLOPER = .20000000E+01

SPECUL = .50000000E+00

SOLSD = .23000000E+01

ALPHA = .10000000E+01

EPS = .10000000E+01

TAC = .20000000E+02

HC = .00000000E+00

ARATIO = .00000000E+00

HK = .00000000E+00

DTRE = .25000000E+02

TOC = .50000000E+02

PCEFCT = .00000000E+00

ENEFT = .00000000E+00

CYCECT = .00000000E+00

MECHE = .00000000E+00

AUXE = .00000000E+00

GEARE = .00000000E+00

GENE = .00000000E+00

FPE = .95000000E+00

OPTMZE = F

PARAB = T

MAXC = F

MAXPHI = F

SECONC = F

MAXSEC = F

IPCSEF = F

IENGEP = F

ICYCEF = F

NWTORF = T

XTRACT = F

SUP2 = F

MORDEC = F

\$END

<u>RECEIVER TEMP.</u>		<u>COLLECTOR</u>	<u>PCS</u>	<u>SYSTEM</u>	<u>FRAC.MAX.</u>
<u>C</u>	<u>F</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>SYS.EFFIC.</u>
700.0	1292.0	.792	.000	.000	.000
725.0	1337.0	.785	.000	.000	.000
750.0	1382.0	.778	.000	.000	.000
775.0	1427.0	.770	.000	.000	.000
800.0	1472.0	.762	.000	.000	.000

```

      SET      2
      ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
      ➔ $NLIST      INS=1000.0,      $END

      $NLIST      INS=1000.0,      $END
      $NLIST
      INS      =      .100000000E+04
      RH01      =      .900000000E+00
      RH02      =      .000000000E+00
      BS1      =      .100000000E+01
      BS2      =      .000000000E+00
      PHI1      =      .950000000E+00
      PHI1S      =      .000000000E+00
      PHI2      =      .000000000E+00
      C1      =      .100000000E+04
      C1S      =      .100000000E+04
      C2      =      .000000000E+00
      F      =      .600000000E+00
      RMA      =      .45239635E+02
      SLOPER      =      .200000000E+01
      SPECUL      =      .500000000E+00
      SOLSD      =      .230000000E+01
      ALPHA      =      .100000000E+01
      EPS      =      .100000000E+01
      TAC      =      .200000000E+02
      HC      =      .000000000E+00
      ARATIO      =      .000000000E+00
      HK      =      .000000000E+00
      DTRE      =      .250000000E+02
      TOC      =      .500000000E+02
      PCEFACT      =      .000000000E+00
      ENEFACT      =      .000000000E+00
      CYCECT      =      .000000000E+00
      MECHE      =      .000000000E+00
      AUXE      =      .000000000E+00
      GEARE      =      .000000000E+00
      GENE      =      .000000000E+00
      PPE      =      .950000000E+00
      OPTMZE      =      F
      PARAB      =      T
      MAXC      =      F
      MAXPHI      =      F
      SECONC      =      F
      MAXSEC      =      F
      IPCSEF      =      F
      IENGEF      =      F
      ICYCEF      =      F
      NWTORF      =      F
      XTRACT      =      F
      SUP2      =      F
      MORDEC      =      F
      $END

```


<u>RECEIVER TEMP.</u>	<u>COLLECTOR</u>	<u>PCS</u>	<u>SYSTEM</u>	<u>FRAC.MAX.</u>	
<u>C</u>	<u>F</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>SYS.EFFIC.</u>
700.0	1292.0	.805	.000	.000	.000
725.0	1337.0	.799	.000	.000	.000
750.0	1382.0	.793	.000	.000	.000
775.0	1427.0	.787	.000	.000	.000
800.0	1472.0	.780	.000	.000	.000

```

SET      3
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
->@EOF

STOP NORMAL
->FIN

```

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CASE B

Power conversion effectiveness entered as fraction of Carnot.

Two data sets.

CONC/11 restored from MASSTOR.

Control and input by interactive terminal. Output breakpointed to file for printer.

Notes on results:

For the selected input values, including a reflectance of 0.90, the system efficiency is highest (0.30) at a receiver temperature of 775-800°C. However, the system efficiency at 650°C is 0.29, or 98% of the peak efficiency. If the reflectance is reduced to 0.80, the peak system efficiency falls to 0.26, and occurs at a slightly lower receiver temperature (750-775°C).

```

➔@RUN ABC,12345,DEF
➔@SRD
  SRD 1R1 SL74R1 12/14/83 12:50:16      1100/80A      37R2C      JPL
  @XQT      SYS$*TEST1.S-R-D

  S U I F (C) COPYRIGHT 1982 MASSTOR SYSTEMS
➔RESTORE MYFILE FROM JAFFE*SOLAR1
  RESTORE: COMMAND ACCEPTED

  CONNECT REQUEST TO ASSIGN SVSS FILE JAFFE*SOLAR1

  SVSS FILE READY

    0 TRACKS TRANSFERRED

    32 TRACKS TRANSFERRED

  DATA RESTORED

  RESTORE: COMMAND COMPLETED

➔STOP
  END OF S/R/D
➔@BK1
  BREAKPOINTED
➔@XQT MYFILE.CONC/11
➔ $NLIST      PCEFCT=0.60,      $END
➔650,650,25
➔ $NLIST      RHO1=0.80,      $END
➔@BK2 LSPH,506/13
  @SYM DEF *BKFIL$ABC(1)..506/13,LSPH
  SYMMED BY ABC
➔@FIN

```

@XQT MYFILE.CONC/11

```

SET      1
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST      PCEFCT=0.60,
ENTER RECEIVER TEMPERATURES (M1,M2,M3      INTEGER)
ITRC1, ITRC2, ITRC3 =      650,      850,      25
$NLIST
INS      =      .80000000E+03
RH01     =      .90000000E+00
RH02     =      .00000000E+00
BS1      =      .10000000E+01
BS2      =      .00000000E+00
PHI1     =      .95000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .00000000E+00
C1       =      .10000000E+04
C1S      =      .10000000E+04
C2       =      .00000000E+00
F        =      .60000000E+00
RMA      =      .45239635E+02
SLOPER   =      .20000000E+01
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC       =      .00000000E+00
ARATIO   =      .00000000E+00
HK       =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFCT   =      .60000000E+00
ENEFCT   =      .00000000E+00
CYCECT   =      .00000000E+00
MECHE    =      .00000000E+00
AUXE     =      .00000000E+00
GEARE    =      .00000000E+00
GENE     =      .00000000E+00
PPE      =      .95000000E+00
OPTMZE   =      F
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SECONC   =      F
MAXSEC   =      F
IPCSEF   =      F
IENGLEF  =      F
ICYCEF   =      F
NWTORF   =      T
XTRACT   =      F
SUP2     =      F
MORDEC   =      F
$END

```

RECEIVER	TEMP.	COLLECTOR	PCS	SYSTEM	FRAC.MAX.
<u>-C-</u>	<u>-E-</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>SYS.EFFIC.</u>
650.0	1202.0	.804	.384	.293	.977
675.0	1247.0	.798	.390	.296	.985
700.0	1292.0	.792	.396	.298	.991
725.0	1337.0	.785	.401	.299	.996
750.0	1382.0	.778	.406	.300	.999
775.0	1427.0	.770	.410	.300	1.000
800.0	1472.0	.762	.415	.300	1.000
825.0	1517.0	.752	.419	.300	.998
850.0	1562.0	.743	.423	.299	.995

```

SET      2
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST      RH01=0.80,                                $END
$NLIST
INS      =      .80000000E+03
RH01     =      .80000000E+00
RH02     =      .00000000E+00
BS1      =      .10000000E+01
BS2      =      .00000000E+00
PHI1     =      .95000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .00000000E+00
C1       =      .10000000E+04
C1S      =      .10000000E+04
C2       =      .00000000E+00
F        =      .60000000E+00
RMA      =      .45239635E+02
SLOPER   =      .20000000E+01
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC       =      .00000000E+00
ARATIO   =      .00000000E+00
HK       =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFACT  =      .60000000E+00
ENEFACT  =      .00000000E+00
CYCECT   =      .00000000E+00
MECHE    =      .00000000E+00
AUXE     =      .00000000E+00
GEARE    =      .00000000E+00
GENE     =      .00000000E+00
PPE      =      .95000000E+00
OPTMZE   =      F
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SFCQMC   =      F
MAXSEC   =      F
IPCSEF   =      F
IENGFE   =      F
ICYCEF   =      F
NWTORF   =      F
XTRACT   =      F
SUP2     =      F
MORDEC   =      F
$END

```


<u>RECEIVER</u>	<u>TEMP.</u>	<u>COLLECTOR</u>	<u>PCS</u>	<u>SYSTEM</u>	<u>FRAC.MAX.</u>
<u>_C_</u>	<u>_E_</u>	<u>_EFFIC.</u>	<u>EFFIC.</u>	<u>EFFIC.</u>	<u>SYS.EFFIC.</u>
650.0	1202.0	.709	.384	.259	.983
675.0	1247.0	.703	.390	.261	.990
700.0	1292.0	.697	.396	.262	.995
725.0	1337.0	.690	.401	.263	.998
750.0	1382.0	.683	.406	.263	1.000
775.0	1427.0	.675	.410	.263	1.000
800.0	1472.0	.667	.415	.263	.998
825.0	1517.0	.657	.419	.262	.995
850.0	1562.0	.648	.423	.261	.990

SET 3
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
STOP NORMAL
@BK2 LSPH,506/13

CASE C

Receiver aperture optimized.

Thermodynamic cycle effectiveness input as fraction of Carnot.

Five data sets.

New receiver temperatures input for last data set.

Extract of output prepared.

CONC/11 assumed to be in file SOLAR.

Control by interactive terminal. Data input from file. Output breakpointed to file for printer.

Notes on results:

For the selected input values, the system efficiency at 700°C falls from 0.28 to 0.24 as the slope error increases from 0.5 to 5.0 mrad. At 800°C, the system efficiency falls from 0.29 to 0.24 over this range of slope errors. The receiver temperature at which system efficiency peaks is 860°C or higher for slope errors of 0.5 to 3.0 mrad. For a slope error of 5.0 mrad, the temperature for peak system efficiency is 710°C or slightly lower. The optimum geometric concentration ratio is about 6500 at a slope error of 0.5 mrad, about 650 at 5.0 mrad. The corresponding optimum intercept factors are 0.996 and 0.97.

```

->@RUN ABC,12345,DEF
->@ASG,A SOLAR
  READY
->@CAT,P DATAFILE
  READY
->@ASG,A DATAFILE
  READY
->@EDM DATAFILE.C
  ED-A 29B 12/14/83 13:41 C(0):F
  INPUT
-> $NLIST      SLOPER=0.5,      OPTMZE=T,      CYCECT=0.65,
->      MECHE=0.9,      AUXE=0.95,      GEARE=0.9,      GENE=0.98,      XTRACT=T. $END
->700,860,20      $END
-> $NLIST      SLOPER=1.0,
-> $NLIST      SLOPER=2.0,      $END
-> $NLIST      SLOPER=3.0,      $END
-> $NLIST      NWTORF=T,      SLOPER=5.0,      $END
->700,860,10
->@EOF
  END EDIT 8 LINES OUTPUT
->@CAT,P OUTFILE(+1)
  READY
->@ASG,A OUTFILE
  READY
->@BK1 OUTFILE
  BREAKPOINTED
->@XQT SOLAR.CONC/11
->@ADD,L DATAFILE.C
->@BK2 LSPH,506/13
  @SYM DEF *OUTFILE(1)..506/13,LSPH
  SYMMED BY ABC
->@BLK,S XTRACT,506/13,LSPH
  BLOCK 5.13 SL74R1 12/14/83 13:41:32
  10 PAGES SENT TO: 506/13,LSPH
->@FIN

```

@XQT SOLAR.CONC/11

```

SET      1
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
  $NLIST  SLOPER=0.5,      OPTMZE=T,      CYCECT=0.65,
          MECHE=0.9,      AUXE=0.95,      GEARE=0.9,      GENE=0.98,      XTRACT=T, $END
ENTER RECEIVER TEMPERATURES (M1,M2,M3  INTEGER)
  ITRC1, ITRC2, ITRC3 =      700,      860,      20
$NLIST
INS      =      .80000000E+03
RH01     =      .90000000E+00
RH02     =      .00000000E+00
BS1      =      .10000000E+01
BS2      =      .00000000E+00
PHI1     =      .00000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .00000000E+00
C1       =      .00000000E+00
C1S      =      .00000000E+00
C2       =      .00000000E+00
F        =      .60000000E+00
RMA      =      .45239635E+02
SLOPER   =      .50000000E+00
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC       =      .00000000E+00
ARATIO   =      .00000000E+00
HK       =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFACT  =      .50000000E+00
ENEFACT  =      .00000000E+00
CYCECT   =      .65000000E+00
MECHE    =      .90000000E+00
AUXE     =      .95000000E+00
GEARE    =      .90000000E+00
GENE     =      .98000000E+00
PPE      =      .95000000E+00
OPTMZE   =      T
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SECONC   =      F
MAXSEC   =      F
IPCSEF   =      F
IENGFE   =      F
ICYCEF   =      F
NWTORF   =      T
XTRACT   =      T
SUP2     =      F
MORDEC   =      F
$END

```

RECEIVER_IEMP.	GEOM.	INTERCEPT	COLLECTOR PCS	SYSTEM	FRAC.MAX.		
C	_E_ CONC.RATIO	EACIOR	EEFIC.	EEFIC.	SYS.EEFIC.		
700.0	1292.0	5827.8	.998	.887	.330	.278	.940
720.0	1328.0	5905.3	.998	.887	.333	.281	.949
740.0	1364.0	5983.2	.998	.886	.336	.283	.957
760.0	1400.0	6061.5	.998	.885	.340	.285	.965
780.0	1436.0	6140.3	.997	.884	.343	.288	.973
800.0	1472.0	6219.6	.997	.882	.346	.290	.980
820.0	1508.0	6299.4	.997	.881	.349	.292	.987
840.0	1544.0	6379.8	.997	.880	.352	.294	.994
860.0	1580.0	6460.7	.996	.879	.354	.296	1.000

```

SET      2
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST   SLOPER=1.0,                                $END
$NLIST
INS      =      .800000000E+03
RH01    =      .900000000E+00
RH02    =      .000000000E+00
BS1     =      .100000000E+01
BS2     =      .000000000E+00
PHI1    =      .000000000E+00
PHI1S   =      .000000000E+00
PHI2    =      .000000000E+00
C1      =      .000000000E+00
C1S     =      .000000000E+00
C2      =      .000000000E+00
F       =      .600000000E+00
RMA     =      .45239635E+02
SLOPER  =      .100000000E+01
SPECUL  =      .500000000E+00
SOLSD   =      .230000000E+01
ALPHA   =      .100000000E+01
EPS     =      .100000000E+01
TAC     =      .200000000E+02
HC      =      .000000000E+00
ARATIO  =      .000000000E+00
HK      =      .000000000E+00
DTRE    =      .250000000E+02
TOC     =      .500000000E+02
PCEFACT =      .500000000E+00
ENEFACT =      .000000000E+00
CYCECT  =      .650000000E+00
MECHE   =      .900000000E+00
AUXE    =      .950000000E+00
GEARE   =      .900000000E+00
GENE    =      .980000000E+00
PPE     =      .950000000E+00
OPTMZE  =      T
PARAB   =      T
MAXC    =      F
MAXPHI  =      F
SECONC  =      F
MAXSEC  =      F
IPCSEF  =      F
IENGEF  =      F
ICYCEF  =      F
NWTORF  =      F
XTRACT  =      T
SUP2    =      F
MORDEC  =      F
$END

```


RECEIVER	TEMP.	GEOM.	INTERCEPT	COLLECTOR	PCS	SYSTEM	FRAC.MAX.
C	_E_	CONC.	RAIIQ	EACIQR	EEFIC.	EEFIC.	SYS.EEFIC.
700.0	1292.0	4251.9	.997	.883	.330	.276	.943
720.0	1328.0	4312.0	.997	.881	.333	.279	.952
740.0	1364.0	4372.7	.997	.880	.336	.281	.960
760.0	1400.0	4433.7	.996	.879	.340	.284	.968
780.0	1436.0	4495.3	.996	.877	.343	.286	.975
800.0	1472.0	4557.3	.996	.876	.346	.288	.982
820.0	1508.0	4619.9	.996	.874	.349	.290	.988
840.0	1544.0	4683.0	.995	.873	.352	.291	.994
860.0	1580.0	4746.7	.995	.871	.354	.293	1.000

SET 3
 ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
 \$NLIST SLOPER=2.0,

\$END

\$NLIST
 INS = .80000000E+03
 RH01 = .90000000E+00
 RH02 = .00000000E+00
 BS1 = .10000000E+01
 BS2 = .00000000E+00
 PHI1 = .00000000E+00
 PHI1S = .00000000E+00
 PHI2 = .00000000E+00
 C1 = .00000000E+00
 C1S = .00000000E+00
 C2 = .00000000E+00
 F = .60000000E+00
 RMA = .45239635E+02
 SLOPER = .20000000E+01
 SPECUL = .50000000E+00
 SOLSD = .23000000E+01
 ALPHA = .10000000E+01
 EPS = .10000000E+01
 TAC = .20000000E+02
 HC = .00000000E+00
 ARATIO = .00000000E+00
 HK = .00000000E+00
 DTRE = .25000000E+02
 TOC = .50000000E+02
 PCEFCT = .50000000E+00
 ENEFCT = .00000000E+00
 CYCECT = .65000000E+00
 MECHE = .90000000E+00
 AUXE = .95000000E+00
 GEARE = .90000000E+00
 GENE = .98000000E+00
 PPE = .95000000E+00
 OPTMZE = T
 PARAB = T
 MAXC = F
 MAXPHI = F
 SECONC = F
 MAXSEC = F
 IPCSEF = F
 IENGCF = F
 ICYCEF = F
 NWTORF = F
 XTRACT = T
 SUP2 = F
 MORDEC = F
 \$END

RECEIVER	TEMP.	GEOM.	INTERCEPT	COLLECTOR	PCS	SYSTEM	FRAC.MAX.
C	_E_	CONC.RATIO	EACIOR	EEEIC.	EFFIC.	EFFIC.	SYS.EFFIC.
700.0	1292.0	2186.1	.994	.865	.330	.271	.956
720.0	1328.0	2222.1	.993	.863	.333	.273	.963
740.0	1364.0	2258.5	.993	.860	.336	.275	.970
760.0	1400.0	2295.4	.992	.858	.340	.277	.976
780.0	1436.0	2332.7	.991	.855	.343	.278	.982
800.0	1472.0	2370.5	.991	.852	.346	.280	.987
820.0	1508.0	2408.9	.990	.849	.349	.281	.992
840.0	1544.0	2447.7	.989	.846	.352	.282	.996
860.0	1580.0	2487.1	.988	.843	.354	.284	1.000

SET 4
 ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
 \$NLIST SLOPER=3.0,

\$END

\$NLIST
 INS = .80000000E+03
 RH01 = .90000000E+00
 RH02 = .00000000E+00
 BS1 = .10000000E+01
 BS2 = .00000000E+00
 PHI1 = .00000000E+00
 PHI1S = .00000000E+00
 PHI2 = .00000000E+00
 C1 = .00000000E+00
 C1S = .00000000E+00
 C2 = .00000000E+00
 F = .60000000E+00
 RMA = .45239635E+02
 SLOPER = .30000000E+01
 SPECUL = .50000000E+00
 SOLSD = .23000000E+01
 ALPHA = .10000000E+01
 EPS = .10000000E+01
 TAC = .20000000E+02
 HC = .00000000E+00
 ARATIO = .00000000E+00
 HK = .00000000E+00
 DTRE = .25000000E+02
 TOC = .50000000E+02
 PCEFACT = .50000000E+00
 ENEFACT = .00000000E+00
 CYCECT = .65000000E+00
 MECHE = .90000000E+00
 AUXE = .95000000E+00
 GEARE = .90000000E+00
 GENE = .98000000E+00
 PPE = .95000000E+00
 OPTMZE = T
 PARAB = T
 MAXC = F
 MAXPHI = F
 SECONC = F
 MAXSEC = F
 IPCSEF = F
 IENGEF = F
 ICYCEF = F
 NWTORF = F
 XTRACT = T
 SUP2 = F
 MORDEC = F
 \$END

RECEIVER_IEMP.	GEOM.	INTERCEPT	COLLECTOR PCS	SYSTEM	FRAC.MAX.		
C	_E_ CONC. RATIO	EACIOR	EEFIC.	EEFIC.	SYS.EEFIC.		
700.0	1292.0	1302.5	.988	.841	.330	.263	.974
720.0	1328.0	1327.2	.987	.837	.333	.265	.980
740.0	1364.0	1352.4	.986	.832	.336	.266	.985
760.0	1400.0	1377.9	.984	.828	.340	.267	.989
780.0	1436.0	1404.0	.983	.823	.343	.268	.992
800.0	1472.0	1430.4	.982	.818	.346	.269	.995
820.0	1508.0	1457.4	.981	.813	.349	.269	.998
840.0	1544.0	1484.9	.979	.808	.352	.270	.999
860.0	1580.0	1512.9	.977	.803	.354	.270	1.000

```

SET      5
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST   NWTORF=T,      SLOPER=5.0,
ENTER RECEIVER TEMPERATURES (M1,M2,M3  INTEGER)
ITRC1, ITRC2, ITRC3 =      700,      860,      10
$NLIST
INS      =      .80000000E+03
RH01     =      .90000000E+00
RH02     =      .00000000E+00
BS1      =      .10000000E+01
BS2      =      .00000000E+00
PHI1     =      .00000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .00000000E+00
C1       =      .00000000E+00
C1S      =      .00000000E+00
C2       =      .00000000E+00
F        =      .60000000E+00
RMA      =      .45239635E+02
SLOPER   =      .50000000E+01
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC       =      .00000000E+00
ARATIO   =      .00000000E+00
HK       =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFCT   =      .50000000E+00
ENEFCT   =      .00000000E+00
CYCECT   =      .65000000E+00
MECHE    =      .90000000E+00
AUXE     =      .95000000E+00
GEARE    =      .90000000E+00
GENE     =      .98000000E+00
PPE      =      .95000000E+00
OPTMZE   =      T
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SECONC   =      F
MAXSEC   =      F
IPCSEF   =      F
IENGFE   =      F
ICYCEF   =      F
NWTORF   =      T
XTRACT   =      T
SUP2     =      F
MORDEC   =      F
$END

```

<u>RECEIVER</u>	<u>IEMP.</u>	<u>GEOM.</u>	<u>INTERCEPT</u>	<u>COLLECTOR</u>	<u>PCS</u>	<u>SYSTEM</u>	<u>FRAC.MAX.</u>
<u>R_C</u>	<u>E</u>	<u>CONC.RATIO</u>	<u>EACIOR</u>	<u>EEFIC.</u>	<u>EEFIC.</u>	<u>EEFIC.</u>	<u>SYS.EEFIC.</u>
700.0	1292.0	650.3	.969	.775	.330	.243	1.000
710.0	1310.0	658.1	.968	.771	.331	.243	1.000
720.0	1328.0	666.0	.966	.767	.333	.243	1.000
730.0	1346.0	674.1	.965	.763	.335	.243	.999
740.0	1364.0	682.2	.964	.758	.336	.242	.999
750.0	1382.0	690.4	.962	.754	.338	.242	.998
760.0	1400.0	698.8	.961	.750	.340	.242	.997
770.0	1418.0	707.3	.959	.745	.341	.242	.995
780.0	1436.0	715.9	.957	.741	.343	.241	.994
790.0	1454.0	724.6	.956	.736	.344	.241	.992
800.0	1472.0	733.5	.954	.731	.346	.240	.990
810.0	1490.0	742.5	.952	.726	.347	.240	.987
820.0	1508.0	751.6	.950	.721	.349	.239	.985
830.0	1526.0	760.9	.949	.716	.350	.238	.982
840.0	1544.0	770.3	.947	.711	.352	.238	.979
850.0	1562.0	779.9	.945	.706	.353	.237	.975
860.0	1580.0	789.6	.943	.701	.354	.236	.972

SET 6
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

STOP NORMAL

@BK2 LSPH,506/13


```

SET      1
$NLIST   SLOPER=0.5,    OPTMZE=T,    CYCECT=0.65,
          MECHE=0.9,    AUXE=0.95,    GEARE=0.9,    GENE=0.98,    XTRACT=T,    $END
ITRC1, ITRC2, ITRC3 =    700,        860,        20
700.0  1292.0  5827.8    .998    .887    .330    .278    .940
860.0  1580.0  6460.7    .996    .879    .354    .296    1.000

SET      2
$NLIST   SLOPER=1.0,                                $END
700.0  1292.0  4251.9    .997    .883    .330    .276    .943
860.0  1580.0  4746.7    .995    .871    .354    .293    1.000

SET      3
$NLIST   SLOPER=2.0,                                $END
700.0  1292.0  2186.1    .994    .865    .330    .271    .956
860.0  1580.0  2487.1    .988    .843    .354    .284    1.000

SET      4
$NLIST   SLOPER=3.0,                                $END
700.0  1292.0  1302.5    .988    .841    .330    .263    .974
860.0  1580.0  1512.9    .977    .803    .354    .270    1.000

SET      5
$NLIST   NWTORF=T,    SLOPER=5.0,                                $END
ITRC1, ITRC2, ITRC3 =    700,        860,        10
700.0  1292.0    650.3    .969    .775    .330    .243    1.000
710.0  1310.0    658.1    .968    .771    .331    .243    1.000
860.0  1580.0    789.6    .943    .701    .354    .236    .972

SET      6

```

CASE D

Output with and without secondary concentrator. Secondary concentration maximized. Receiver aperture optimized.

Engine efficiencies input as table.

Ten data sets.

New engine efficiencies input at sixth data set.

Extract of output prepared. (The extract is printed before the standard output. For table headings, see the standard output.)

CONC/11 assumed to be in file SOLAR.

Batch run.

Notes on results:

For the selected input values, and without a secondary concentrator, system efficiency is highest at low focal ratio (0.4). With the engine efficiencies used in data sets 1-5, system efficiency at this focal ratio peaks at 0.32 and a receiver temperature of 1450°C; the optimum geometric concentration ratio for these conditions is 4700. With the engine efficiencies used in data sets 6-10, system efficiency at focal ratio 0.4 peaks at 0.38 and a receiver temperature of 1325°C; the optimum geometric concentration ratio for these conditions is 4200.

If the receiver temperature is limited to 500°C, the system efficiencies attainable are 0.11 for the first set of engine efficiencies, and 0.19 for the engine efficiencies of data sets 6-10. If the receiver efficiency is limited to 900°C, a system efficiency of 0.27 (84% of the peak efficiency) can be obtained with the first set of engine efficiencies, and the optimum geometric concentration ratio is 3100. For the engine efficiencies of sets 6-10, a system efficiency of 0.34 (89% of peak) can be obtained; the optimum geometric concentration ratio is again 3100.

Use of a secondary concentrator improves system efficiency at the longer focal ratios and higher receiver temperatures. Highest system efficiency (0.33 for data sets 1-5, 0.39 for sets 6-10) is obtained at focal ratios of 0.8 or longer and receiver temperatures of 1500°C or higher. The optimum geometric concentration ratio of the primary is 2200 and 1500 for focal lengths of 0.8 and 1.0, respectively; with the corresponding secondary geometric concentration ratios of 3.0 and 4.4, the overall geometric concentration ratio is 6800. The efficiencies attainable with a secondary concentrator are slightly higher than those attainable without a secondary. If, however, receiver temperature is limited to 900°C, system efficiencies attainable with a secondary are not as high as those attainable without one.

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->@RUN ABC,12345,DEF
->@BLK,F ,506/13,LSPH
->@ASG,A SOLAR
->@XQT SOLAR.CONC/11
->$NLIST F=0.4, SECONC=T, RH02=0.96, MAXSEC=T, OPTMZE=T,
-> IENGEF=T, GENE=0.98, GEARE=0.9, XTRACT=T, $END
->500,1500,25
->.154, .175, .195, .214, .232
->.249, .265, .280, .293, .307, .318, .329, .339, .349, .359
->.367, .376, .385, .393, .401, .409, .416, .424, .430, .437
->.443, .450, .457, .463, .470, .476, .483, .489, .495, .500
->.505, .511, .516, .522, .527, .533
->$NLIST F=0.5, $END
->$NLIST F=0.6, $END
->$NLIST F=0.8, $END
->$NLIST F=1.0, $END
->$NLIST F=0.4, NWTORF=T, $END
->500,1500,25
->.254, .275, .295, .314, .332
->.349, .365, .380, .393, .407, .418, .429, .439, .449, .459
->.467, .476, .485, .493, .501, .509, .516, .524, .530, .537
->.543, .550, .557, .563, .570, .576, .583, .589, .595, .600
->.605, .611, .616, .622, .627, .633
->$NLIST F=0.5, $END
->$NLIST F=0.6, $END
->$NLIST F=0.8, $END
->$NLIST F=1.0, $END
->@BLK,S XTRACT,506/13,LSPH
->@FIN

```

```

SET 1
$NLIST F=0.4, SECONC=T, RHO2=0.96, MAXSEC=T, OPTMZE=T,
IENGEF=T, GENE=0.98, GEARE=0.9, XTRACT=T, $END
ITRC1, ITRC2, ITRC3 = 500, 1500, 25
500.0 932.0 2251.7 2192.6 .998 .998 .887 .853 -.034 .136 .114 .110 -.004 .363 .352
1.23 2701.5 .998
1450.0 2642.0 4667.1 4420.2 .951 .958 .722 .713 -.008 .460 .316 .312 -.004 1.000 .998
1.23 5446.2 .958
1500.0 2732.0 4851.8 4585.7 .945 .953 .706 .700 -.006 .470 .315 .312 -.003 .999 1.000
1.23 5650.0 .953

SET 2
$NLIST F=0.5, $END
500.0 932.0 2142.0 2012.1 .998 .999 .887 .855 -.032 .136 .114 .110 -.004 .366 .343
1.55 3122.3 .999
1400.0 2552.0 4313.7 3817.4 .953 .969 .729 .743 .014 .451 .312 .318 .006 1.000 .990
1.55 5923.5 .969
1500.0 2732.0 4667.5 4091.9 .941 .961 .697 .720 .023 .470 .311 .321 .010 .997 1.000
1.55 6349.4 .961

SET 3
$NLIST F=0.6, $END
500.0 932.0 1845.9 1669.2 .998 .999 .884 .855 -.029 .136 .114 .110 -.004 .377 .340
1.97 3280.5 .999
1325.0 2417.0 3603.6 2986.3 .954 .975 .730 .764 .034 .437 .303 .317 .014 1.000 .978
1.97 5869.0 .975
1500.0 2732.0 4168.2 3363.9 .930 .963 .669 .726 .057 .470 .299 .324 .026 .986 1.000
1.97 6611.2 .963

SET 4
$NLIST F=0.8, $END
500.0 932.0 1322.2 1109.5 .996 .999 .878 .856 -.022 .136 .113 .110 -.003 .405 .339
3.04 3376.7 .999
1225.0 2237.0 2526.4 1849.0 .946 .932 .711 .785 .074 .415 .280 .309 .029 1.000 .949
3.04 5627.6 .982
1500.0 2732.0 3283.6 2224.4 .895 .964 .592 .729 .137 .470 .264 .326 .061 .945 1.000
3.04 6770.1 .964

SET 5
$NLIST F=1.0, $END
500.0 932.0 977.4 765.0 .995 .999 .870 .856 -.014 .136 .112 .110 -.002 .433 .339
4.44 3395.4 .999
1100.0 2012.0 1756.8 1172.0 .945 .987 .708 .805 .097 .385 .259 .295 .036 1.000 .903
4.44 5201.5 .987
1500.0 2732.0 2713.1 1532.3 .848 .964 .505 .730 .225 .470 .225 .326 .101 .870 1.000
4.44 5800.7 .964

SET 6
$NLIST F=0.4, MAXTORF=T, $END
ITRC1, ITRC2, ITRC3 = 500, 1500, 25
500.0 932.0 2251.7 2192.6 .998 .998 .887 .853 -.034 .224 .189 .182 -.007 .500 .489
1.23 2701.5 .998
1325.0 2417.0 4241.8 4036.9 .963 .969 .758 .744 -.014 .525 .378 .371 -.007 1.000 .998
1.23 4973.9 .969
1400.0 2552.0 4491.0 4262.0 .956 .963 .737 .726 -.011 .539 .377 .372 -.005 .998 1.000
1.23 5251.3 .963
1500.0 2732.0 4851.8 4585.7 .945 .953 .706 .700 -.006 .558 .374 .371 -.003 .990 .998

```

.953

SET .7

$$F \approx 0.5,$$

\$END

500.0	932.0	2142.0	2012.1	.998	.999	.887	.855	-.032	.224	.189	.182	-.007	.504	.477
			1.55	3122.3		.999								
1325.0	2417.0	4069.9	3625.2	.961	.974	.752	.759	.008	.525	.375	.379	.004	1.000	.992
			1.55	5625.3		.974								
1500.0	2732.0	4667.5	4091.9	.941	.961	.697	.720	-.023	.558	.370	.382	.012	.987	1.000
			1.55	6349.4		.961								

SET 8

$$F = 0.6 \text{ t}$$

SEND

500.0	932.0	1845.9	1669.2	.998	.999	.884	.855	-.029	.224	.188	.182	-.006	.517	.473
			1.97	3280.5		.999								
1275.0	2327.0	3460.2	2887.1	.959	.978	.746	.774	.028	.514	.364	.378	.014	1.000	.982
			1.97	5674.1		.978								
1500.0	2732.0	4168.2	3363.9	.930	.963	.669	.726	.057	.558	.355	.385	.030	.974	1.000
			1.97	6611.2		.963								

SET 9

 $F \approx 0.8,$

SEND

500.0	932.0	1322.2	1109.5	.996	.999	.878	.856	-.022	.224	.187	.182	-.005	.549	.471
			3.04	3376.7		.999								
1175.0	2147.0	2414.2	1788.2	.953	.984	.729	.793	.064	.491	.340	.370	.030	1.000	.957
			3.04	5442.5		.984								
1500.0	2732.0	3283.6	2224.4	.895	.964	.592	.729	.137	.558	.314	.387	.073	.923	1.000
			3.04	6770.1		.964								

SET 10

F=1.0,

SEND

500.0	932.0	977.4	765.0	.995	.999	.870	.856	-.014	.224	.185	.182	-.003	.579	.470
			4.44	3395.4		.999								
1050.0	1922.0	1671.2	1133.3	.953	.989	.728	.811	.083	.462	.320	.356	.037	1.000	.920
			4.44	5029.8		.989								
1500.0	2732.0	2713.1	1532.3	.848	.964	.505	.730	.225	.558	.268	.387	.120	.838	1.000
			4.44	6800.7		.964								

SET 11

C-37

BRUN ABC,12345,DEF

BLK,F ,506/13,LSPH

BLOCK 5.13 SL74R1 12/16/83 14:58:27

NEW DEFAULT ROUTING: 506/13,LSPH

ASG,A SOLAR

QQT SOLAR.CONC/11

```

SET      1
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST   F=0.4,      SECONC=T,      RH02=0.96,      MAXSEC=T,      OPTMZE=T,
        IENGEF=T,    GENE=0.98,    GEARE=0.9,      XTRACT=T,      $END
ENTER RECEIVER TEMPERATURES (M1,M2,M3  INTEGER)
ITRC1, ITRC2, ITRC3 =      500,      1500,      25
ENTER ENGINE EFFICIENCIES (FREE-FIELD, REAL)
EFFICIENCIES ENTERED
$NLIST
INS      =      .80000000E+03
RH01     =      .90000000E+00
RH02     =      .96000000E+00
BS1      =      .10000000E+01
BS2      =      .10000000E+01
PHI1     =      .00000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .10000000E+01
C1       =      .00000000E+00
C1S      =      .00000000E+00
C2       =      .00000000E+00
F        =      .40000000E+00
RMA      =      .64010816E+02
SLOPER   =      .20000000E+01
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC        =      .00000000E+00
ARATIO   =      .00000000E+00
HK        =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFACT  =      .00000000E+00
ENEFACT  =      .00000000E+00
CYCECT   =      .00000000E+00
MECHE    =      .00000000E+00
AUXE     =      .00000000E+00
GEARE    =      .90000000E+00
GENE     =      .98000000E+00
PPE      =      .95000000E+00
OPTMZE   =      T
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SECONC   =      T
MAXSEC   =      T
IPCSEF   =      F
IENGEF   =      T
ICYCEF   =      F
NWTORF   =      T
XTRACT   =      T
SUP2     =      F
HORDEC   =      F
$END

```


RECEIVER TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY ERAC.MAX.SYS.EFFIC.
 C _F_ W/O SEC. W/SEC. W/O SEC. W/SEC. W/O SEC. W/SEC. DELTA EFFIC. W/O SEC. W/SEC. DELTA W/O SEC. W/SEC.

			SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.	OVERALL ICPI.FACI.									
500.0	932.0	2251.7	2192.6	.998	.998	.887	.853	-.034	.136	.114	.110	-.004	.363	.352
			1.23 2731.5			.958								
525.0	977.0	2299.6	2238.0	.998	.998	.886	.852	-.034	.154	.130	.125	-.005	.411	.400
			1.23 2757.5			.998								
550.0	1022.0	2347.9	2283.7	.997	.998	.884	.851	-.033	.172	.144	.139	-.005	.458	.445
			1.23 2813.8			.998								
575.0	1067.0	2396.6	2329.8	.997	.998	.882	.849	-.033	.189	.158	.152	-.006	.501	.487
			1.23 2870.5			.998								
600.0	1112.0	2445.8	2376.3	.997	.997	.880	.848	-.033	.205	.171	.165	-.006	.542	.527
			1.23 2927.8			.997								
625.0	1157.0	2495.5	2423.1	.996	.997	.878	.846	-.032	.220	.183	.177	-.007	.581	.565
			1.23 2985.6			.997								
650.0	1202.0	2545.7	2470.5	.996	.997	.876	.844	-.032	.234	.195	.187	-.007	.616	.600
			1.23 3043.9			.997								
675.0	1247.0	2596.6	2518.3	.996	.996	.874	.842	-.032	.247	.205	.198	-.007	.650	.633
			1.23 3102.8			.996								
700.0	1292.0	2648.0	2566.7	.995	.996	.872	.840	-.031	.258	.214	.206	-.008	.678	.660
			1.23 3162.4			.996								
725.0	1337.0	2700.1	2615.6	.994	.995	.869	.838	-.031	.271	.224	.216	-.008	.708	.690
			1.23 3222.7			.995								
750.0	1382.0	2752.9	2665.1	.994	.995	.866	.836	-.030	.280	.231	.223	-.008	.731	.713
			1.23 3283.7			.995								
775.0	1427.0	2806.4	2715.2	.993	.994	.864	.834	-.030	.290	.238	.230	-.008	.754	.736
			1.23 3345.4			.994								
800.0	1472.0	2860.6	2766.0	.993	.994	.861	.831	-.029	.295	.244	.236	-.008	.774	.756
			1.23 3408.0			.994								
825.0	1517.0	2915.7	2817.4	.992	.993	.858	.829	-.029	.308	.251	.242	-.008	.794	.775
			1.23 3471.3			.993								
850.0	1562.0	2971.5	2869.5	.991	.992	.854	.826	-.028	.317	.257	.248	-.009	.814	.795
			1.23 3535.5			.992								
875.0	1607.0	3028.2	2922.4	.990	.992	.851	.823	-.028	.324	.262	.253	-.009	.829	.810
			1.23 3600.7			.992								
900.0	1652.0	3085.8	2976.0	.989	.991	.847	.820	-.027	.332	.267	.258	-.009	.845	.827
			1.23 3666.7			.991								
925.0	1697.0	3144.4	3030.4	.988	.990	.843	.817	-.027	.340	.272	.263	-.009	.862	.843
			1.23 3733.7			.990								
950.0	1742.0	3203.9	3085.6	.987	.989	.839	.813	-.026	.347	.276	.268	-.009	.876	.857
			1.23 3801.8			.989								
975.0	1787.0	3264.4	3141.7	.986	.989	.835	.810	-.025	.354	.281	.272	-.009	.889	.871
			1.23 3870.9			.989								
1000.0	1832.0	3325.9	3198.7	.985	.988	.831	.806	-.025	.361	.285	.276	-.008	.902	.884
			1.23 3941.1			.988								
1025.0	1877.0	3388.6	3256.5	.984	.987	.826	.802	-.024	.367	.288	.280	-.008	.913	.895
			1.23 4012.4			.987								
1050.0	1922.0	3452.3	3315.4	.983	.985	.822	.798	-.023	.374	.292	.284	-.008	.925	.908
			1.23 4084.9			.985								
1075.0	1967.0	3517.2	3375.2	.982	.984	.817	.794	-.023	.379	.294	.286	-.008	.932	.916
			1.23 4158.6			.984								
1100.0	2012.0	3583.4	3436.1	.980	.983	.812	.790	-.022	.385	.297	.289	-.008	.942	.926
			1.23 4233.6			.983								
1125.0	2057.0	3650.8	3498.0	.979	.982	.807	.786	-.021	.391	.299	.292	-.008	.949	.933

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SET 2
 ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
 \$NLIST F=0.5,

\$END

\$NLIST
 INS = .80000000E+03
 RH01 = .90000000E+00
 RH02 = .96000000E+00
 BS1 = .10000000E+01
 BS2 = .10000000E+01
 PHI1 = .00000000E+00
 PHI1S = .00000000E+00
 PHI2 = .10000000E+01
 C1 = .00000000E+00
 C1S = .00000000E+00
 C2 = .00000000E+00
 F = .50000000E+00
 RMA = .53130088E+02
 SLOPER = .20000000E+01
 SPECUL = .50000000E+00
 SOLSD = .23000000E+01
 ALPHA = .10000000E+01
 EPS = .10000000E+01
 TAC = .20000000E+02
 HC = .00000000E+00
 ARATIO = .00000000E+00
 HK = .00000000E+00
 DTRE = .25000000E+02
 TOC = .50000000E+02
 PCEFCT = .00000000E+00
 ENEFCT = .00000000E+00
 CYCECT = .00000000E+00
 MECHE = .00000000E+00
 AUXE = .00000000E+00
 GEARE = .90000000E+00
 GENE = .98000000E+00
 PPE = .95000000E+00
 OPTMZE = T
 PARAB = T
 MAXC = F
 MAXPHI = F
 SECONC = T
 MAXSEC = T
 IPCSEF = F
 IENGEF = T
 ICYCEF = F
 NWTORF = F
 XTRACT = T
 SUP2 = F
 MORDEC = F
 \$END

RECEIVER_TEMP. PRIM.GEOM.CONC. PEIM.INTERCEPT_FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY FRAC.MAX.SYS.EFFIC.
 C _F_ W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

SECONDARY OVERALL
 GEOM.CONC. GEOM.CONC. OVERALL
 ICEI.FACI.

500.0	932.0	2142.0	2012.1	.598	.999	.887	.855	-.032	.136	.114	.110	-.004	.366	.343
			1.55	3122.3		.999								
525.0	977.0	2188.0	2052.7	.998	.998	.885	.854	-.031	.154	.130	.125	-.005	.416	.390
			1.55	3185.2		.998								
550.0	1022.0	2234.4	2093.5	.997	.998	.883	.853	-.031	.172	.144	.139	-.005	.462	.433
			1.55	3248.5		.998								
575.0	1067.0	2281.3	2134.5	.997	.998	.881	.851	-.030	.189	.158	.153	-.005	.506	.475
			1.55	3312.2		.998								
600.0	1112.0	2328.6	2175.9	.997	.998	.879	.850	-.029	.205	.171	.165	-.006	.547	.514
			1.55	3376.4		.998								
625.0	1157.0	2376.4	2217.6	.996	.997	.877	.849	-.029	.220	.183	.177	-.006	.586	.551
			1.55	3441.1		.997								
650.0	1202.0	2424.8	2259.7	.996	.997	.875	.847	-.028	.234	.194	.188	-.006	.622	.585
			1.55	3506.4		.997								
675.0	1247.0	2473.8	2302.1	.995	.997	.873	.845	-.027	.247	.205	.198	-.006	.656	.617
			1.55	3572.2		.997								
700.0	1292.0	2523.3	2345.0	.995	.996	.870	.844	-.027	.258	.214	.207	-.007	.684	.644
			1.55	3638.8		.996								
725.0	1337.0	2573.6	2388.3	.994	.996	.868	.842	-.026	.271	.223	.217	-.007	.715	.674
			1.55	3706.0		.996								
750.0	1382.0	2624.5	2432.1	.994	.996	.865	.840	-.025	.280	.230	.224	-.007	.738	.696
			1.55	3773.9		.996								
775.0	1427.0	2676.1	2476.4	.993	.995	.862	.838	-.024	.290	.238	.231	-.007	.761	.719
			1.55	3842.6		.995								
800.0	1472.0	2728.4	2521.1	.992	.995	.859	.836	-.023	.299	.244	.237	-.007	.781	.738
			1.55	3912.1		.995								
825.0	1517.0	2781.6	2566.4	.991	.994	.855	.833	-.022	.308	.250	.244	-.006	.801	.758
			1.55	3982.4		.994								
850.0	1562.0	2835.6	2612.3	.991	.994	.852	.831	-.021	.317	.256	.250	-.006	.821	.778
			1.55	4053.6		.994								
875.0	1607.0	2890.4	2658.8	.990	.993	.848	.828	-.020	.324	.261	.255	-.006	.835	.793
			1.55	4125.6		.993								
900.0	1652.0	2946.1	2705.8	.989	.992	.844	.826	-.019	.332	.266	.260	-.006	.852	.809
			1.55	4198.7		.992								
925.0	1697.0	3002.7	2753.5	.988	.992	.841	.823	-.018	.340	.271	.265	-.006	.868	.826
			1.55	4272.7		.992								
950.0	1742.0	3060.3	2801.9	.987	.991	.836	.820	-.016	.347	.275	.270	-.005	.882	.840
			1.55	4347.7		.991								
975.0	1787.0	3118.9	2850.9	.986	.990	.832	.817	-.015	.354	.280	.274	-.005	.895	.854
			1.55	4423.8		.990								
1000.0	1832.0	3178.6	2900.7	.984	.990	.828	.814	-.014	.361	.284	.279	-.005	.908	.868
			1.55	4501.0		.990								
1025.0	1877.0	3239.3	2951.2	.983	.989	.823	.810	-.012	.367	.287	.282	-.004	.918	.879
			1.55	4579.4		.989								
1050.0	1922.0	3301.2	3002.4	.982	.988	.818	.807	-.011	.374	.291	.287	-.004	.931	.892
			1.55	4658.9		.988								
1075.0	1967.0	3364.2	3054.5	.980	.987	.813	.803	-.010	.379	.293	.289	-.003	.938	.901
			1.55	4735.7		.987								
1100.0	2012.0	3428.4	3107.4	.979	.986	.808	.800	-.008	.385	.296	.293	-.003	.947	.911
			1.55	4821.7		.986								
1125.0	2057.0	3493.9	3161.1	.977	.985	.802	.796	-.006	.391	.298	.295	-.002	.953	.919

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SET 3
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

\$NLIST F=0.6,

SEND

\$NLIST
INS = .80000000E+03
RH01 = .90000000E+00
RH02 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .60000000E+00
RMA = .45239535E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFACT = .00000000E+00
ENEFACT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
SEND

RECEIVER_TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT FACI- COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY ERAC.MAX.SYS.EFFIC.
 C _E_ W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

			SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.		OVERALL ICPI.FACI.								
500.0	932.0	1845.9	1669.2	.998	.999	.884	.855	-.029	.136	.114	.110	-.004	.377	.340
			1.97 3280.5			.999								
525.0	977.0	1886.8	1702.5	.997	.998	.882	.854	-.028	.154	.129	.125	-.004	.427	.386
			1.97 3346.0			.998								
550.0	1022.0	1928.0	1736.0	.997	.998	.880	.853	-.027	.172	.144	.139	-.004	.475	.430
			1.97 3411.9			.998								
575.0	1067.0	1969.7	1769.8	.996	.998	.878	.852	-.026	.189	.158	.153	-.005	.520	.471
			1.97 3478.2			.998								
600.0	1112.0	2011.9	1803.7	.996	.998	.876	.851	-.025	.205	.170	.165	-.005	.562	.510
			1.97 3544.9			.998								
625.0	1157.0	2054.6	1838.0	.995	.998	.874	.849	-.024	.220	.182	.177	-.005	.602	.547
			1.97 3612.2			.998								
650.0	1202.0	2097.8	1872.5	.995	.997	.871	.848	-.023	.234	.193	.188	-.005	.639	.581
			1.97 3680.1			.997								
675.0	1247.0	2141.7	1907.3	.994	.997	.868	.846	-.022	.247	.204	.199	-.005	.673	.612
			1.97 3748.5			.997								
700.0	1292.0	2186.1	1942.5	.994	.997	.865	.845	-.021	.258	.212	.207	-.005	.702	.640
			1.97 3817.6			.997								
725.0	1337.0	2231.1	1978.0	.993	.996	.862	.843	-.020	.271	.222	.217	-.005	.733	.669
			1.97 3887.4			.996								
750.0	1382.0	2276.9	2013.9	.992	.996	.859	.841	-.018	.280	.229	.224	-.005	.756	.691
			1.97 3957.9			.996								
775.0	1427.0	2323.3	2050.1	.991	.995	.856	.839	-.017	.290	.236	.231	-.005	.779	.713
			1.97 4029.1			.995								
800.0	1472.0	2370.5	2086.8	.991	.995	.852	.837	-.015	.299	.242	.238	-.004	.799	.733
			1.97 4101.2			.995								
825.0	1517.0	2418.5	2123.9	.990	.995	.848	.835	-.014	.308	.248	.244	-.004	.819	.753
			1.97 4174.1			.995								
850.0	1562.0	2467.3	2161.4	.989	.994	.844	.832	-.012	.317	.254	.250	-.004	.839	.772
			1.97 4247.8			.994								
875.0	1607.0	2516.9	2199.4	.988	.993	.840	.830	-.010	.324	.258	.255	-.003	.853	.787
			1.97 4322.5			.993								
900.0	1652.0	2567.5	2237.9	.987	.993	.836	.827	-.008	.332	.263	.261	-.003	.870	.804
			1.97 4398.1			.993								
925.0	1697.0	2618.9	2276.8	.985	.992	.831	.825	-.006	.340	.268	.266	-.002	.886	.821
			1.97 4474.7			.992								
950.0	1742.0	2671.3	2316.3	.984	.992	.827	.822	-.005	.347	.272	.271	-.001	.899	.835
			1.97 4552.4			.992								
975.0	1787.0	2724.7	2356.4	.983	.991	.822	.819	-.002	.354	.276	.275	-.001	.912	.849
			1.97 4631.1			.991								
1000.0	1832.0	2779.1	2397.0	.981	.990	.816	.816	-.000	.361	.280	.280	-.000	.924	.863
			1.97 4710.9			.990								
1025.0	1877.0	2834.6	2438.2	.980	.989	.811	.813	.002	.367	.283	.283	.001	.934	.874
			1.97 4791.8			.989								
1050.0	1922.0	2891.3	2480.0	.978	.988	.805	.810	.004	.374	.286	.288	.001	.945	.887
			1.97 4873.9			.988								
1075.0	1967.0	2949.1	2522.4	.977	.988	.800	.806	.006	.379	.288	.290	.002	.951	.896
			1.97 4957.3			.988								
1100.0	2012.0	3008.1	2565.5	.975	.987	.794	.803	.009	.385	.291	.294	.003	.960	.906
			1.97 5042.0			.987								
1125.0	2057.0	3068.5	2609.2	.973	.986	.787	.799	.011	.391	.292	.297	.004	.965	.915

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SET 4
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
\$NLIST F=0.8,

SEND

\$NLIST
INS = .80000000E+03
RHO1 = .90000000E+00
RHO2 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .80000000E+00
RMA = .34707878E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFACT = .00000000E+00
ENEFACT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
SEND

RECEIVER	TEMP.	PRIM.GEOM.CONC.	PRIM.INTERCEPT FACI.	COLLECTOR EFFICIENCY	PCS	SYSTEM EFFICIENCY	FRAC.MAX.SYS.EFFIC.
C	_F_	W/O_SEC.	W/SEC.	W/O_SEC.	W/SEC.	W/O_SEC.	W/SEC.
		DELTA				DELTA	
		SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.	OVERALL ICPI.FACI.	EFFIC.	W/O_SEC.	W/SEC.
						DELTA	W/O_SEC.
							W/SEC.
500.0	932.0	1322.2	1109.5	.996	.999	.378	.856
		3.04	3376.7	.999			-.022
525.0	977.0	1353.6	1131.5	.996	.999	.375	.855
		3.04	3443.8	.999			-.021
550.0	1022.0	1385.5	1153.7	.955	.998	.373	.853
		3.04	3511.3	.993			-.019
575.0	1067.0	1417.7	1176.0	.955	.998	.370	.852
		3.04	3579.1	.998			-.017
600.0	1112.0	1450.5	1198.4	.994	.998	.866	.851
		3.04	3647.5	.998			-.015
625.0	1157.0	1483.8	1221.0	.993	.998	.863	.850
		3.04	3716.3	.998			-.013
650.0	1202.0	1517.6	1243.8	.992	.997	.860	.848
		3.04	3785.7	.997			-.011
675.0	1247.0	1551.9	1266.8	.991	.997	.856	.847
		3.04	3855.7	.997			-.009
700.0	1292.0	1586.9	1290.0	.991	.997	.852	.845
		3.04	3926.4	.997			-.007
725.0	1337.0	1622.5	1313.5	.990	.996	.848	.843
		3.04	3997.7	.996			-.004
750.0	1382.0	1658.8	1337.2	.988	.996	.843	.842
		3.04	4069.7	.996			-.001
775.0	1427.0	1695.8	1361.1	.987	.996	.838	.840
		3.04	4142.6	.996			.001
800.0	1472.0	1733.5	1385.3	.986	.995	.833	.838
		3.04	4216.2	.995			.004
825.0	1517.0	1772.0	1409.7	.985	.995	.828	.836
		3.04	4290.6	.995			.007
850.0	1562.0	1811.2	1434.5	.983	.994	.823	.833
		3.04	4365.9	.994			.010
875.0	1607.0	1851.4	1459.5	.982	.994	.817	.831
		3.04	4442.2	.994			.014
900.0	1652.0	1892.4	1484.9	.980	.993	.811	.828
		3.04	4519.3	.993			.017
925.0	1697.0	1934.3	1510.6	.978	.993	.805	.826
		3.04	4597.5	.993			.021
950.0	1742.0	1977.1	1536.6	.978	.992	.799	.823
		3.04	4676.7	.992			.025
975.0	1787.0	2021.0	1562.9	.974	.991	.792	.820
		3.04	4757.0	.991			.028
1000.0	1832.0	2065.9	1589.7	.972	.990	.785	.817
		3.04	4838.3	.990			.032
1025.0	1877.0	2112.0	1616.8	.970	.990	.778	.814
		3.04	4920.8	.990			.036
1050.0	1922.0	2159.1	1644.3	.967	.989	.770	.811
		3.04	5004.5	.989			.041
1075.0	1967.0	2207.5	1672.2	.965	.988	.763	.808
		3.04	5089.5	.988			.045
1100.0	2012.0	2257.2	1700.5	.962	.987	.755	.804
		3.04	5175.7	.987			.050
1125.0	2057.0	2308.1	1729.3	.959	.986	.746	.801
							.054

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SET 5
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

\$NLIST F=1.0,

\$END

\$NLIST
INS = .80000000E+03
RH01 = .90000000E+00
RH02 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .10000000E+01
RMA = .28072355E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFACT = .00000000E+00
ENEFACT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
\$END

RECEIVER_TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT_FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY FRAC.MAX.SYS.EFFIC.
 C _F_ W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

			SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.	OVERALL ICPI.FACI.										
500.0	932.0	977.4	765.0	.995	.999	.870	.856	-.014	.136	.112	.110	-.002	.433	.339	
			4.44	3395.4	.999	.999									
525.0	977.0	1002.3	780.2	.994	.999	.866	.855	-.012	.154	.127	.125	-.002	.490	.384	
			4.44	3452.7	.999	.999									
550.0	1022.0	1027.7	795.5	.993	.998	.863	.854	-.009	.172	.141	.139	-.001	.544	.428	
			4.44	3530.5	.998	.998									
575.0	1067.0	1053.4	818.8	.992	.998	.859	.852	-.006	.189	.154	.153	-.001	.594	.469	
			4.44	3598.6	.998	.998									
600.0	1112.0	1079.7	826.3	.991	.998	.854	.851	-.003	.205	.166	.165	-.001	.641	.507	
			4.44	3657.3	.998	.998									
625.0	1157.0	1106.4	841.9	.990	.998	.850	.850	-.000	.220	.177	.177	-.000	.684	.544	
			4.44	3736.4	.998	.998									
650.0	1202.0	1133.7	857.6	.989	.997	.845	.848	.003	.234	.188	.188	.001	.724	.578	
			4.44	3806.1	.997	.997									
675.0	1247.0	1161.6	873.4	.988	.997	.840	.847	.007	.247	.197	.199	.002	.761	.609	
			4.44	3876.4	.997	.997									
700.0	1292.0	1190.0	885.4	.986	.997	.835	.845	.011	.258	.205	.208	.003	.791	.636	
			4.44	3947.4	.997	.997									
725.0	1337.0	1219.1	905.6	.985	.996	.829	.844	.015	.271	.213	.217	.004	.823	.665	
			4.44	4019.0	.996	.996									
750.0	1382.0	1248.8	921.9	.983	.996	.823	.842	.019	.280	.219	.224	.005	.846	.688	
			4.44	4091.4	.996	.996									
775.0	1427.0	1279.2	938.3	.981	.996	.817	.840	.023	.290	.225	.232	.006	.869	.710	
			4.44	4164.5	.996	.996									
800.0	1472.0	1310.4	955.0	.980	.995	.810	.838	.027	.299	.230	.238	.008	.888	.730	
			4.44	4238.4	.995	.995									
825.0	1517.0	1342.3	971.8	.978	.995	.803	.836	.032	.308	.235	.244	.009	.907	.749	
			4.44	4313.1	.995	.995									
850.0	1562.0	1375.0	988.9	.976	.994	.796	.833	.037	.317	.240	.251	.011	.925	.769	
			4.44	4388.7	.994	.994									
875.0	1607.0	1408.6	1006.1	.973	.994	.789	.831	.042	.324	.243	.256	.013	.936	.784	
			4.44	4465.3	.994	.994									
900.0	1652.0	1443.1	1023.6	.971	.993	.781	.829	.048	.332	.246	.261	.015	.950	.801	
			4.44	4542.7	.993	.993									
925.0	1697.0	1478.5	1041.2	.968	.993	.773	.826	.053	.340	.249	.266	.017	.963	.817	
			4.44	4621.2	.993	.993									
950.0	1742.0	1514.8	1059.2	.966	.992	.765	.823	.059	.347	.252	.271	.019	.972	.831	
			4.44	4700.7	.992	.992									
975.0	1787.0	1552.3	1077.3	.963	.991	.756	.821	.065	.354	.254	.276	.022	.980	.846	
			4.44	4781.3	.991	.991									
1000.0	1832.0	1590.7	1055.7	.960	.991	.747	.818	.071	.361	.256	.280	.024	.988	.859	
			4.44	4862.9	.991	.991									
1025.0	1877.0	1630.4	1114.4	.956	.990	.738	.815	.077	.367	.257	.284	.027	.992	.871	
			4.44	4945.8	.990	.990									
1050.0	1922.0	1671.2	1133.3	.953	.989	.728	.811	.083	.374	.259	.288	.030	.998	.884	
			4.44	5029.8	.989	.989									
1075.0	1967.0	1713.3	1152.5	.949	.988	.718	.808	.090	.379	.259	.291	.032	.998	.893	
			4.44	5115.0	.988	.988									
1100.0	2012.0	1756.8	1172.0	.945	.987	.708	.805	.097	.385	.259	.295	.036	1.000	.903	
			4.44	5201.5	.987	.987									
1125.0	2057.0	1801.6	1191.8	.941	.986	.697	.801	.104	.391	.259	.297	.039	.999	.912	

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SET      6
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
$NLIST   F=0.4,      NWTORF=T,
ENTER RECEIVER TEMPERATURES (M1,M2,M3  INTEGER)
ITRC1, ITRC2, ITRC3 =      500,      1500,
ENTER ENGINE EFFICIENCIES (FREE-FIELD, REAL)
EFFICIENCIES ENTERED

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25

\$END

```

$NLIST
INS      =      .80000000E+03
RH01     =      .90000000E+00
RH02     =      .96000000E+00
BS1      =      .10000000E+01
BS2      =      .10000000E+01
PHI1     =      .00000000E+00
PHI1S    =      .00000000E+00
PHI2     =      .10000000E+01
C1       =      .00000000E+00
C1S      =      .00000000E+00
C2       =      .00000000E+00
F        =      .40000000E+00
RMA      =      .64010816E+02
SLOPER   =      .20000000E+01
SPECUL   =      .50000000E+00
SOLSD    =      .23000000E+01
ALPHA    =      .10000000E+01
EPS      =      .10000000E+01
TAC      =      .20000000E+02
HC       =      .00000000E+00
ARATIO   =      .00000000E+00
HK       =      .00000000E+00
DTRE     =      .25000000E+02
TOC      =      .50000000E+02
PCEFACT  =      .00000000E+00
ENEFACT  =      .00000000E+00
CYCECT   =      .00000000E+00
MECHE    =      .00000000E+00
AUXE     =      .00000000E+00
GEARE    =      .90000000E+00
GENE     =      .98000000E+00
PPE      =      .95000000E+00
OPTMZE   =      T
PARAB    =      T
MAXC     =      F
MAXPHI   =      F
SECONC   =      T
MAXSEC   =      T
IPCSEF   =      F
IENGFE   =      T
ICYCEF   =      F
NWTORF   =      T
XTRACT   =      T
SUP2     =      F
MORDEC   =      F
$END

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RECEIVER TEMP. PRIM. GEOM. CONC. PEIM. INTERCEPT FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY FRAC. MAX. SYS. EFFIC.
 C F W/O SEC. W/SEC. W/O SEC. W/SEC. W/O SEC. W/SEC. DELTA EFFIC. W/O SEC. W/SEC. DELTA W/O SEC. W/SEC.

		SECONDARY GEOM. CONC.	OVERALL GEOM. CONC.	OVERALL ICPI FACI.										
500.0	932.0	2251.7	2192.6	.998	.998	.887	.853	-.034	.224	.189	.182	-.007	.500	.489
		1.23	2701.5		.998									
525.0	977.0	2299.6	2238.0	.998	.998	.886	.852	-.034	.243	.204	.196	-.008	.540	.528
		1.23	2757.5		.998									
550.0	1022.0	2347.9	2283.7	.997	.998	.884	.851	-.033	.260	.219	.210	-.008	.578	.566
		1.23	2813.8		.998									
575.0	1067.0	2396.6	2329.8	.997	.998	.882	.849	-.033	.277	.232	.223	-.009	.614	.601
		1.23	2870.5		.998									
600.0	1112.0	2445.8	2376.3	.997	.997	.880	.848	-.033	.293	.245	.236	-.009	.648	.634
		1.23	2927.8		.997									
625.0	1157.0	2495.5	2423.1	.996	.997	.878	.846	-.032	.308	.257	.247	-.009	.680	.665
		1.23	2985.6		.997									
650.0	1202.0	2545.7	2470.5	.996	.997	.876	.844	-.032	.322	.268	.258	-.010	.709	.695
		1.23	3043.9		.997									
675.0	1247.0	2596.6	2518.3	.996	.996	.874	.842	-.032	.335	.278	.268	-.010	.736	.721
		1.23	3102.8		.996									
700.0	1292.0	2648.0	2566.7	.995	.996	.872	.840	-.031	.347	.287	.277	-.010	.759	.744
		1.23	3162.4		.996									
725.0	1337.0	2700.1	2615.6	.994	.995	.869	.838	-.031	.359	.296	.286	-.011	.784	.769
		1.23	3222.7		.995									
750.0	1382.0	2752.9	2665.1	.994	.995	.866	.836	-.030	.369	.303	.293	-.011	.803	.788
		1.23	3285.7		.995									
775.0	1427.0	2806.4	2715.2	.993	.994	.864	.834	-.030	.378	.310	.300	-.011	.821	.806
		1.23	3345.4		.994									
800.0	1472.0	2860.6	2766.0	.993	.994	.861	.831	-.029	.387	.317	.306	-.011	.838	.822
		1.23	3408.0		.994									
825.0	1517.0	2915.7	2817.4	.992	.993	.858	.829	-.029	.396	.323	.312	-.011	.853	.838
		1.23	3471.3		.993									
850.0	1562.0	2971.5	2869.5	.991	.992	.854	.826	-.028	.405	.329	.318	-.011	.869	.854
		1.23	3535.5		.992									
875.0	1607.0	3028.2	2922.4	.990	.992	.851	.823	-.028	.412	.333	.322	-.011	.881	.866
		1.23	3600.7		.992									
900.0	1652.0	3085.8	2976.0	.989	.991	.847	.820	-.027	.420	.338	.327	-.011	.894	.879
		1.23	3666.7		.991									
925.0	1697.0	3144.4	3030.4	.988	.990	.843	.817	-.027	.428	.343	.332	-.011	.907	.893
		1.23	3731.7		.990									
950.0	1742.0	3203.9	3085.6	.987	.989	.839	.813	-.026	.435	.347	.336	-.011	.917	.904
		1.23	3801.8		.989									
975.0	1787.0	3264.4	3141.7	.986	.989	.835	.810	-.025	.442	.351	.340	-.011	.928	.914
		1.23	3870.9		.989									
1000.0	1832.0	3325.9	3198.7	.985	.988	.831	.806	-.025	.449	.354	.344	-.011	.938	.925
		1.23	3941.1		.988									
1025.0	1877.0	3388.6	3256.5	.984	.987	.826	.802	-.024	.455	.357	.347	-.010	.945	.933
		1.23	4012.4		.987									
1050.0	1922.0	3452.3	3315.4	.983	.985	.822	.798	-.023	.462	.361	.351	-.010	.955	.943
		1.23	4084.9		.985									
1075.0	1967.0	3517.2	3375.2	.982	.984	.817	.794	-.023	.467	.363	.353	-.010	.960	.949
		1.23	4158.6		.984									
1100.0	2012.0	3583.4	3436.1	.980	.983	.812	.790	-.022	.474	.365	.355	-.010	.966	.956
		1.23	4233.6		.983									
1125.0	2057.0	3650.8	3498.0	.979	.982	.807	.786	-.021	.479	.367	.357	-.010	.971	.961

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SET 7
 ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
 \$NLIST F=0.5,

\$END

\$NLIST
 INS = .80000000E+03
 RH01 = .90000000E+00
 RH02 = .96000000E+00
 BS1 = .19000000E+01
 BS2 = .19000000E+01
 PHI1 = .00000000E+00
 PHI1S = .00000000E+00
 PHI2 = .10000000E+01
 C1 = .00000000E+00
 C1S = .00000000E+00
 C2 = .00000000E+00
 F = .50000000E+00
 RMA = .53130088E+02
 SLOPER = .20000000E+01
 SPECUL = .50000000E+00
 SOLSD = .23000000E+01
 ALPHA = .10000000E+01
 EPS = .10000000E+01
 TAC = .20000000E+02
 HC = .00000000E+00
 ARATIO = .00000000E+00
 HK = .00000000E+00
 DTRE = .25000000E+02
 TOC = .50000000E+02
 PCEFACT = .00000000E+00
 ENEFACT = .00000000E+00
 CYCECT = .00000000E+00
 MECHE = .00000000E+00
 AUXE = .00000000E+00
 GEARE = .90000000E+00
 GENE = .98000000E+00
 PPE = .95000000E+00
 OPTMZE = T
 PARAB = T
 MAXC = F
 MAXPHI = F
 SECONC = T
 MAXSEC = T
 IPCSEF = F
 IENGEF = T
 ICYCEF = F
 NWTORF = F
 XTRACT = T
 SUP2 = F
 MORDEC = F
 \$END

RECEIVER_TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT_EACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY FRAC.MAX.SYS.EFFIC.
 C _F_ W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

		SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.	OVERALL ICPI,EACI.										
500.0	932.0	2142.0	2012.1	.998	.999	.887	.855	-.032	.224	.189	.182	-.007	.504	.477
		1.55	3122.3		.999									
525.0	977.0	2188.0	2052.7	.998	.998	.885	.854	-.031	.243	.204	.197	-.007	.544	.515
		1.55	3185.2		.998									
550.0	1022.0	2234.4	2093.5	.997	.998	.883	.853	-.031	.260	.218	.211	-.008	.583	.552
		1.55	3248.5		.998									
575.0	1067.0	2281.3	2134.5	.997	.998	.881	.851	-.030	.277	.232	.224	-.008	.619	.587
		1.55	3312.2		.998									
600.0	1112.0	2328.6	2175.9	.997	.998	.879	.850	-.029	.293	.245	.236	-.008	.653	.619
		1.55	3375.4		.998									
625.0	1157.0	2376.4	2217.6	.996	.997	.877	.849	-.029	.308	.257	.248	-.008	.685	.650
		1.55	3441.1		.997									
650.0	1202.0	2424.8	2259.7	.996	.997	.875	.847	-.028	.322	.268	.259	-.009	.714	.679
		1.55	3505.4		.997									
675.0	1247.0	2473.8	2302.1	.995	.997	.873	.845	-.027	.335	.278	.269	-.009	.742	.705
		1.55	3572.2		.997									
700.0	1292.0	2523.3	2345.0	.995	.996	.870	.844	-.027	.347	.287	.278	-.009	.765	.728
		1.55	3633.8		.996									
725.0	1337.0	2573.6	2388.3	.994	.996	.868	.842	-.026	.359	.296	.287	-.009	.790	.752
		1.55	3705.0		.996									
750.0	1382.0	2624.5	2432.1	.994	.996	.855	.840	-.025	.369	.303	.294	-.009	.808	.771
		1.55	3775.9		.996									
775.0	1427.0	2676.1	2476.4	.993	.995	.852	.838	-.024	.378	.310	.301	-.009	.827	.789
		1.55	3843.6		.995									
800.0	1472.0	2728.4	2521.1	.992	.995	.859	.836	-.023	.387	.316	.307	-.009	.843	.805
		1.55	3912.1		.995									
825.0	1517.0	2781.6	2566.4	.991	.994	.855	.833	-.022	.396	.322	.313	-.008	.859	.821
		1.55	3982.4		.994									
850.0	1562.0	2835.6	2612.3	.991	.994	.852	.831	-.021	.405	.328	.320	-.008	.874	.837
		1.55	4053.6		.994									
875.0	1607.0	2890.4	2658.8	.990	.993	.848	.828	-.020	.412	.332	.324	-.008	.886	.849
		1.55	4125.6		.993									
900.0	1652.0	2946.1	2705.8	.989	.992	.844	.826	-.019	.420	.337	.329	-.008	.899	.863
		1.55	4198.7		.992									
925.0	1697.0	3002.7	2753.5	.988	.992	.841	.823	-.018	.428	.342	.334	-.007	.912	.876
		1.55	4272.7		.992									
950.0	1742.0	3060.3	2801.9	.987	.991	.836	.820	-.016	.435	.345	.339	-.007	.922	.887
		1.55	4347.7		.991									
975.0	1787.0	3118.9	2850.9	.986	.990	.832	.817	-.015	.442	.349	.343	-.006	.932	.898
		1.55	4423.8		.990									
1000.0	1832.0	3178.6	2900.7	.984	.990	.828	.814	-.014	.449	.353	.347	-.006	.942	.909
		1.55	4501.0		.990									
1025.0	1877.0	3239.3	2951.2	.983	.989	.823	.810	-.012	.455	.356	.350	-.005	.949	.918
		1.55	4579.4		.989									
1050.0	1922.0	3301.2	3002.4	.982	.988	.818	.807	-.011	.462	.359	.354	-.005	.958	.928
		1.55	4656.9		.988									
1075.0	1967.0	3364.2	3054.5	.980	.987	.813	.803	-.010	.467	.361	.357	-.004	.963	.935
		1.55	4735.7		.987									
1100.0	2012.0	3428.4	3107.4	.979	.986	.808	.800	-.008	.474	.363	.360	-.004	.970	.943
		1.55	4821.7		.986									
1125.0	2057.0	3493.9	3161.1	.977	.985	.802	.796	-.006	.479	.365	.362	-.003	.974	.949

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SET 8
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
\$NLIST F=0.6,

\$END

\$NLIST
INS = .80000000E+03
RHO1 = .90000000E+00
RHO2 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .60000000E+00
RMA = .45239635E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFACT = .00000000E+00
ENEFACT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
\$END

RECEIVER_TEMP.	PRIM.GEOM.CONC.	PEIM.INTERCEPI.EACI.	COLLECTOR.EFFICIENCY	PCS	SYSTEM EFFICIENCY			FRAC.MAX.SYS.EFFIC.						
-C-	-F-	W/O_SEC.	W/SEC.	W/O_SEC.	W/SEC.	W/O_SEC.	W/SEC.	DELTA	EFFIC.	W/O_SEC.	W/SEC.	DELTA	W/O_SEC.	W/SEC.
		SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.			OVERALL ICPI.EACI.								
500.0	932.0	1845.9	1669.2 .998	.999	.884	.855	-.029	.224	.188	.182	-.006	.517	.473	
		1.97	3280.5		.999									
525.0	977.0	1886.8	1702.5 .997	.998	.882	.854	-.028	.243	.203	.197	-.007	.558	.511	
		1.97	3346.0		.998									
550.0	1022.0	1928.0	1736.0 .997	.998	.880	.853	-.027	.260	.218	.211	-.007	.597	.548	
		1.97	3411.9		.998									
575.0	1067.0	1969.7	1769.8 .996	.998	.878	.852	-.026	.277	.231	.224	-.007	.634	.582	
		1.97	3478.2		.998									
600.0	1112.0	2011.9	1803.7 .996	.998	.876	.851	-.025	.293	.244	.237	-.007	.669	.615	
		1.97	3544.9		.998									
625.0	1157.0	2054.6	1838.0 .995	.998	.874	.849	-.024	.308	.255	.248	-.007	.701	.645	
		1.97	3612.2		.998									
650.0	1202.0	2097.8	1872.5 .995	.997	.871	.848	-.023	.322	.266	.259	-.007	.731	.673	
		1.97	3680.1		.997									
675.0	1247.0	2141.7	1907.3 .994	.997	.868	.846	-.022	.335	.276	.269	-.007	.759	.700	
		1.97	3748.5		.997									
700.0	1292.0	2186.1	1942.5 .994	.997	.865	.845	-.021	.347	.285	.278	-.007	.782	.722	
		1.97	3817.6		.997									
725.0	1337.0	2231.1	1978.0 .993	.996	.862	.843	-.020	.359	.294	.287	-.007	.807	.747	
		1.97	3887.4		.996									
750.0	1382.0	2276.9	2013.9 .992	.996	.859	.841	-.018	.369	.301	.295	-.006	.826	.765	
		1.97	3957.9		.996									
775.0	1427.0	2323.3	2050.1 .991	.995	.856	.839	-.017	.378	.308	.302	-.006	.844	.783	
		1.97	4029.1		.995									
800.0	1472.0	2370.5	2086.8 .991	.995	.852	.837	-.015	.387	.313	.308	-.006	.860	.800	
		1.97	4101.2		.995									
825.0	1517.0	2418.5	2123.9 .990	.995	.848	.835	-.014	.396	.319	.314	-.005	.876	.816	
		1.97	4174.1		.995									
850.0	1562.0	2467.3	2161.4 .989	.994	.844	.832	-.012	.405	.325	.320	-.005	.891	.832	
		1.97	4247.8		.994									
875.0	1607.0	2516.9	2199.4 .988	.993	.840	.830	-.010	.412	.329	.325	-.004	.902	.844	
		1.97	4322.5		.993									
900.0	1652.0	2567.5	2237.9 .987	.993	.836	.827	-.008	.420	.333	.330	-.003	.915	.857	
		1.97	4398.1		.993									
925.0	1697.0	2618.9	2276.8 .985	.992	.831	.825	-.006	.428	.338	.335	-.003	.927	.871	
		1.97	4474.7		.992									
950.0	1742.0	2671.3	2316.3 .984	.992	.827	.822	-.005	.435	.341	.340	-.002	.937	.882	
		1.97	4552.4		.992									
975.0	1787.0	2724.7	2356.4 .983	.991	.822	.819	-.002	.442	.345	.344	-.001	.947	.893	
		1.97	4631.1		.991									
1000.0	1832.0	2779.1	2397.0 .981	.990	.816	.816	-.000	.449	.348	.348	-.000	.956	.904	
		1.97	4710.9		.990									
1025.0	1877.0	2834.6	2438.2 .980	.989	.811	.813	.002	.455	.351	.351	.001	.963	.913	
		1.97	4791.8		.989									
1050.0	1922.0	2891.3	2480.0 .978	.988	.805	.810	.004	.462	.354	.355	.002	.971	.923	
		1.97	4873.9		.988									
1075.0	1967.0	2949.1	2522.4 .977	.988	.800	.806	.006	.467	.355	.358	.003	.975	.930	
		1.97	4957.3		.988									
1100.0	2012.0	3008.1	2565.5 .975	.987	.794	.803	.009	.474	.357	.361	.004	.980	.938	
		1.97	5042.0		.987									
1125.0	2057.0	3068.5	2609.2 .973	.986	.787	.799	.011	.479	.358	.363	.005	.984	.944	

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SET 9
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")
\$NLIST F=0.8,

\$END

\$NLIST
INS = .80000000E+03
RH01 = .90000000E+00
RH02 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .80000000E+00
RMA = .34707878E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFCT = .00000000E+00
ENEFCT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
\$END

RECEIVER_TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY ERAC.MAX.SYS.EFFIC.
 C F W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

			SECONDARY GEOM.CONC.	OVERALL GEOM.CONC.	OVERALL ICPI.FACI.									
500.0	932.0	1322.2	1109.5	.996	.999	.878	.856	-.022	.224	.187	.182	-.005	.549	.471
			3.04	3376.7	.999									
525.0	977.0	1353.6	1131.5	.996	.999	.875	.855	-.021	.243	.202	.197	-.005	.593	.509
			3.04	3443.8	.999									
550.0	1022.0	1385.5	1153.7	.995	.998	.873	.853	-.019	.260	.216	.211	-.005	.634	.545
			3.04	3511.3	.998									
575.0	1067.0	1417.7	1176.0	.995	.998	.870	.852	-.017	.277	.229	.224	-.005	.672	.580
			3.04	3579.1	.998									
600.0	1112.0	1450.5	1198.4	.994	.998	.866	.851	-.015	.293	.241	.237	-.004	.708	.612
			3.04	3647.5	.998									
625.0	1157.0	1483.8	1221.0	.993	.998	.863	.850	-.013	.308	.252	.248	-.004	.742	.642
			3.04	3716.3	.998									
650.0	1202.0	1517.6	1243.8	.992	.997	.860	.848	-.011	.322	.263	.259	-.003	.773	.671
			3.04	3785.7	.997									
675.0	1247.0	1551.9	1266.8	.991	.997	.856	.847	-.009	.335	.272	.270	-.003	.801	.697
			3.04	3855.7	.997									
700.0	1292.0	1586.9	1290.0	.991	.997	.852	.845	-.007	.347	.280	.278	-.002	.824	.719
			3.04	3926.4	.997									
725.0	1337.0	1622.5	1313.5	.990	.996	.848	.843	-.004	.359	.289	.288	-.001	.849	.743
			3.04	3997.7	.996									
750.0	1382.0	1658.8	1337.2	.988	.996	.843	.842	-.001	.369	.295	.295	-.001	.868	.762
			3.04	4069.7	.996									
775.0	1427.0	1695.8	1361.1	.987	.996	.838	.840	.001	.378	.301	.302	.000	.886	.780
			3.04	4142.6	.996									
800.0	1472.0	1733.5	1385.3	.986	.995	.833	.838	.004	.387	.307	.308	.002	.901	.796
			3.04	4216.2	.995									
825.0	1517.0	1772.0	1409.7	.985	.995	.828	.836	.007	.396	.312	.314	.003	.916	.812
			3.04	4290.6	.995									
850.0	1562.0	1811.2	1434.5	.983	.994	.823	.833	.010	.405	.316	.320	.004	.930	.828
			3.04	4365.9	.994									
875.0	1607.0	1851.4	1459.5	.982	.994	.817	.831	.014	.412	.320	.325	.005	.940	.840
			3.04	4442.2	.994									
900.0	1652.0	1892.4	1484.9	.980	.993	.811	.828	.017	.420	.324	.330	.007	.951	.854
			3.04	4519.3	.993									
925.0	1697.0	1934.3	1510.6	.978	.993	.805	.826	.021	.428	.327	.336	.008	.962	.867
			3.04	4597.5	.993									
950.0	1742.0	1977.1	1536.6	.976	.992	.799	.823	.025	.435	.330	.340	.010	.970	.879
			3.04	4676.7	.992									
975.0	1787.0	2021.0	1562.9	.974	.991	.792	.820	.028	.442	.332	.344	.012	.977	.890
			3.04	4757.0	.991									
1000.0	1832.0	2065.9	1589.7	.972	.990	.785	.817	.032	.449	.335	.349	.014	.984	.901
			3.04	4838.3	.990									
1025.0	1877.0	2112.0	1616.8	.970	.990	.778	.814	.036	.455	.336	.352	.016	.988	.910
			3.04	4920.8	.990									
1050.0	1922.0	2159.1	1644.3	.957	.989	.770	.811	.041	.462	.338	.356	.018	.994	.920
			3.04	5004.6	.989									
1075.0	1967.0	2207.5	1672.2	.955	.988	.763	.808	.045	.467	.339	.359	.020	.995	.927
			3.04	5089.5	.988									
1100.0	2012.0	2257.2	1700.5	.952	.987	.755	.804	.050	.474	.340	.362	.022	.998	.935
			3.14	5175.7	.987									
1125.0	2057.0	2308.1	1729.3	.959	.986	.746	.801	.054	.479	.340	.364	.025	.998	.941

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SET 10
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

\$NLIST F=1.0,

\$END

\$NLIST
INS = .80000000E+03
RH01 = .90000000E+00
RH02 = .96000000E+00
BS1 = .10000000E+01
BS2 = .10000000E+01
PHI1 = .00000000E+00
PHI1S = .00000000E+00
PHI2 = .10000000E+01
C1 = .00000000E+00
C1S = .00000000E+00
C2 = .00000000E+00
F = .10000000E+01
RMA = .28072355E+02
SLOPER = .20000000E+01
SPECUL = .50000000E+00
SOLSD = .23000000E+01
ALPHA = .10000000E+01
EPS = .10000000E+01
TAC = .20000000E+02
HC = .00000000E+00
ARATIO = .00000000E+00
HK = .00000000E+00
DTRE = .25000000E+02
TOC = .50000000E+02
PCEFACT = .00000000E+00
ENEFACT = .00000000E+00
CYCECT = .00000000E+00
MECHE = .00000000E+00
AUXE = .00000000E+00
GEARE = .90000000E+00
GENE = .98000000E+00
PPE = .95000000E+00
OPTMZE = T
PARAB = T
MAXC = F
MAXPHI = F
SECONC = T
MAXSEC = T
IPCSEF = F
IENGEF = T
ICYCEF = F
NWTORF = F
XTRACT = T
SUP2 = F
MORDEC = F
\$END

RECEIVER_TEMP. PRIM.GEOM.CONC. PRIM.INTERCEPT FACI. COLLECTOR EFFICIENCY PCS SYSTEM EFFICIENCY FRAC.MAX.SYS.EFFIC.
 C _F_ W/O_SEC. W/SEC. W/O_SEC. W/SEC. W/O_SEC. W/SEC. DELTA EFFIC. W/O_SEC. W/SEC. DELTA W/O_SEC. W/SEC.

		SECONDARY GEOM.CONC.		OVERALL GEOM.CONC.	OVERALL ICPI.FACI.					SYSTEM EFFICIENCY			FRAC.MAX.SYS.EFFIC.	
500.0	932.0	977.4	765.0	.995	.999	.870	.856	-.014	.224	.185	.182	-.003	.579	.470
		4.44	3395.4			.959								
525.0	977.0	1002.3	780.2	.994	.999	.866	.855	-.012	.243	.200	.197	-.003	.625	.508
		4.44	3462.7			.999								
550.0	1022.0	1027.7	795.5	.993	.998	.863	.854	-.009	.260	.213	.211	-.002	.667	.545
		4.44	3530.5			.998								
575.0	1067.0	1053.4	810.8	.992	.998	.859	.852	-.006	.277	.226	.224	-.002	.707	.579
		4.44	3593.6			.998								
600.0	1112.0	1079.7	826.3	.991	.998	.854	.851	-.003	.293	.238	.237	-.001	.744	.611
		4.44	3667.3			.998								
625.0	1157.0	1106.4	841.9	.990	.998	.850	.850	-.000	.308	.249	.248	-.000	.778	.642
		4.44	3736.4			.998								
650.0	1202.0	1133.7	857.6	.989	.997	.845	.848	.003	.322	.258	.259	.001	.809	.670
		4.44	3806.1			.997								
675.0	1247.0	1161.6	873.4	.988	.997	.840	.847	.007	.335	.267	.270	.002	.837	.696
		4.44	3876.4			.997								
700.0	1292.0	1190.0	889.4	.986	.997	.835	.845	.011	.347	.275	.278	.003	.860	.719
		4.44	3947.4			.997								
725.0	1337.0	1219.1	905.6	.985	.996	.829	.844	.015	.359	.283	.288	.005	.885	.743
		4.44	4019.0			.995								
750.0	1382.0	1248.8	921.9	.983	.996	.823	.842	.019	.369	.288	.295	.007	.902	.761
		4.44	4091.4			.996								
775.0	1427.0	1279.2	938.3	.981	.996	.817	.840	.023	.378	.294	.302	.008	.919	.780
		4.44	4164.5			.996								
800.0	1472.0	1310.4	955.0	.980	.995	.810	.838	.027	.387	.298	.308	.010	.933	.796
		4.44	4238.4			.995								
825.0	1517.0	1342.3	971.8	.978	.995	.803	.836	.032	.396	.302	.314	.012	.946	.812
		4.44	4313.1			.995								
850.0	1562.0	1375.0	988.9	.976	.994	.796	.833	.037	.405	.306	.321	.014	.958	.828
		4.44	4388.7			.994								
875.0	1607.0	1408.6	1006.1	.973	.994	.789	.831	.042	.412	.309	.325	.017	.966	.840
		4.44	4465.3			.994								
900.0	1652.0	1443.1	1023.6	.971	.993	.781	.829	.048	.420	.312	.331	.019	.975	.853
		4.44	4542.7			.993								
925.0	1697.0	1478.5	1041.2	.968	.993	.773	.826	.053	.428	.314	.336	.022	.983	.867
		4.44	4621.2			.993								
950.0	1742.0	1514.8	1059.2	.966	.992	.765	.823	.059	.435	.316	.340	.024	.988	.878
		4.44	4700.7			.992								
975.0	1787.0	1552.3	1077.3	.963	.991	.756	.821	.065	.442	.317	.344	.027	.993	.889
		4.44	4781.3			.991								
1000.0	1832.0	1590.7	1095.7	.960	.991	.747	.818	.071	.449	.319	.349	.030	.997	.900
		4.44	4862.9			.991								
1025.0	1877.0	1630.4	1114.4	.956	.990	.738	.815	.077	.455	.319	.352	.033	.998	.909
		4.44	4945.8			.990								
1050.0	1922.0	1671.2	1133.3	.953	.989	.728	.811	.083	.462	.320	.356	.037	1.000	.920
		4.44	5029.8			.989								
1075.0	1967.0	1713.3	1152.5	.949	.988	.718	.808	.090	.467	.319	.359	.040	.998	.927
		4.44	5115.0			.988								
1100.0	2012.0	1756.8	1172.0	.945	.987	.708	.805	.097	.474	.318	.362	.044	.996	.935
		4.44	5201.5			.987								
1125.0	2057.0	1801.6	1191.8	.941	.986	.697	.801	.104	.479	.317	.364	.047	.992	.941

SET 11
ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")

STOP NORMAL

0BLK,S XTRACT,506/13,LSPH
BLOCK 5.13 SL74R1 12/16/83 14:58:34
30 PAGES SENT TO: 506/13,LSPH

0FIN

APPENDIX D
LISTING, WITH SYMBOL TABLE AND INDEX

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CLEMENT: JAFFE*SOLAR1.CONC/11 OPTIONS: BFQS
ATHENA EXTENDED FORTRAN 25J-28 (14 SEP 82)
COMPILATION DONE ON 13 DEC 83 AT 11:18:52

MAIN PROGRAM

SUBROUTINE	NAMLRD	ENTRY POINT	03727	SEQ	001474
SUBROUTINE	OPT	ENTRY POINT	06153	SEQ	001674
ENTRY	CKNOPT	ENTRY POINT	06156	SEQ	001712
ENTRY	CKOPT	ENTRY POINT	06161	SEQ	002241
ENTRY	OPTAP	ENTRY POINT	06164	SEQ	002432

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	006167
0006	*CODE	000000
0000	*TEMP	000066
0004	*CONSTANTS	001665
0002	*SIMPLE VAR	000113
0010	*ARRAYS	002133
0011	N\$BLNK	000000

EXTERNAL REFERENCES

0012	CSF8
0013	PRINT\$
0014	ASSIGN
0015	SLUP
0016	NINTR\$
0017	NER18\$
0020	NRDU\$
0021	NI02\$
0022	NWDU\$
0023	NWNL\$
0024	NSTOP\$
0025	NI01\$
0026	ATH4\$
0027	NI03\$
0030	NREW\$
0031	NRNL\$
0032	NER10\$
0033	NER19\$
0034	ALOG
0035	ATAN2
0036	SIN
0037	COS
0040	TAN
0041	EXP
0042	SQRT
0043	NER21\$
0044	NERR4\$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0010 R 000000 A	0010 R 000153 AA	0010 R 002113 ALPHA	0010 R 002117 ARATIO	0002 L 000016 ASG100
0010 R 002127 AUE	0002 R 000047 A5MAX	0002 R 000050 A6MAX	0002 R 000032 BOLTZ	0002 R 000034 BOUND
0010 R 002076 BS1	0010 R 002077 BS2	0002 R 000060 CARNOT	0002 R 000111 CINV	0002 R 000112 CINVS
0001 003737 CKNOPT	0001 005123 CKOPT	0012 I 000000 CSF8	0002 R 000064 CYCE	0010 R 002125 CYCECT
0010 R 002103 C1	0002 R 000103 C1MAX	0010 R 002104 C1S	0002 R 000105 C1SMAX	0010 R 002105 C2
0002 R 000110 C2HOLD	0002 R 000107 C2MAX	0002 R 000106 DELT	0002 R 000077 DELTSQ	0010 R 002121 DTRE
0002 R 000100 DUMMY	0010 R 001447 EFF	0010 R 002124 ENEFCT	0002 R 000063 ENGE	0010 R 002114 EPS
0010 R 002106 F	0010 R 001607 FRAY	0002 I 000020 F\$ 1	0002 I 000021 F\$ 2	0002 I 000022 F\$ 3
0002 I 000023 F\$ 4	0002 I 000024 F\$ 5	0002 I 000025 F\$ 6	0002 I 000026 F\$ 7	0002 I 000027 F\$ 8
0002 I 000072 F\$ 12	0002 I 000073 F\$ 13	0010 R 002130 GEARE	0010 R 002131 GENE	0010 R 002116 HC
0010 R 002120 HK	0002 I 000075 I	0002 L 000003 ICYCEF	0002 I 000067 IDUMM	0002 L 000002 IENGEF
0010 I 001531 INFAD	0010 R 002073 INS	0002 L 000001 IPCSEF	0002 L 000071 IRFLG	0002 I 000070 ISTAT
0002 I 000054 ITFC	0002 I 000037 ITRC1	0002 I 000040 ITRC2	0002 I 000041 ITRC3	0002 I 000065 IS
0002 I 000036 J	0002 I 000045 JJ	0002 I 000044 K	0002 I 000066 L	0002 I 000035 M
0002 L 000007 MAXC	0002 L 000010 MAXPHI	0002 L 000011 MAXSEC	0010 R 002126 MECHE	0002 I 000043 MNT
0002 L 000014 MORDEC	0002 I 000033 NSET	0002 I 000053 NTCNT	0002 I 000042 NTRC	0002 L 000004 NWTORF
0010 R 001055 OPT1A	0001 005661 OPTAP	0002 L 000005 OPTMZE	0002 L 000006 PARAB	0010 R 002123 PCEFACT
0010 R 002100 PH11	0002 R 000102 PH11FC	0010 R 002101 PH11S	0002 R 000104 PH11SF	0010 R 002102 PH12
0002 R 000030 PI	0010 R 002132 PPE	0002 R 000031 P4	0010 R 002074 RH01	0010 R 002075 RHC2
0010 R 002107 RMA	0002 R 000076 RMAR	0010 R 001741 RMARAY	0002 L 000000 SECONC	0002 R 000101 SIG2DF
0010 R 002110 SLOPER	0010 R 002112 SOLSD	0010 R 002111 SPECUL	0002 L 000013 SUP2	0010 R 002115 TAC
0002 R 000046 TAK	0002 R 000056 TIK	0010 R 002122 TOC	0002 R 000057 TOK	0002 R 000055 TRK
0002 R 000051 TRMA	0002 R 000052 TRMAS	0002 R 000061 TRMB	0002 R 000062 TRMC	0010 R 000007 TT
0002 R 000074 VF	0002 L 000015 XFLAG	0002 L 000012 XTRACT	0002 L 000017 XTRON	0010 R 001547 Y
0010 R 002073 Z	0001 001553 1001I	0001 003346 100202	0001 001553 100640	0001 001576 1012G
0001 001651 1022I	0001 001703 1024I	0001 001703 1024I	0001 001726 1035G	0001 001744 1041G
0001 001762 1045G	0001 002000 1046I	0004 001161 105F	0001 002017 1055G	0001 002035 1061G
0001 002053 1065G	0001 002070 1066I	0001 002111 1076G	0004 000222 110F	0001 002127 1102G
0001 002145 1106G	0001 002162 1107I	0001 002303 1131I	0001 002302 1131I	0001 002367 1145I
0001 002367 1145I	0001 002370 1145I	0001 002367 1145I	0001 002406 1157G	0001 002424 1163G
0001 002442 1164I	0001 002456 1173G	0001 002474 1177G	0001 002511 1200I	0001 002527 1210G
0001 002545 1214G	0001 002562 1215I	0001 002562 1215I	0001 002567 1215I	0001 002577 1225G
0001 002635 1234I	0001 002651 1236I	0001 002651 1236I	0001 002674 1247G	0001 002712 1253G
0001 002730 1257G	0001 002746 1260I	0001 002765 1267G	0001 003003 1273G	0001 003021 1277G
0001 003036 1300I	0001 003057 1310G	0001 003075 1314G	0001 003113 1320G	0001 003131 1321I
0001 003130 1321I	0001 003147 1332G	0001 003165 1336G	0001 003203 1337I	0001 003217 1346G
0001 003235 1352G	0001 003252 1353I	0001 003270 1363G	0001 003306 1367G	0001 003326 1370I
0001 003323 1370I	0001 003323 1370I	0001 003331 1402G	0001 003410 1504I	0001 003417 1514G
0001 003466 1536I	0001 003470 1541G	0001 003510 1544G	0001 003601 1575I	0001 003616 1606G
0001 003646 1623I	0001 003653 1627I	0001 003654 1631I	0001 003762 1722I	0001 004012 1733I
0001 004027 1747I	0001 004037 1755I	0001 004045 1757I	0001 004045 1757I	0001 004077 1771I
0001 004133 2006I	0001 001555 200640	0001 004205 2014I	0001 003533 201514	0001 000200 202G
0001 004262 2024I	0001 004271 2033I	0001 004274 2035I	0001 004273 2035I	0001 004306 2044G
0004 001163 205F	0001 004323 2051I	0001 004341 2054I	0001 004355 2057I	0001 004356 2057I
0001 004355 2057I	0001 004400 2065I	0001 004407 2067I	0001 004407 2067I	0001 000210 207G
0001 004442 2101I	0001 004562 2105I	0001 004606 2107I	0004 001142 211F	0001 004624 2113I
0001 004640 2117I	0004 001145 212F	0001 004642 2121I	0001 004654 2126I	0001 004672 2134I
0001 004672 2134I	0001 004672 2134I	0001 004712 2143I	0001 004726 2147I	0004 000223 215F
0001 004730 2151I	0001 004742 2156I	0001 004760 2164I	0001 004760 2164I	0001 004760 2164I
0001 005001 2177I	0004 000652 220F	0004 000676 221F	0001 005030 2215I	0004 000707 222F
0001 005063 2222I	0001 005107 2226I	0004 000736 223F	0001 005121 2234I	0001 005121 2234I
0001 005121 2234I	0004 000755 225F	0004 000772 226F	0001 005144 2260I	0004 000775 227F
0001 005201 2274I	0004 001012 228F	0004 001112 230F	0001 005213 2302G	0001 005230 2307I
0001 005246 2312I	0001 005262 2315I	0001 005263 2315I	0001 005262 2315I	0001 005300 2326I
0001 005322 2333I	0001 005331 2335I	0001 005331 2335I	0001 005331 2335I	0004 001127 235F

0001	005401	2350I	0001	035521	2354I	0001	005545	2356I	0001	005570	2371I	0001	005617	2407I
0001	005643	2416I	0001	035657	2426I	0001	005657	2426I	0001	005657	2426I	0001	005676	2442I
0001	006030	2457I	0001	030265	246I	0001	006051	2463I	0001	006063	2471I	0001	006063	2471I
0001	006113	2476I	0001	036124	2500I	0001	000301	263I	0004	000350	270F	0004	000403	271F
0004	000417	272F	0004	030457	273F	0004	000567	275F	0004	000610	276F	0004	000613	277F
0004	000634	278F	0004	031073	280F	0004	001121	285F	0004	000507	290F	0004	000517	291F
0004	000525	292F	0004	030534	293F	0004	001077	294F	0004	000542	295F	0004	000547	296F
0004	000554	297F	0004	030562	298F	0004	001104	299F	0001	000331	311I	0001	000336	321I
0001	000343	330I	0001	000345	336I	0001	000345	336I	0001	000357	344G	0001	000372	353I
0001	000372	353I	0001	000402	363I	0001	000407	366I	0001	000415	374I	0001	000424	405I
0001	000432	411I	0001	000435	413I	0001	000477	425I	0001	000504	432I	0001	000565	472I
0001	001553	50L	0001	000611	507I	0001	000611	507I	0001	000612	507I	0001	000637	526I
0001	000636	526I	0001	000666	545I	0001	000712	562I	0001	000712	562I	0001	000723	575G
0001	003326	60L	0001	000736	603G	0001	000737	606G	0001	000747	614G	0001	000757	622G
0001	001010	640G	0001	001035	656I	0001	001121	667I	0001	001204	674I	0001	003656	70L
0001	001241	710I	0001	001240	710I	0001	001256	714I	0004	001107	730F	0001	001300	730I
0001	001301	730I	0001	001311	734I	0004	001124	735F	0001	003660	75L	0001	001334	750I
0001	001333	750I	0001	001337	753I	0001	001343	755I	0001	001343	755I	0001	001354	757I
0001	001354	757I	0001	001467	771G	0001	001505	773I	0004	001066	780F	0004	001115	785F
0001	003350	80L	0001	003352	90L	0001	003361	92L	0001	003667	95L	0001	003676	96L
0001	003705	97L												

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00101 1*
00101 2* C * * * * *
00101 3* CONC/11
00101 4* C CALCULATES PERFORMANCE OF SOLAR THERMAL CONCENTRATOR, COLLECTOR, OR
00101 5* C POWER SYSTEM.
00101 6*
00101 7* C * * * * *
00101 8* C
00101 9* C CALCULATES COLLECTOR EFFICIENCY AS
00101 10* C  $A(1) = (INS * RH01 * BS1 * PHI * ALPHA - (1/D11 * (EPS * BOLTZ * (TRK ** 4 - TAK ** 4) + HC * (TRK - TAK)) - ARATIO * HK * (TRK - TAK))) / INS$ 
00101 11* C
00101 12* C WHERE QUANTITIES ARE DEFINED IN BLOCK 1..
00101 13* C
00101 14* C CALCULATES SYSTEM EFFICIENCY AS
00101 15* C  $A(5) = A(1) * PCSE * PPE$ 
00101 16* C WHERE POWER CONVERSION EFFICIENCY PCSE OR A(4) IS GIVEN BY
00101 17* C PCSE=PCSEFF(TEMPERATURE)
00101 18* C OR PCSE=PCSEFF*(TIK-TOK)/TIK
00101 19* C OR PCSE=ENGE*GEARE*GENE
00101 20* C AND ENGE=ENGEFF(TEMPERATURE)
00101 21* C OR ENGE=ENEFF*(TIK-TOK)/TIK
00101 22* C OR ENGE=CYCE*MECHE*AUXE
00101 23* C AND CYCE=CYCEFF(TEMPERATURE)
00101 24* C OR CYCE=CYCEFF*(TIK-TOK)/TIK
00101 25* C PCSEFF(TEMPERATURE), ENGEFF(TEMPERATURE), CYCEFF(TEMPERATURE), ARE
00101 26* C RESPECTIVELY THE POWER CONVERSION, ENGINE, AND CYCLE EFFICIENCIES
00101 27* C AS FUNCTIONS OF TEMPERATURE, TIK AND TOK ARE THE INPUT AND OUTPUT
00101 28* C TEMPERATURES (KELVIN), AND THE OTHER QUANTITIES ARE DEFINED IN
00101 29* C BLOCK 1.
00101 30* C
00101 31* C CALCULATES PERFORMANCE FOR AS MANY RECEIVER TEMPERATURES AS DESIRED
00101 32* C AND INDICATES WHICH TEMPERATURE GIVES MAXIMUM SYSTEM EFFICIENCY.
00101 33* C
00101 34* C IF DESIRED WILL ALSO OPTIMIZE RECEIVER APERTURE AREA.
00101 35* C THIS OPTIMIZATION IS DESCRIBED IN SUBROUTINE OPT BELOW.
00101 36* C
00101 37* C CAN HANDLE COMPOUND CONCENTRATORS (PRIMARY PLUS SECONDARY).
00101 38* C
00101 39* C PROVIDES MANY OPTIONAL FORMS OF INPUT, WITH DEFAULT VALUES.
00101 40* C ALL INPUT IS PROMPTED AND IS ECHOED TO OUTPUT.

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00101 41* C
00101 42* C PROVIDES CERTAIN CHECKS OF THEORETICAL POSSIBILITY OF SPECIFIED
00101 43* C OPTICAL AND ENGINE PERFORMANCE.
00101 44* C
00101 45* C ASSUMES OVERALL CONTOUR OF PRIMARY CONCENTRATOR IS EITHER AN
00101 46* C APPROXIMATELY PARABOLOIDAL MIRROR OR AN APPROXIMATELY PLANAR MIRROR
00101 47* C OR LENS.
00101 48* C
00101 49* C *****
00101 50* C *****
00101 51* C ** WHEN PROMPTED FOR INPUT, ENTER VALUES OF INPUT VARIABLES AS **
00101 52* C ** NAMELIST (REAL) WITH NAME "NLIST". **
00101 53* C ** (IF NOT FAMILIAR WITH NAMELIST INPUT, SEE FORTRAN MANUAL.) **
00101 54* C ** FOR FIRST SET OF INPUTS, PROGRAM WILL USE VALUES GIVEN IN **
00101 55* C ** BLOCK 1 AS DEFAULTS. FOR SUBSEQUENT SETS OF INPUTS, IT WILL **
00101 56* C ** USE VALUES FROM PRECEDING SET AS DEFAULTS (EXCEPT NWTORF). **
00101 57* C **
00101 58* C ** THEN, WHEN PROMPTED, ENTER RECEIVER TEMPERATURES IN CELSIUS AS **
00101 59* C ** DO-LOOP PARAMETERS: MIN, MAX, AND INCREMENT (INTEGER). **
00101 60* C ** FOR FIRST DATA SET THESE MUST BE INPUT (NO DEFAULT). FOR **
00101 61* C ** SUBSEQUENT DATA SETS, TEMPERATURES FROM PRECEDING SET ARE **
00101 62* C ** DEFAULT. **
00101 63* C **
00101 64* C **
00101 65* C ** IF WANT TO ENTER A TABLE OF EFFICIENCIES PERTAINING TO POWER **
00101 66* C ** CONVERSION, SET IPCSEF, IENGFE, OR ICYCEF=T WHEN INPUTTING **
00101 67* C ** NAMELIST. THEN, WHEN PROMPTED, ENTER EFFICIENCIES AS FREE-FIELD **
00101 68* C ** LIST (REAL), ONE PER RECEIVER TEMPERATURE. **
00101 69* C ** IF WANT RECEIVER APERTURE OPTIMIZATION, SET OPTMZE=T WITH **
00101 70* C ** NAMELIST. **
00101 71* C ** FOR OTHER OPTIONS, SEE LIST OF LOGICAL VARIABLES IN BLOCK 1. **
00101 72* C **
00101 73* C ** RE-ENTER NEW SETS OF DATA FOR INPUT VARIABLES AS DESIRED. **
00101 74* C **
00101 75* C ** IF, AFTER FIRST DATA SET HAS BEEN PROCESSED, WANT TO ENTER NEW **
00101 76* C ** RECEIVER TEMPERATURES OR NEW EFFICIENCIES PERTAINING TO POWER **
00101 77* C ** CONVERSION, MUST RESET NWTORF=T WHEN ENTERING NAMELIST. **
00101 78* C **
00101 79* C ** USE ASCII PRINTER TO ASSURE PROPER TABLE HEADINGS. **
00101 80* C **
00101 81* C ** IF RECOMPILE: **
00101 82* C ** USE ATHENA FORTRAN COMPILER (@TFOR). **
00101 83* C ** WITH @MAP USE THE STATEMENTS: **
00101 84* C ** LIB LIB*JPL$ **
00101 85* C ** LIB LIB*CLIB$ **
00101 86* C ** TO INCLUDE PROPER ROUTINES. **
00101 87* C *****
00101 88* C *****
00101 89* C
00101 90* C
00101 91* C
00101 92* C * * * * *
00101 93* C * * * * *
00101 94* C BLOCK 0. DEFINE STORAGE.
00101 95* C COMPILER (DATA=IBM)
00103 96* C PARAMETER NT=50
00105 97* C MAX NO. OF TEMPERATURES
MONITOR

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00107  98*      REAL INS,MECHE
00110  99*      INTEGER CSF8
00111 100*      LOGICAL SECONC,IPCSEF,IENGSEF,ICYCEF,NWTORF,OPTMZE,PARAB,
00111 101*      & MAXC,MAXPHI,
00111 102*      & MAXSEC,XTRACT,SUP2,MORDEC,XFLAG,ASG100,XTRON
00112 103*      DIMENSION A(7),TT(2,NT),AA(9,NT),OPTAA(5,NT),EFF(NT),INREAD(14),
00112 104*      & Y(32),Z(32)
00113 105*      EQUIVALENCE (INS,Z(1)),(RH01,Z(2)),(RH02,Z(3)),(BS1,Z(4)),
00113 106*      & (BS2,Z(5)),(PHI1,Z(6)),(PHI1S,Z(7)),(PHI2,Z(8)),(C1,Z(9)),
00113 107*      & (C1S,Z(10)),(C2,Z(11)),
00113 108*      & (F,Z(12)),(RMA,Z(13)),(SLOPER,Z(14)),(SPECUL,Z(15)),
00113 109*      & (SOLSD,Z(16)),(ALPHA,Z(17)),(EPS,Z(18)),(TAC,Z(19)),(HC,Z(20)),
00113 110*      & (ARATIO,Z(21)),(HK,Z(22)),(DTRE,Z(23)),
00113 111*      & (TOC,Z(24)),(PCEFFT,Z(25)),
00113 112*      & (ENEFFT,Z(26)),(CYCECT,Z(27)),(MECHE,Z(28)),(AUXE,Z(29)),
00113 113*      & (GEARE,Z(30)),(GENE,Z(31)),(PPE,Z(32))
00114 114*      NAMELIST/NLIST/INS,RH01,RH02,BS1,BS2,PHI1,PHI1S,PHI2,C1,C1S,C2,
00114 115*      & F,RMA,SLOPER,SPECUL,SOLSD,ALPHA,EPS,
00114 116*      & TAC,HC,ARATIO,HK,DTRE,TOC,PCEFFT,ENEFFT,CYCECT,MECHE,AUXE,
00114 117*      & GEARE,GENE,PPE,OPTMZE,PARAB,MAXC,MAXPHI,SECONC,MAXSEC,IPCSEF,
00114 118*      & IENGSEF,ICYCEF,NWTORF,XTRACT,SUP2,MORDEC
00114 119*      C
00114 120*      C * * * * *
00114 121*      C * * * * *
00114 122*      C * * * * *
00114 123*      C
00114 124*      C BLOCK 1. INITIALIZATION.
00114 125*      C  DEFAULT VALUES FOR INPUT OF SYSTEM CHARACTERISTICS.
00115 126*      INS=800.0      @INSULATION, W/M**2
00116 127*      RH01=0.9      @REFLECTANCE OR TRANSMITTANCE
00117 128*                      @ OF (PRIMARY) CONCENTRATOR.
00117 129*      RH02=0.9      @EFFECTIVE REFLECTANCE OR
00120 130*                      @ TRANSMITTANCE OF SECONDARY
00120 131*                      @ CONCENTRATOR, CONSIDERING
00120 132*                      @ AVERAGE NUMBER OF REFLECTIONS
00120 133*                      @ AT SECONDARY. (IGNORED IF NO
00120 134*                      @ SECONDARY CONCENTRATOR.)
00120 135*      RS1=1.0          @BLOCKING AND SHADOWING FACTOR
00121 136*                      @ (OF PRIMARY).
00121 137*      RS2=1.0          @BLOCKING AND SHADOWING FACTOR OF
00122 138*                      @ SECONDARY. (IGNORED IF NO
00122 139*                      @ SECONDARY.)
00122 140*      PHI1=0.95        @INTERCEPT FACTOR, WITHOUT
00123 141*                      @ SECONDARY.
00123 142*                      @ (IGNORED IF OPTIMIZE RECEIVER
00123 143*                      @ APERTURE.)
00123 144*      PHI1S=0.0        @PRIMARY INTERCEPT FACTOR WITH
00124 145*                      @ SECONDARY. (IGNORED IF NO
00124 146*                      @ SECONDARY.)
00124 147*                      @ PROGRAM SETS PHI1S=PHI1 IF
00124 148*                      @ PHI1S.LE.0.0
00124 149*                      @ (IGNORED IF OPTIMIZE RECEIVER
00124 150*                      @ APERTURE.)
00124 151*      PHI2=1.0          @SECONDARY INTERCEPT FACTOR
00125 152*      C1=1000.0        @GEOMETRIC CONCENTRATION RATIO
00126 153*                      @ WITHOUT SECONDARY.
00126 154*                      @ (IGNORED IF OPTIMIZE RECEIVER

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00126	155*		@ APERTURE.)	
00126	156*	C1S=1000.0	@PRIMARY GEOMETRIC CONCENTRATION	
00127	157*		@ RATIO WITH SECONDARY.	00042
00127	158*		@ (IGNORED IF OPTIMIZE RECEIVER	
00127	159*		@ APERTURE.)	
00127	160*	C2=1.0	@SECONDARY GEOMETRIC	
00130	161*		@ CONCENTRATION RATIO.	00044
00130	162*		@ (IGNORED IF MAXIMIZE SECONDARY	
00130	163*		@ CONCENTRATION.)	
00130	164*	F=0.6	@FOCAL RATIO (OF PRIMARY).	
00131	165*		@ REQUIRED ONLY IF OPTIMIZE	00046
00131	166*		@ RECEIVER APERTURE OR IF	
00131	167*		@ MAXIMIZE INTERCEPT FACTOR OR	
00131	168*		@ CONCENTRATION RATIO, AND	
00131	169*		@ DO NOT SUPPLY RIM ANGLE.	
00131	170*	RMA=0.0	@RIM ANGLE OF (PRIMARY)	
00132	171*		@ CONCENTRATOR, IN DEGREES.	00047
00132	172*		@ REQUIRED ONLY IF OPTIMIZE	
00132	173*		@ RECEIVER APERTURE OR IF	
00132	174*		@ MAXIMIZE INTERCEPT FACTOR OR	
00132	175*		@ CONCENTRATION RATIO.	
00132	176*		@ (SUPPLY EITHER RMA OR F.)	
00132	177*	SLOPER=2.0	@SLOPE ERROR OF	
00133	178*		@ (PRIMARY) REFLECTOR, IN MRAD.	00051
00133	179*		@ FOR (PRIMARY) LENS SET	
00133	180*		@ SLOPER=0.5* STD. DEV. OF	
00133	181*		@ TRANSMITTED RAYS.	
00133	182*		@ (REQUIRED ONLY IF OPTIMIZE.)	
00133	183*	SPECUL=0.5	@SPECULARITY SPREAD OF (PRIMARY)	
00134	184*		@ CONCENTRATOR, IN MRAD.	00053
00134	185*		@ (REQUIRED ONLY IF OPTIMIZE.)	
00134	186*	SOLSD=2.3	@STD. DEV. OF ANGULAR SPREAD OF	
00135	187*		@ INCOMING SUNLIGHT, IN MRAD.	00055
00135	188*		@ (REQUIRED ONLY IF OPTIMIZE.)	
00135	189*	ALPHA=1.0	@RECEIVER EFFECTIVE ABSORPTIVITY	
00136	190*	EPS=1.0	@RECEIVER EFFECTIVE EMISSIVITY	00057
00137	191*	TAC=20.0	@AMBIENT TEMPERATURE, CELSIUS	00061
00140	192*	HC=0.0	@EFFECTIVE CONVECTION COEFFICIENT	00063
00141	193*		@ W/((M**2 OF RECEIVER APERTURE)	00064
00141	194*		@ * DEG C)	
00141	195*	ARATIO=0.025	@RATIO, (RECEIVER CAVITY WALL	
00142	196*		@ AREA) / (CONCENTRATOR AREA)	00066
00142	197*	HK=0.0	@EFFECTIVE CONDUCTION COEFFICIENT	
00143	198*		@ W/((M**2 OF RECEIVER WALL)	00067
00143	199*		@ * DEG C)	
00143	200*	DTRE=25.0	@TEMPERATURE DROP FROM RECEIVER	
00144	201*		@ TO ENGINE, CELSIUS	00071
00144	202*	TOC=50.0	@TEMPERATURE OF HEAT	
00145	203*		@ REJECTION, CELSIUS	00073
00145	204*	PCEFACT=0.5	@POWER CONVERSION EFFECTIVENESS	
00146	205*		@ AS FRACTION OF CARNOT	00075
00146	206*		@ EFFICIENCY.	
00146	207*		@ (SUPPLY EITHER PCEFACT, ENEFACT,	
00146	208*		@ OR CYCECT, OR ELSE SET IPCSEF,	
00146	209*		@ IENGEF, OR ICYCEF=T AND SUPPLY	
00146	210*		@ LIST OF EFFICIENCIES).	
00146	211*	ENEFACT=0.0	@ENGINE EFFECTIVENESS: FRACTION	

00147	212*		@ OF CARNOT EFFICIENCY	00076
00147	213*	CYCECT=0.0	@CYCLE EFFECTIVENESS: FRACTION OF	
00150	214*		@ CARNOT EFFICIENCY	00077
00150	215*	MECHE=0.0	@MECHANICAL EFFICIENCY OF ENGINE	
00151	216*	AUXE=0.0	@EFFICIENCY FACTOR TO ACCOUNT FOR	00100
00152	217*		@ POWER USED BY AUXILIARIES	00101
00152	218*	GEARE=0.0	@GEAR EFFICIENCY	
00153	219*	GENE=0.0	@GENERATOR EFFICIENCY	00102
00154	220*	PPE=0.95	@POWER PROCESSING EFFICIENCY	00103
00154	221*			
00154	222*	C		
00154	223*	C		
00155	224*	DEFAULT VALUES FOR OPTIONS		
00156	225*	OPTMZE=.FALSE.	@.TRUE. TO OPTIMIZE RECEIVER	00105
00156	226*	PARAB=.TRUE.	@ APERTURE.	00106
00157	227*		@ OVERALL CONTOUR OF PRIMARY	
00157	228*		@ APPROXIMATELY PARABOLOICAL.	00110
00157	229*		@ .FALSE. IF OVERALL CONTOUR	
00157	230*	MAXC=.FALSE.	@ APPROXIMATELY PLANAR.	
00160	231*		@.TRUE. TO MAXIMIZE PRIMARY	
00160	232*		@ GEOMETRIC CONCENTRATION RATIO.	00111
00160	233*		@ (DO NOT USE WITH OPTMZE OR	
00160	234*	MAXPHI=.FALSE.	@ MAXPHI.)	
00161	235*		@.TRUE. TO MAXIMIZE PRIMARY	
00161	236*		@ INTERCEPT FACTOR.	00112
00161	237*		@ (DO NOT USE WITH OPTMZE OR	
00161	238*	SECONC=.FALSE.	@ MAXC.)	
00162	239*		@SECONDARY CONCENTRATOR:.TRUE. TO	
00162	240*		@ CALCULATE WITH SECONDARY	00113
00162	241*	MAXSEC=.FALSE.	@ CONCENTRATOR AS WELL AS WITHOUT	
00163	242*		@.TRUE. TO USE MAXIMUM POSSIBLE	
00163	243*	IPCSEF=.FALSE.	@ SECONDARY CONCENTRATION.	00114
00164	244*		@.TRUE. TO INPUT PCS EFFICIENCY	
00164	245*	IENGEF=.FALSE.	@ VS. TEMPERATURE	00115
00165	246*		@.TRUE. TO INPUT ENGINE	
00165	247*	ICYCEF=.FALSE.	@ EFFICIENCY VS. TEMPERATURE.	00116
00166	248*		@.TRUE. TO INPUT ENGINE CYCLE	
00166	249*		@ EFFICIENCY VS. TEMPERATURE	00117
00166	250*		@ (DO NOT SET MORE THAN ONE OF	
00166	251*		@ THESE 3 EQUAL TO .TRUE.	
00166	252*		@ IF NONE OF THESE ARE TRUE,	
00166	253*		@ WILL USE PCS EFFECTIVENESS IF	
00166	254*		@ IF NON-ZERO	
00166	255*		@ OTHERWISE WILL USE ENGINE	
00166	256*		@ EFFECTIVENESS IF NON-ZERO	
00166	257*		@ OTHERWISE WILL USE CYCLE	
00166	258*	NWTF=.TRUE.	@ EFFECTIVENESS.)	
00167	259*		@READ IN NEW RECEIVER	
00167	260*		@ TEMPERATURES OR NEW POWER	00120
00167	261*		@ CONVERSION EFFICIENCIES.	
00167	262*		@ (NWTF = NEW TEMPERATURE OR	
00167	263*		@ EFFICIENCIES).	
00167	264*		@ WARNING! NWTF IS SET FALSE	
00167	265*		@ AFTER ANY OUTPUT. MUST BE RESET	
00167	266*		@ .TRUE. IF WISH TO INPUT NEW	
00167	267*		@ RECEIVER TEMPERATURES OR NEW	
00167	268*		@ LIST OF POWER CONVERSION,	
			@ ENGINE, OR CYCLE EFFICIENCIES.	

00167	269*	XTRACT=.FALSE.	@PROVIDES EXTRACT OF OUTPUT, IN	
00170	270*		@ FILE XTRACT.	00121
00170	271*		@ EXTRACT CONSISTS OF SET NO.,	
00170	272*		@ ECHO OF NAMELIST AND RECEIVER	
00170	273*		@ TEMPERATURE INPUT, PLUS OUTPUT	
00170	274*		@ FOR LOWEST AND HIGHEST	
00170	275*		@ TEMPERATURES AND FOR	
00170	276*		@ TEMPERATURE AT WHICH SYSTEM	
00170	277*		@ EFFICIENCY IS HIGHEST.	
00170	278*	SUP2=.FALSE.	@.TRUE. TO SUPPRESS SECOND LINE	
00171	279*		@ OF OUTPUT (C2, OVERALL	00122
00171	280*		@ CONCENTRATION RATIO, OVERALL	
00171	281*		@ INTERCEPT FACTOR), WHICH	
00171	282*		@ OTHERWISE IS PRINTED WHEN	
00171	283*		@ OPTIMIZE WITH SECONDARY	
00171	284*		@ CONCENTRATOR.	
00171	285*	MORDEC=.FALSE.	@.TRUE. TO PRINT MORE DECIMAL	
00172	286*		@ PLACES ON EFFICIENCIES.	00123
00172	287*		@ (5 PLACES INSTEAD OF 3)	
00172	288*			
00172	289*	C OTHER INITIALIZATION		
00172	290*	C		
00172	291*	C PI=3.141592	@TRUNCATED TO AVOID ROUND-OFF	
00173	292*		@ ABOVE EXACT VALUE AND	00125
00173	293*		@ CONSEQUENT WRONG QUADRANT	
00173	294*		@ IN RMA-RMAR CONVERSION.	
00173	295*	P4=PI/4.0		
00174	296*	BOLTZ=5.67032E-8	@BOLTZMANN CONSTANT, W/M2K4	00127
00175	297*	NSET=0	@NO. OF DATA SETS ENTERED.	00131
00176	298*	BOUND=1.0E-7	@BOUND FOR EQUALITY COMPARISONS	00132
00177	299*		@ OF REAL NUMBERS AND TO PREVENT	00134
00177	300*		@ DIVIDE BY ZERO.	
00177	301*	ASG100=.FALSE.	@FLAG TO INDICATE ASSIGNMENT OF	
00200	302*		@ EXTRACT FILE XTRACT, WHICH IS	00135
00200	303*		@ NAMED FILE 100 INTERNALLY	
00200	304*		@ IN FORTRAN. (NOT USED UNLESS	
00200	305*		@ XTRACT=.TRUE.)	
00200	306*	XTRON=.FALSE.	@FLAG TO INDICATE IF XTRACT HAS	
00201	307*		@ JUST BEEN .TRUE.	00136
00201	308*	C		
00201	309*	C		
00201	310*	C		
00201	311*	C		
00201	312*	C		
00201	313*	C BLOCK 2.		
00201	314*	C LOOP TO INPUT 1 DATA SET, PROCESS DATA, AND OUTPUT RESULTS		
00201	315*	C FOR THIS DATA SET.		
00201	316*	C		
00201	317*	DO M=1,1000	@REPEAT UNTIL READ @EOF	
00204	318*	NSET=NSET+1	@SERIAL NO. OF SET OF INPUT	
00205	319*		@ VALUES.	00202
00205	320*	C		00205
00205	321*	C		
00205	322*	C		
00205	323*	C		
00205	324*	C BLOCK 2.1.		
		C READ 1 SET OF INPUT DATA		

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00205 325* C      (EXCEPT RECEIVER TEMPERATURES AND ARRAY OF EFFICIENCIES FOR
00205 326* C      POWER CONVERSION).
00205 327* C
00205 328* C      CALL NAMLRD              @PROVIDE NAMELIST INPUT
00206 329* C      DO J=1,32              @SAVES INPUT VALUES

00211 330* C      Y(J)=Z(J)
00212 331* C      ENDOLOOP              @ENDLOOP J
00212 332* C
00212 333* C      *      *      *      *      *      *      *      *      *      *
00212 334* C      *      *      *      *      *      *      *      *      *      *
00212 335* C      BLOCK 2.2.
00212 336* C      READ RECEIVER TEMPERATURES AND POWER CONVERSION, ENGINE, OR
00212 337* C      CYCLE EFFICIENCY ARRAY, IF DESIRED.
00212 338* C

00214 339* C      IF (NWTORF) THEN

00216 340* C      ERPRINT , 'ENTER RECEIVER TEMPERATURES (M1,M2,M3  INTEGER)'
00216 341* C
00216 342* C      *****
00216 343* C      *****
00216 344* C      **
00216 345* C      ** INPUT NEW RECEIVER TEMPERATURES.
00216 346* C      **
00216 347* C      *****
00216 348* C      *****
00225 349* C
00225 350* C      READ (5,110,ERR=90,END=80) ITRC1,ITRC2,ITRC3 @INPUT RECEIVER
00233 351* C      @ TEMPERATURES, CELSIUS, IN FORM
00233 352* C      @ OF DO LIST PARAMETERS (FROM
00233 353* C      @ ITRC TO ITRC2 BY ITRC3)
00233 354* C      WRITE (6,215) ITRC1,ITRC2,ITRC3
00241 355* C      IF (XTRACT) WRITE (100,215) ITRC1,ITRC2,ITRC3
00250 356* C      IF (ITRC3.LE.0) THEN

00252 357* C      WRITE (6,NLIST)
00256 358* C      ERPRINT , 'BAD ITRC3'
00263 359* C      STOP @DREAD
00264 360* C      ENDIF              @ENDIF ITRC3

00265 361* C      NTRC=1+(ITRC2-ITRC1)/ITRC3 @NO. OF TEMPERATURES
00266 362* C      IF (IPCSEF.OR.IENGINEF.OR.ICYCEF) THEN @WILL READ EFFICIENCIES

00270 363* C      @ OF POWER CONVERSION, ENGINE,
00270 364* C      @ OR CYCLE.
00270 365* C      MNT=NTRC
00271 366* C      IF (NTRC.GT.MT) THEN

00273 367* C      MNT=NT              @TO PREVENT ARRAY OVERFLOW
00274 368* C      ERPRINT , ' *      * WARNING: INPUT LIST OF EFFICIENCIES IS
00274 369* C      &TOO LONG FOR ARRAY SIZE ALLOCATED. *      *'
00301 370* C      ERPRINT0,'END OF OUTPUT MAY BE ERRONEOUS.'
00306 371* C      ERPRINT0,'USE SHORTER LIST OR RECOMPILE WITH LARGER VALUE
00306 372* C      &OF PARAMETER NT'
00313 373* C      ENDIF              @ENDIF NTRC

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00314 374*      IF (IPCSEF) THEN
00316 375*          ERPRINT , 'ENTER PCS EFFICIENCIES (FREE-FIELD, REAL)'
00323 376*      ELSEIF (IENGFE)
00325 377*          ERPRINT , 'ENTER ENGINE EFFICIENCIES (FREE-FIELD, REAL)'
00332 378*      ELSE
00333 379*          ERPRINT , 'ENTER CYCLE EFFICIENCIES (FREE-FIELD, REAL)'
00340 380*      ENDIF
00340 381*      C
00340 382*      C *****
00340 383*      C *****
00340 384*      C **
00340 385*      C **      INPUT TABLE OF EFFICIENCIES      **
00340 386*      C **
00340 387*      C *****
00340 388*      C *****
00340 389*      C

00341 390*          READ (5,110, ERR=92, END=80) (EFF(K), K=1,MNT)
00350 391*          ERPRINT , ' EFFICIENCIES ENTERED'
00355 392*      ENDIF
00355 392*          @ENDIF IPCSEF,IENGFE,ICYCEF

00356 393*      ENDIF
00356 394*      C
00356 395*      C * * * * *
00356 396*      C * * * * *
00356 397*      C
00356 398*      C BLOCK 2.3.
00356 399*      C CALCULATE CONCENTRATOR PERFORMANCE.
00356 400*      C
00356 401*      C * * * * *
00356 402*      C BLOCK 2.3.1
00356 403*      C CLEAR INAPPLICABLE OUTPUT VALUES.
00356 404*      C CHECK CONSISTENCY OF INSOLATION INPUT.
00356 405*      C

00357 406*      IF (IPCSEF.OR.IENGFE.OR.ICYCEF) THEN

00361 407*          PCEFFT=0.0      @TO CLARIFY PRINTOUT
00362 408*          ENEFFT=0.0
00363 409*          CYCECT=0.0
00364 410*      ENDIF
00364 410*          @ENDIF IPCSEF,IENGFE,ICYCEF

00365 411*      IF (HK.LE. 0.0) ARATIO=0.0      @TO CLARIFY PRINTOUT
00367 412*      IF (.NOT.SECONC) THEN

00371 413*          RH02=0.0      @TO CLARIFY PRINTOUT
00372 414*          BS2 =0.0
00373 415*          PHI2=0.0
00374 416*          C2 =0.0
00375 417*      ENDIF
00375 417*          @ENDIF SECONC

00376 418*      IF (INS .LE. 0.0) THEN

00400 419*          ERPRINT , 'INS MUST BE POSITIVE.'
00405 420*          CYCLE M
00406 421*      ENDIF
00406 421*          @ENDIF INS

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00406 422* C
00406 423* C * * * * *
00406 424* C BLOCK 2.3.2.
00406 425* C CALL APPROPRIATE ENTRY OF SUBROUTINE OPT TO CHECK CONSISTENCY
00406 426* C OF INPUTS AND TO PERFORM PRELIMINARY CALCULATIONS STATED
00406 427* C THERE.
00406 428* C

00407 429* IF (OPTMZE) THEN

00411 430* CALL CKOPT ($60)
00412 431* ELSE
00413 432* CALL CKNOPT ($60)
00414 433* ENDF BENDIF OPTMZE
00414 434* C
00414 435* C * * * * *
00414 436* C * BLOCK 2.3.3.
00414 437* C * WRITE INPUT VALUES TO OUTPUT.
00414 438* C * WRITE COLUMN HEADINGS FOR OUTPUT TABLE.
00414 439* C * CLEAR ARRAYS FOR OUTPUT.
00414 440* C * * * * *
00414 441* C

00415 442* WRITE (6,NLIST) @OUTPUT THE PARAMETERS USED.
00421 443* IF ((NTRC+JJ+(2*NWTRF)).GE. 5)
00421 444* & .CR.(NWTRF.AND.(.NOT.(IPCSEF.OR.IENGEF.OR.ICYCEF)))
00421 445* & .CR.(SECONC.AND.OPTMZE.AND.(.NOT.SUP2))) THEN

00423 446* @START NEW PAGE IF WILL WRITE
00423 447* @ A LOT
00427 448* ELSE @ELSE DOUBLE-SPACE
00430 449* WRITE (6,'(1H)')
00434 450* ENDF BENDIF NTRC

00435 451* IF (OPTMZE) THEN @WRITE COLUMN HEADS.

00437 452* @ WHEN OPTIMIZE OR MAXIMIZE.
00437 453* IF (SECONC)

00440 454* WRITE (6,270) @COLUMN HEADS WITH
00443 455* WRITE (6,271) @ SECONDARY CONCENTRATOR
00446 456* WRITE (6,272)
00451 457* WRITE (6,273)
00454 458* IF (.NOT.SUP2) THEN

00456 459* IF (MAXSEC) THEN

00460 460* WRITE (6,290) @SECOND LINE OF COLUMN HEADS
00463 461* WRITE (6,291)
00466 462* WRITE (6,292)
00471 463* WRITE (6,293)
00474 464* ELSE
00475 465* WRITE (6,295)
00500 466* WRITE (6,296)
00503 467* WRITE (6,297)
00506 468* WRITE (6,298)
00511 469* ENDF BENDIF MAXSEC

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00512	470*	ENDIF	@ENDIF SUP2		
00513	471*	ELSE			
00514	472*	WRITE (6,275)	@WRITE COLUMN HEADS IF NO		
00517	473*	WRITE (6,276)	@ SECONDARY CONCENTRATOR		00620
00522	474*	WRITE (6,277)			00625
00525	475*	WRITE (6,278)			00632
00530	476*	ENDIF	@ENDIF SECONC		00640
00531	477*	ELSE			
00532	478*	IF (SECONC)	@NO OPTIMIZE		
00533	479*	WRITE (6,220)	@WRITE COLUMN HEADS IF		00642
00536	480*	WRITE (6,221)	@ SECONDARY CONCENTRATOR		00647
00541	481*	WRITE (6,222)			00654
00544	482*	WRITE (6,223)			00661
00547	483*	ELSE			00667
00550	484*	WRITE (6,225)	@WRITE COLUMN HEADS IF NO		
00553	485*	WRITE (6,226)	@ SECONDARY CONCENTRATOR		00674
00556	486*	WRITE (6,227)			00701
00561	487*	WRITE (6,228)			00706
00564	488*	ENDIF	@ENDIF SECONC		00713
00565	489*	ENDIF	@ENDIF OPTMZE		
00566	490*	ERPRINT 1, ' '			
00574	491*	DO J=1,7			00715
00577	492*	A(J)=0.0			00724
00600	493*	ENDLOOP	@ENDLOOP J		00740
00602	494*	DO K=1,NT			
00605	495*	DO J=1,2			
00610	496*	TT(J,K)=0.0			
00611	497*	ENDLOOP	@ENDLOOP J		00750
00613	498*	DO J=1,5			
00616	499*	OPTAA(J,K)=0.0			
00617	500*	ENDLOOP	@ENDLOOP J		00760
00621	501*	DO J=1,9			
00624	502*	AA(J,K)=0.0			
00625	503*	ENDLOOP	@ENDLOOP J		00770
00627	504*	ENDLOOP	@ENDLOOP K		
00627	505*	C			
00627	506*	C			
00627	507*	C			
00627	508*	C			
00627	509*	C			
00627	510*	C			
		BLOCK 2.3.4.			
		CALCULATE SOLAR POWER REACHING RECEIVER PLANE, PER UNIT			
		CONCENTRATOR AREA.			

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00631 511*
00631 512*      TAK=TAC*273.16
00632 513*      A5MAX=1.0E-36      @INITIALIZATION. SET .GT. 0.0 TO
00633 514*      A6MAX=1.0E-36      @ PREVENT DIVISION BY ZERO
00634 515*      TRMA=INS*RH01*BS1*ALPHA
00635 516*      TRMAS=TRMA*R*02*BS2
00636 517*      NTCNT=0      @COUNT OF TEMPERATURES
00636 518* C
00636 519* C * * * * *
00636 520* C * * * * *
00636 521* C
00636 522* C BLOCK 2.4.
00636 523* C LOOP TO HANDLE EFFICIENCY CALCULATIONS FOR 1 RECEIVER TEMPERATURE
00636 524* C
00637 525* C DO ITRC=ITRC1,ITRC2,ITRC3 @RECEIVER TEMPERATURE
00637 526* C
00637 527* C * * * * *
00637 528* C
00637 529* C BLOCK 2.4.1.
00637 530* C CALCULATE RECEIVER PERFORMANCE TERMS
00637 531* C

00642 532*      NTCNT=NTCNT+1
00643 533*      IF (NTCNT.GT.NT) EXITLOOP ITRC
00645 534*      TRK=ITRC*273.16
00646 535*      TIK=TRK-DTRE
00647 536*      IF (TIK.LE. 0.0) THEN

00651 537*      ERPRINT,'ENGINE INLET TEMPERATURE BELOW ABSOLUTE ZERO.'
00656 538*      CYCLE ITRC
00657 539*      ENDIF @ENDIF TRK

00660 540*      TOK=TOC*273.16
00661 541*      CARNOT=(TIK-TOK)/TIK
00662 542*      TT(1,NTCNT)=ITRC @RECEIVER TEMPERATURE, CELSIUS
00663 543*      TT(2,NTCNT)=(ITRC+40.)*1.8-40. @RECEIVER FAHRENHEIT
00664 544*      TRMB=EP3*BOETZ*(TRK**4-TAK**4)+HC*(TRK-TAK)
00665 545*      TRMC= ARATIO*HK*(TRK-TAK)
00665 546* C
00665 547* C * * * * *
00665 548* C
00665 549* C BLOCK 2.4.2.
00665 550* C IF OPTIMIZING RECEIVER APERTURE, CALL ENTRY OF SUBROUTINE OPT
00665 551* C TO PERFORM THIS OPTIMIZATION.
00665 552* C
00666 553* C IF (OPTNZE) CALL OPTAP ($50)
00666 554* C
00666 555* C * * * * *
00666 556* C BLOCK 2.4.3.
00666 557* C CALCULATE EFFICIENCIES. ENTER THEM IN OUTPUT ARRAY.
00666 558* C
00670 559* C A(1)=AMAX1(0.0,(TRMA*PHI1-TRMB/C1-TRMC)/INS)
00670 560* C @COLLECTOR EFFICIENCY,
00670 561* C @ WITHOUT SECONDARY
00671 562* C IF (SECCNC) THEN

00673 563*      A(2)=AMAX1(0.),(TRMAS*PHI1S*PHI2-TRMB/(C1S*C2)-TRMC)/INS

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00673	564*	&	@COLLECTOR EFFICIENCY,	:::	
00674	565*		@ WITH SECONDARY	:::	01171
00674	566*		@COLLECTOR EFFICIENCY	:::	
00674	567*	&	@ INCREASE DUE TO SECONDARY	:::	
00675	568*	ENDIF	@ENDIF SECONC	:::	01205
00676	569*	IF (IPCSEF) THEN		<-----	
00700	570*	A(4)=EFF(NTCNT)	@POWER CONVERSION SUBSYSTEM	:::	01207
00701	571*		@ EFFICIENCY USING PCSEFF.	:::	01224
00701	572*	IF (A(4).GT.CARNOT) THEN		<-----	
00703	573*	ERPRINT , 'PCS EFFICIENCY GREATER THAN CARNOT.'		:::	01236
00710	574*	CYCLE ITRC		:::	01240
00711	575*	ENDIF	@ENDIF A(4)	:::	01242
00712	576*	ELSEIF (PCEFFT.GT.0.0)		-----	
00714	577*	A(4)=PCEFFT*CARNOT	@PCS EFFICIENCY	:::	01246
00715	578*		@ USING PCEFFT OF CARNOT	:::	01257
00715	579*	ELSE	@USING PCSE=ENGE*GEARE*GENE	:::	
00716	580*	IF (IENGEF) THEN	@USING ENGEFF(T)	<-----	
00720	581*	ENGE=EFF(NTCNT)		:::	01261
00721	582*	IF (ENGE.GT.CARNOT) THEN		<-----	01271
00723	583*	ERPRINT , 'ENG EFFICIENCY GREATER THAN CARNOT.'		:::	01276
00730	584*	CYCLE ITRC		:::	01300
00731	585*	ENDIF	@ENDIF ENGE	:::	01302
00732	586*	ELSEIF (ENEFCT.GT.0.0)	@USING ENGINE EFFICIENCY	-----	
00734	587*		@ ENEFCT OF CARNOT	:::	01306
00734	588*	ENGE=ENEFCT*CARNOT		:::	
00735	589*	ELSE	@USING ENGE=CYCE*MECHE*AUXE	:::	01312
00736	590*	IF (ICYCEF) THEN	@USING CYCEFF(T)	<-----	
00740	591*	CYCE=EFF(NTCNT)		:::	01314
00741	592*	IF (CYCE.GT.CARNOT) THEN		<-----	01324
00743	593*	ERPRINT , 'CYCLE EFFICIENCY GREATER THAN CARNOT.'		:::	01331
00750	594*	CYCLE ITRC		:::	01333
00751	595*	ENDIF	@ENDIF CYCE	:::	01335
00752	596*	ELSE		-----	
00753	597*	CYCE=CYCECT*CARNOT		:::	01340
00754	598*	ENDIF	@ENDIF ICYCEF	-----	
00755	599*	ENGE=CYCE*MECHE*AUXE		:::	01344
00756	600*	ENDIF	@ENDIF IENGEF	-----	
00757	601*	A(4)=ENGE*GEARE*GENE		:::	01355
00760	602*	ENDIF	@ENDIF IPCSEF	-----	
00761	603*	A(5)=A(1)+A(4)+PPE	@SYSTEM EFFICIENCY	:::	01400
00762	604*		@ W/O SECONDARY	:::	
00762	605*	ASMAX=AMAX1(ASMAX,A(5))		:::	01405
00763	606*	IF (SECONC) THEN		<-----	


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00765 607*      A(6)=A(2)*A(4)*PPE      @SYSTEM EFFICIENCY      : 01407
00766 608*      @WITH SECONDARY      : 01432
00766 609*      A6MAX=AMAX1(A6MAX,A(6))
00767 610*      A(7)= A(5)-A(5)      @SYSTEM EFFICIENCY INCREASE : 01437
00770 611*      @ DUE TO SECONDARY      : 01461
00770 612*      DO J=1,7
00773 613*      AA(J,NTCNT)=A(J)
00774 614*      ENDDOOP      @ENDLOOP J      : 01470
00776 615*      ELSE      @NO SECONDARY CONCENTRATOR      : 01506
00777 616*      AA(1,NTCNT)=A(1)
01000 617*      AA(2,NTCNT)=A(4)
01001 618*      AA(3,NTCNT)=A(5)
01002 619*      ENDIF      @ENDIF SECONC      : 01510
01003 620*      50      CONTINUE      @ERROR RETURN FOR      : 01524
01004 621*      @ SUBROUTINE OPTAP      : 01540
01004 622*      ENDDOOP      @ENDLOOP ITRC      : 01556
01006 623*      NTCNT=MIN(NTCNT,NT)
01006 624*      C
01006 625*      C *      *      *      *      *      *      *      *      *      *      *      *      *
01006 626*      C *      *      *      *      *      *      *      *      *      *      *      *      *
01006 627*      C *
01006 628*      C *      BLOCK 2.5.
01006 629*      C *      WRITE OUTPUT FOR 1 SET OF DATA.
01006 630*      C *
01006 631*      C *      *      *      *      *      *      *      *      *      *      *      *      *
01006 632*      C
01007 633*      IF (SECONC) THEN
01011 634*      DO K=1,NTCNT
01014 635*      AA(8,K)=AA(5,K)/A5MAX
01015 636*      AA(9,K)=AA(6,K)/A6MAX
01016 637*      XFLAG=.FALSE.      @FLAG, SET TRUE TO IDENTIFY THOSE
01017 638*      @ LINES OF OUTPUT TABLE TO BE
01017 639*      @ INCLUDED IN EXTRACT, IF EXTRACT
01017 640*      @ HAS BEEN REQUESTED.
01017 641*      IF (XTRACT) THEN
01021 642*      IF ((K.EQ.1).OR.(K.EQ.NTCNT)) XFLAG=.TRUE.
01023 643*      IF ((AA(8,K).GT.(1.0-BOUND)).OR.(AA(9,K).GT.(1.0-BOUND)))
01023 644*      &      XFLAG=.TRUE.
01025 645*      ENDF      @ENDIF XTRACT
01026 646*      IF (OPTMZE) THEN
01030 647*      IF (MORDEC) THEN
01032 648*      WRITE (6,780) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,4),
01032 649*      &      ,AA(L,K),J=1,9))
01051 650*      ELSE
01052 651*      &      WRITE (6,280) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,4),
01052 652*      &      ,AA(J,K),J=1,9))
01071 653*      ENDF      @ENDIF MORDEC

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01072	654*		IF (XFLAG)			
01072	655*	&	WRITE (100,280) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,4),			
01072	656*	&	(AA(J,K),J=1,9))			
01112	657*		IF (.NOT.SUP2) THEN			02163
01114	658*		IF (MAXSEC) THEN			02165
01116	659*		WRITE (6,294) OPTAA(5,K), OPTAA(2,K)*OPTAA(5,K),			02167
01116	660*	&	OPTAA(4,K)*PHI2			02234
01124	661*		IF (XFLAG) WRITE (100,294) OPTAA(5,K),			02304
01124	662*	&	OPTAA(2,K)*OPTAA(5,K), OPTAA(4,K)*PHI2			02335
01133	663*		ELSE			02371
01134	664*		WRITE (6,299) OPTAA(2,K)*C2, OPTAA(4,K)*PHI2			
01141	655*		IF (XFLAG) WRITE (100,299) OPTAA(2,K)*C2,			
01141	666*	&	OPTAA(4,K)*PHI2			
01147	667*		ENDIF @ENDIF MAXSEC			
01150	668*		ENDIF @ENDIF SUP2			
01151	669*		ELSE			
01152	670*		IF (MORDEC) THEN			
01154	671*		WRITE (6,730) ((TT(J,K),J=1,2),(AA(J,K), J=1,9))			02373
01167	672*		ELSE			02443
01170	673*		WRITE (6,230) ((TT(J,K),J=1,2),(AA(J,K), J=1,9))			02512
01203	674*		ENDIF @ENDIF MORDEC			
01204	675*		IF (XFLAG)			
01204	676*	&	WRITE (100,230) ((TT(J,K),J=1,2),(AA(J,K), J=1,9))			02570
01220	677*		ENDIF @ENDIF OPTMZE			
01221	678*		ENDLOOP @ENDLOOP K			
01223	679*		ELSE @SECONC=F			
01224	680*		DO K=1,NTCNT			
01227	681*		AA(4,K)=AA(3,K)/A5MAX			02601
01230	682*		XFLAG=.FALSE.			02616
01231	683*		IF (XTRACT) THEN			02617
01233	684*		IF ((K.EQ.1).OR.(K.EQ.NTCNT)) XFLAG=.TRUE.			02621
01235	685*		IF (AA(4,K).GT.(1.0-BOUND)) XFLAG=.TRUE.			02636
01237	686*		ENDIF @ENDIF XTRACT			02652
01240	687*		IF (OPTMZE) THEN			
01242	688*		IF (MORDEC) THEN			02654
01244	689*		WRITE (6,785) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,2),			02656
01244	690*	&	(AA(J,K),J=1,4))			02747
01263	691*		ELSE			
01264	692*		WRITE (6,285) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,2),			
01264	693*	&	(AA(J,K),J=1,4))			
01303	694*		ENDIF @ENDIF MORDEC			03037
01304	695*		IF (XFLAG)			

01304	696*	1	WRITE (100,285) ((TT(J,K),J=1,2),(OPTAA(J,K),J=1,2),	03132
01304	697*	2	(AA(J,K),J=1,4))	
01324	698*		ELSE	
01325	699*		IF (MORDEC) THEN	
01327	700*		WRITE (6,735) ((TT(J,K),J=1,2), (AA(J,K), J=1,4))	03134
01342	701*		ELSE	03204
01343	702*		WRITE (6,235) ((TT(J,K),J=1,2), (AA(J,K), J=1,4))	
01356	703*		ENDIF @ENDIF MORDEC	03253
01357	704*		IF (XFLAG)	
01357	705*	8	WRITE (100,235) ((TT(J,K),J=1,2), (AA(J,K), J=1,4))	
01373	706*		ENDIF @ENDIF OPTMZE	03327
01374	707*		ENDLOOP @ENDLOOP K	
01376	708*		ENDIF @ENDIF SECONC	
01377	709*	60	CONTINUE @ERROR RETURN FOR	
01400	710*		@ SUBROUTINES CKNOPT AND CKOPT.	
01400	711*		NWTORF=.FALSE. @MUST INPUT NAMELIST NWTORF=T IN	
01401	712*		@ NEXT SET OF DATA IF WANT NEW	03332
01401	713*		@ RECEIVER TEMPERATURES OR	
01401	714*		@ NEW EFFICIENCIES FOR POWER	
01401	715*		@ CONVERSION..	
01401	716*		DO J=1,32 @RESTORES INPUT VALUES THAT WERE	
01404	717*		Z(J)=Y(J) @ SAVED.	
01405	718*		ENCLLOOP @ENDLOOP J	03351
01407	719*		ENDLOOP @ENDLOOP M	
01411	720*		@GO BACK AND READ NEW INPUTS	
01411	721*	C		
01411	722*	C *	*	
01411	723*	C *	*	
01411	724*	C *	*	
01411	725*	C		
01411	726*	C	BLOCK 3.	
01411	727*	C	NORMAL STOP OF PROGRAM AFTER 1000 SETS OF DATA.	
01411	728*	C		
01411	729*	80	STOP NORMAL	
01411	730*	C		
01411	731*	C	ABNORMAL STOPS OF PROGRAM.	
01411	732*	C		
01412	733*	90	ERPRINT , 'BAD ITRC READ'	03353
01417	734*		STOP BOREAD	03360
01420	735*	92	ERPRINT , 'BAD PCSEFF READ'	03362
01425	736*		STOP BOREAD	03367
01425	737*	C		
01425	738*	C *	*	
01425	739*	C *	*	
01425	740*	C *	*	
01425	741*	C		
01425	742*	C	BLOCK 4.	
01425	743*	C	INPUT AND OUTPUT FORMATS.	
01425	744*	C		

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01426 745* 110 FORMAT ( )
01427 746* 215 FORMAT (' ITRC1, ITRC2, ITRC3 =' ,2(I10,' '),I10)
01430 747* 220 FORMAT (1H+,3X,'RECEIVER TEMP.',1X,2X,'COLLECTOR EFFICIENCY',
01430 748* & 2X,2X,'PCS',3X,3X,'SYSTEM EFFICIENCY',3X,'FRAC.MAX.SYS.EFFIC.')
01431 749* 221 FORMAT (1H+,3X,13(' '),4X,20(' '),13X,17(' '),3X,18(' '))
01432 750* 222 FORMAT (1X,5X,'C',4X,3X,'F',4X,'W/O SEC.',1X,'W/SEC.',
01432 751* & 2X,'DELTA',3X,'EFFIC.',1X,1X,'W/O SEC.',1X,'W/SEC.',1X,'DELTA',
01432 752* & 1X,1X,'W/O SEC.',1X,'W/ SEC.')
01433 753* 223 FORMAT (1H+,2(4X,3(' '),1X),2X,7(' '),2X,3(5(' '),3X),7(' '),
01433 754* & 2(2X,5(' '),2X,7(' '),2X,6(' '))
01434 755* 225 FORMAT (1H+,2X,'RECEIVER TEMP.',1X,'COLLECTOR',3X,'PCS',2X,
01434 756* & 'SYSTEM',2X,'FRAC.MAX.')
01435 757* 226 FORMAT (1H+,2X,14(' '))
01436 758* 227 FORMAT (1X,5X,'C',4X,3X,'F',5X,'EFFIC.',2X,1X,'EFFIC.',1X,
01436 759* & 'EFFIC.',1X,'SYS.EFFIC.')
01437 760* 228 FORMAT (1H+,2(4X,3(' '),1X),2X,7(' '),3X,5(' '),2X,5(' '),2X,
01437 761* & 9(' '))
01440 762* 230 FORMAT (1X,2F8.1,9F8.3)
01441 763* 235 FORMAT (1X,2F8.1,4F8.3)
01442 764* 270 FORMAT (1H+,2X,'RECEIVER TEMP.',1X,'PRIM.GEOM.CONC.',1X,
01442 765* & 'PRIM.INTERCEPT FACT.',1X,'COLLECTOR EFFICIENCY',
01442 766* & 2X,2X,'PCS',3X,2X,'SYSTEM EFFICIENCY',3X,'FRAC.MAX.SYS.EFFIC.')
01443 767* 271 FORMAT (1H+,2X,13(' '),2X,14(' '),2X,19(' '),2X,20(' '),12X,
01443 768* & 17(' '),3X,18(' '))
01444 769* 272 FORMAT (1X,5X,'C',4X,3X,'F',3X,'W/O SEC.',2X,'W/SEC.',2X,
01444 770* & 'W/O SEC.',1X,'W/SEC.',3X,'W/O SEC.',1X,'W/SEC.',
01444 771* & 1X,'DELTA',2X,'EFFIC.',1X,'W/O SEC.',1X,'W/SEC.',2X,'DELTA',
01444 772* & 1X,1X,'W/O SEC.',1X,'W/ SEC.')
01445 773* 273 FORMAT (1H+,2(4X,3(' '),1X),1X,7(' '),3X,5(' '),3X,7(' '),2X,
01445 774* & 5(' '),4X,7(' '),2X,2(5(' '),2X),5(' '),2X,7(' '),
01445 775* & 2X,5(' '),3X,5(' '),2X,7(' '),2X,6(' '))
01446 776* 275 FORMAT (1H+,2X,'RECEIVER TEMP.',2X,'GEOM.',2X,'INTERCEPT',1X,
01446 777* & 'COLLECTOR',1X,'PCS',3X,'SYSTEM',2X,'FRAC.MAX.')
01447 778* 276 FORMAT (1H+,2X,13(' '))
01450 779* 277 FORMAT (1X,5X,'C',4X,3X,'F',2X,'CONC.RATIO',1X,'FACTOR',3X,
01450 780* & 'EFFIC.',2X,'EFFIC.',1X,
01450 781* & 'EFFIC.',1X,'SYS.EFFIC.')
01451 782* 278 FORMAT (1H+,2(4X,3(' '),1X),10(' '),1X,6(' '),3X,5(' '),3X,5(' '),
01451 783* & 2X,5(' '),2X,9(' '))
01452 784* 280 FORMAT (1X,4F8.1,1X,11F8.3,L5)
01453 785* 285 FORMAT (1X,3F8.1,5F8.3)
01454 786* 290 FORMAT (1H0,20X,'SECONDARY',3X,'OVERALL',9X,'OVERALL')
01455 787* 291 FORMAT (1H+,20X,9(' '),3X,7(' '),9X,7(' '))
01456 788* 292 FORMAT (21X,2('GEOM.CONC. '),5X,'ICPT.FACT.')
01457 789* 293 FORMAT (1H+,20X,9(' '),2X,9(' '),7X,9(' '))
01460 790* 294 FORMAT (22X,F8.2,1X,F8.1,8X,F8.3)
01461 791* 295 FORMAT (33X,'OVERALL',9X,'OVERALL')
01462 792* 296 FORMAT (1H+,32X,7(' '),9X,7(' '))
01463 793* 297 FORMAT (32X,'GEOM.CONC.',6X,'ICPT.FACT.')
01464 794* 298 FORMAT (1H+,31X,9(' '),7X,9(' '))
01465 795* 299 FORMAT (31X,F8.1,8X,F8.3)
01466 796* 730 FORMAT (1X,2F8.1,9F8.5)
01467 797* 735 FORMAT (1X,2F8.1,4F8.5)
01470 798* 780 FORMAT (1X,4F8.1,1X,2F8.3,9F8.5)
01471 799* 785 FORMAT (1X,3F8.1,F8.3,4F8.5)
01471 800* C
01471 801* C

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01471 802* C * * * * *
01471 803* C * * * * *
01471 804* C * * * * *
01471 805* C
01472 806* SUBROUTINE NAMLRD
01472 807* C READS INPUT DATA
01472 808* C (EXCEPT ARRAYS OF RECEIVER TEMPERATURES AND OF POWER CONVERSION
01472 809* C EFFICIENCIES).
01472 810* C FIRST READS SET OF DATA ALPHANUMERICALLY, ECHOES IT, AND WRITES DATA
01472 811* C SET TO A TEMPORARY FILE.
01472 812* C THEN READS DATA SET FROM TEMPORARY FILE USING NAMELIST.
01472 813* C
01472 814* C * * * * *
01472 815* C * * * * *
01472 816* C
01475 817* WRITE (6,211) NSET @WRITES SET NUMBER
01501 818* IF (XTRON) WRITE (100,212) NSET @BEGINS WRITE OF XTRACT, IF
01506 819* @ EXTRACT HAS BEEN REQUESTED.
01506 820* ERPRINT , 'ENTER INPUT VALUES (NAMELIST, WITH NAME "NLIST")'
01506 821* C
01506 822* C *****
01506 823* C *****
01506 824* C **
01506 825* C ** INPUT 1 SET OF DATA (EXCEPT ARRAYS). **
01506 826* C ** SET IS LIMITED TO 20 LINES (NOT INCLUDING ARRAYS). **
01506 827* C **
01506 828* C *****
01506 829* C *****
01506 830* C
01506 831* C BLOCK S.1.
01506 832* C READ 1 SET OF DATA ALPHANUMERICALLY. ECHO IT. WRITE DATA SET
01506 833* C INTO TEMPORARY FILE.
01506 834* C
01513 835* DO J=1,20 @LOOP TO READ 1 LINE EACH TIME.
01516 836* @ (NOT OVER 20 LINES PER DATA
01516 837* @ SET)
01516 838* JJ=J
01517 839* READ (5,105,ERR=75,END=70) INREAD @FIRST READ (ALPHANUMERIC).
01523 840* WRITE (98,105) INREAD @ USES FILE 98 FOR TEMPORARY
01527 841* @ STORE AND RE-READ (NAMELIST).
01527 842* WRITE (6,205) INREAD @ECHO PRINT
01533 843* IF (XTRON) WRITE (100,205) INREAD @ECHO TO EXTRACT, IF
01540 844* @ EXTRACT REQUESTED IN PRECEDING
01540 845* @ DATA SET.
01540 846* DO K=1,14 @LOOP TO READ 1 WORD EACH TIME.
01543 847* @ (14 WORDS PER LINE OF INREAD)
01543 848* DO L=((K.EQ.1)*(1+(J.EQ.1))),5 @LOOP TO READ 1 CHARACTER.
01546 849* @ (SCANS CHARACTERS 0-5 OF
01546 850* @ INREAD WORD, EXCEPT 0 OF FIRST
01546 851* @ WORD AND 1 OF FIRST CARD FIRST
01546 852* @ WORD, WHICH SERVE ONLY TO
01546 853* @ IDENTIFY INPUT AS NAMELIST)
01546 854* IF (FLD(IL*6,6,INREAD(K)).EQ.(FLD(0,6,'S').OR.(FLD(0,6,'E'))))
01546 855* & EXITLOOP J @FINDS TERMINATING 'S' OR 'E'

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01550	856*	ENDLOOP	@ENDLOOP L	03534
01552	857*	ENDLOOP	@ENDLOOP K	
01554	858*	ENDLOOP	@ENDLOOP J.	
01556	859*		@ ENDS FIRST READ (ALPHANUMERIC).	
01556	860*	REWIND 98	@RESETS FILE 98 FOR	
01560	861*		@ NAMELIST READ	03537
01560	862*	C		
01560	863*	C *	*	
01560	864*	C *	*	
01560	865*	C		
01560	866*	C BLOCK S.2		
01560	867*	C NAMELIST READ OF DATA FROM TEMPORARY FILE.		
01560	868*	C		
01560	869*	READ (98, NLIST, ERR=95, END=96)		
01564	870*	REWIND 98	@RESET	03545
01564	871*	C		
01564	872*	C *	*	
01564	873*	C *	*	
01564	874*	C		
01564	875*	C BLOCK S.3		
01564	876*	C ON INITIAL REQUEST FOR EXTRACT, CATALOGS AND ASSIGNS FILE FOR THIS		
01564	877*	C OUTPUT.		
01564	878*	C		
01566	879*	IF ((XTRACT).AND.(.NOT.ASG100)) THEN		03550
01570	880*	CALL ASSIGN('@CAT,P XTRACT(+1)',IDUMM,1,\$97)		03553
01571	881*	CALL ASSIGN('@ASG,A XTRACT',IDUMM,1,\$97)		03561
01572	882*	ISTAT=CSF8(3,'@USE 100,XTRACT')		03567
01573	883*	IF (ISTAT.LT.0) GO TO 97		03574
01575	884*	ASG100=.TRUE.		03600
01576	885*	ENDIF	@ENDIF XTRACT/ASG100	03602
01576	886*	C		
01576	887*	C *	*	
01576	888*	C		
01576	889*	C IF EXTRACT IS REQUESTED NOW AND HAS NOT BEEN PREVIOUSLY REQUESTED,		
01576	890*	C ECHOES INPUT TO EXTRACT FILE.		
01576	891*	C		
01577	892*	IF ((XTRACT).AND.(.NOT. XTRON)) THEN		
01601	893*	WRITE (100,212) NSET		03605
01605	894*	DO J=1,JJ		03613
01610	895*	READ (98, 105, ERR=95, END=96) INREAD		03620
01614	896*	WRITE (100,205) INREAD	@TO EXTRACT FILE.	03632
01620	897*	ENDLOOP	@ENDLOOP JJ	03644
01622	898*	REWIND 98		
01624	899*	ENDIF	@ENDIF XTRACT/XTRON	03647
01625	900*	IF (XTRACT) THEN		
01627	901*	XTRON=.TRUE.		03651
01630	902*	ELSE		03654

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01671 938* C
01671 939* C * * * * *
01671 940* C * * * * *
01671 941* C * * * * *
01671 942* C
01672 943* SUBROUTINE OPT
01672 944* C
01672 945* C CALCULATES OR CHECKS OPTICAL CHARACTERISTICS.
01672 946* C
01672 947* C CHECKS WHETHER SPECIFIED COLLECTOR CHARACTERISTICS ARE CONSISTENT.
01672 948* C CALCULATES FOCAL PLANE DISTRIBUTION.
01672 949* C IF REQUESTED, OPTIMIZES RECEIVER APERTURE OR MAXIMIZES INTERCEPT
01672 950* C FACTOR OR CONCENTRATION RATIO.
01672 951* C FOR COMPOUND CONCENTRATOR, ASSUMES SECONDARY PROVIDES UNIFORM FLUX ON
01672 952* C ON FOCAL PLANE. IF REQUESTED, MAXIMIZES SECONDARY CONCENTRATION RATIO
01672 953* C
01672 954* C ENTRY CKNOPT IS CALLED IF RECEIVER APERTURE OPTIMIZATION IS
01672 955* C NOT REQUESTED.
01672 956* C ENTRIES CKOPT AND OPTAP ARE CALLED IF RECEIVER APERTURE OPTIMIZATION
01672 957* C IS REQUESTED. THESE OPTIMIZE RECEIVER APERTURE AREA FOR EACH
01672 958* C EACH TEMPERATURE.

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01672 959* C
01672 960* C * * * * *
01672 961* C * * * * *
01672 962* C BLOCK E.0
01672 963* C DEFINE STORAGE FOR SUBROUTINE.
01672 964* C
01675 965* LOGICAL IRFLG @FLAG INDICATING IF ARRAY OF RIM
01676 966* @ ANGLES HAS ALREADY BEEN
01676 967* @GENERATED.
01676 968* DIMENSION FRAY(90),RMARAY(90) @ARRAYS GIVING FOCAL RATIOS AND
01677 969* @ CORRESPONDING RIM ANGLES FOR
01677 970* @ PARABOLOID.
01677 971* DATA IRFLG/.FALSE./
01701 972* DATA VF/6.0/ @VARIANCE RATIO LIMITING
01703 973* @ MAXIMUM CONCENTRATION WHEN
01703 974* @ PH1 .EQ. 1.0. USED TO CUT OFF
01703 975* @ GAUSSIAN FLUX DISTRIBUTION.
01703 976* DATA (FRAY(I), I=1,60)/
01703 977* & .28647187E02,.14322502E02,.95471230E01,.71590694E01,.57259462E01,
01703 978* & .47702882E01,.40874673E01,.35751696E01,.31765539E01,.28575155E01,
01703 979* & .25963515E01,.23785931E01,.21542237E01,.20360883E01,.18989402E01,
01703 980* & .17788440E01,.16727905E01,.15784392E01,.14939424E01,.14178217E01,
01703 981* & .13488805E01,.12861396E01,.12287903E01,.11761585E01,.11276781E01,
01703 982* & .10825699E01,.10413259E01,.10026961E01,.96667913E00,.93301354E00,
01703 983* & .90147168E00,.87185438E00,.84398661E00,.81771389E00,.79289942E00,
01703 984* & .75942158E00,.74717192E00,.72605339E00,.70597887E00,.68686999E00,
01703 985* & .65865599E00,.65127287E00,.63466256E00,.61877229E00,.60355396E00,
01703 986* & .58896364E00,.57496118E00,.56150973E00,.54857546E00,.53612724E00,
01703 987* & .52413641E00,.51257646E00,.50142292E00,.49065311E00,.48024601E00,
01703 988* & .47018209E00,.46044318E00,.45101240E00,.44187396E00,.43301315E00,
01703 989* & /
01705 990* DATA (FRAY(I), I=61,90)/
01705 991* & .42441622E00,.41607030E00,.40796335E00,.40008405E00,.39242181E00,
01705 992* & .38496665E00,.37777921E00,.37054665E00,.36375266E00,.35703740E00,
01705 993* & .35048746E00,.34409586E00,.33735599E00,.33176158E00,.32580671E00,
01705 994* & .31998578E00,.31429344E00,.30872466E00,.30327461E00,.29793876E00,
01705 995* & .29271274E00,.28759245E00,.28257395E00,.27765347E00,.27282747E00,
01705 996* & .26809252E00,.26344537E00,.25888291E00,.25440218E00,.25000000E00,
01705 997* & /
01707 998* @TABLE OF FOCAL RATIOS AT
01707 999* @ 1 DEGREE INCREMENTS OF RIM
01707 1000* @ ANGLE (1 TO 60 DEGREES,
01707 1001* @ 61 TO 90 DEGREES)
01707 1002* @ PARABOLOIDAL CONTOUR.
01710 1003* DEFINE S=SIN(RMAR)
01711 1004* DEFINE C=COS(RMAR)
01711 1005* DEFINE T=TAN(RMAR)
01711 1006* C
01711 1007* C * * * * *
01711 1008* C * * * * *
01711 1009* C
01711 1010* C BLOCK E.1
01711 1011* C OPTICAL CHECKS AND CALCULATIONS.
01711 1012* C
01711 1013* C CALLED IF RECEIVER APERTURE OPTIMIZATION IS NOT REQUESTED.
01711 1014* C CHECKS CONSISTENCY OF COLLECTOR INPUT VALUES.
01711 1015* C CALCULATES RIM ANGLE FROM GIVEN FOCAL RATIO OR VICE VERSA.
01711 1016* C CALCULATES FLUX DISTRIBUTION IN FOCAL PLANE AS A GAUSSIAN WITH

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01711 1016* C SIG2DF=TWICE THE VARIANCE OF FLUX DISTRIBUTION (IN UNITS OF
01711 1017* C PRIMARY CONCENTRATOR RADIUS):
01711 1018* C FOR OVERALL CONTOUR PARABOLOIDAL,
01711 1019* C SIG2DF=2.0*DELTQ*(1.0/(RMA*((TAN(RMAR/2.0))**2)))*
01711 1020* C ((-1.0/(3.0*(S**3)+C))+(2.0/(3.0*(S**3)))+(2.0/S)-
01711 1021* C C/(3.0*(S**3)))-(2.0*C/S)+((4.0*S)/(3.0*C))-
01711 1022* C LN(TAN(PI/4+RMA/2.0))+LN(TAN(PI/4-RMAR/2.0)))
01711 1023* C FOR OVERALL CONTOUR PLANAR,
01711 1024* C SIG2DF=2.0*DELTQ*(1.0+2.0*(C**2))/(3.0*RMA*C*S)
01711 1025* C (THESE ARE DUFF-LAMIERO EXPRESSIONS FOR FLUX SPREAD IN FOCAL
01711 1026* C PLANE).
01711 1027* C HERE S=SIN(RMAR)
01711 1028* C C=COS(RMAR)
01711 1029* C RMAR=RIM ANGLE IN RADIANS (RELATED TO FOCAL RATIO F).
01711 1030* C DELTQ=(2.0*SLOPER/1000.0)**2+(SPECUL/1000.0)**2+(SOLSD/1000.0)**2
01711 1031* C SLOPER=EQUIVALENT SLOPE ERROR.
01711 1032* C SPECUL=SPECULARITY SPREAD.
01711 1033* C SOLSD=STD. DEV. OF INCOMING SUNLIGHT.
01711 1034* C
01712 1035* C ENTRY CKNOPT (B)
01712 1036* C
01712 1037* C * * * * *
01712 1038* C BLOCK E.1.1
01712 1039* C CHECKS INPUT OF COLLECTOR CHARACTERISTICS.
01712 1040* C CALCULATES CONCENTRATOR RIM ANGLE OR FOCAL RATIO.
01712 1041* C CALCULATES VARIANCE OF GAUSSIAN ANGULAR DISTRIBUTION OF SUNLIGHT
01712 1042* C LEAVING A LOCAL AREA OF (PRIMARY) MIRROR OR LENS.
01712 1043* C
01713 1044* C IF ((C1.LE. 0.0).AND.(MAXPHI.OR.(.NOT.MAXC))) THEN
01715 1045* C ERPRINT , 'C1 MUST BE POSITIVE.'
01722 1046* C RETURN 1
01723 1047* C ENDDIF @ENDIF C1
01724 1048* C IF (((PHI1.LE. 0.0).OR.(PHI1.GT. 1.0)).AND.
01724 1049* C & (MAXC.OR.(.NOT.MAXPHI))) THEN
01726 1050* C ERPRINT , 'PHI1 MUST BE POSITIVE AND NOT OVER 1.0'
01733 1051* C RETURN 1
01734 1052* C ENDDIF @ENDIF PHI1
01735 1053* C IF (MAXC.AND.MAXPHI) THEN
01737 1054* C ERPRINT , 'CANNOT MAXIMIZE C AND PHI SIMULTANEOUSLY.'
01744 1055* C ERPRINTO, 'WILL MAXIMIZE C.'
01751 1056* C ENDDIF @ENDIF MAXC/MAXPHI
01752 1057* C IF (SECONC) THEN
01754 1058* C IF (C1S.LE. 0.0) C1S=C1
01756 1059* C IF (PHI1S.LE. 0.0) PHI1S=PHI1
01760 1060* C ENDDIF @ENDIF SECONC
01761 1061* C DELTQ=(2.0*SLOPER/1000.0)**2+(SPECUL/1000.0)**2+(SOLSD/1000.0)**2
01762 1062* C @VARIANCE OF GAUSSIAN ANGULAR
01762 1063* C @ DISTRIBUTION OF SUNLIGHT
01762 1064* C @ LEAVING A LOCAL AREA OF MIRROR

```

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<-----+
: 03752
: 03757
: 03763
-----+
<-----+
: 04002
: 04007
: 04013
-----+
<-----+
: 04016
: 04023
: 04030
-----+
<-----+
: 04032
: 04040
: 04046
-----+
04063

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01762 1065*           @ OR LENS.
01762 1066*           IF (DELTSG.LE. 0.0) THEN

01764 1067*           ERPRINT , 'CANNOT HANDLE ZERO ANGLE SOURCE'
01771 1068*           RETURN 1
01772 1069*           ENDEF                               @ENDIF DELTSG

01773 1070*           IF (RMA.LE. 0.0) THEN               @NO RMA INPUT

01775 1071*           IF ((F.LE. 0.10).OR.(PARAB .AND. (F.LE. 0.25))) THEN @NO F INPUT

01777 1072*           IF (MAXC.OR.MAXPHI) THEN

02001 1073*           ERPRINT , 'CANNOT MAXIMIZE C OR PHI WITHOUT ACCEPTABLE RIM AN
02001 1074*           &ELE OR FOCAL RATIO'
02006 1075*           RETURN 1
02007 1076*           ELSE
02010 1077*           IF (((PHI1.EQ. 1.0).AND.(C1.GT.(1.0/DELTSG))).OR.
02010 1078*           & ((PHI1.LT. 1.0).AND.(C1.GT.(VF/(DELTSG*(-ALOG(1.0-PHI1))))))
02010 1079*           & ERPRINT , 'WARNING! C1 GREATER THAN OPTICALLY POSSIBLE.'
02016 1080*           IF (SECONC) THEN

02020 1081*           IF (((PHI1S.EQ. 1.0).AND.(C1S.GT.(1.0/DELTSG))).OR.
02020 1082*           & ((PHI1S.LT. 1.0).AND.
02020 1083*           & C1S.GT.(VF/(DELTSG*(-ALOG(1.0-PHI1S))))))
02020 1084*           & ERPRINT , 'WARNING! C1S GREATER THAN OPTICALLY POSSIBLE.'
02026 1085*           ERPRINT , 'NOTE: CANNOT VERIFY THAT C2 IS OPTICAL
02026 1086*           &LY POSSIBLE WITHOUT F OR RMA INPUT.'
02033 1087*           RETURN
02034 1088*           ENDEF                               @ENDIF SECONC

02035 1089*           RETURN
02036 1090*           ENDEF                               @ENDIF MAXC/MAXPHI

02037 1091*           ELSEIF ((PARAB).AND.(F.LE. 10.0))      @F INPUT
02041 1092*           IF (.NOT. IRFLG) THEN                 @PREPARES RMARAY IF NOT

02043 1093*           DO I=1, 90                          @ ALREADY PREPARED

02046 1094*           RMARAY(I)=I
02047 1095*           ENDOLOOP                               @ENDLOOP I

02051 1096*           IRFLG=.TRUE.
02052 1097*           ENDEF                               @ENDIF IRFLG

02053 1098*           CALL SLUP(F,RMA,DUMMY,FRAY,RMARAY,90,2)
02054 1099*           @TABLE LOOKUP AND INTERPOLATION
02054 1100*           @ TO GET RIM ANGLE FOR
02054 1101*           @ PARABOLOIDAL CONTOUR.
02054 1102*           @CONVERT TO RADIAN
02055 1103*           ELSE
02056 1104*           RMAR=ATAN2(1.0,(2.0*F))                   @FOCAL LENGTH OUTSIDE
02057 1105*           RMA=RMAR/(PI/180.0)                     @ OF TABLE RANGE,
02060 1106*           @ OR PLANAR CONTOUR.
02060 1107*           ENDEF                               @ENDIF F

02061 1108*           ELSE                                  @RMA INPUT

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<-----
: 04067
: 04074
: 04100
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: 04104
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: 04120
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: 04123
: 04130
: 04134
: 04206
<-----
: 04210
: 04263
: 04270
: 04272
-----
: 04275
-----
: 04303
<-----
: 04310
<-----
: 04322
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: 04324
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: 04335
: 04342
: 04352
: 04357
-----
:

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02062 1109*      RMAR=RMA*(PI/180.0)
02063 1110*      IF (PARAB) THEN

02065 1111*          F=(1.0+C)/(4.0*S)
02066 1112*      ELSE
02067 1113*          F=1.0/(2.0*T)
02070 1114*      ENDIF                                @ENDIF PARAB

02071 1115*      ENDIF                                @ENDIF RMA

02072 1116*      IF ((C .LE. 0.0) .OR. (S .LE. 0.0)) THEN      @TO PREVENT DIVIDE

02074 1117*          ERPRINT , 'NOTE: RIM ANGLE OUTSIDE OF RANGE.' @ BY ZERO OR LOG
02101 1118*          RETURN 1                                @ OF NEGATIVE NUMBER.
02102 1119*      ENDIF                                @ENDIF C,S
02102 1120*      C
02102 1121*      C *
02102 1122*      C BLOCK E 1.2
02102 1123*      C CALCULATES FOCAL PLANE FLUX DISTRIBUTION.
02102 1124*      C MAXIMIZES CONCENTRATION RATIOS OR INTERCEPT FACTOR IF REQUESTED.
02102 1125*      C

02103 1126*      IF (PARAB) THEN

02105 1127*          SIG2DF=2.0*DELT SQ*(1.0/(RMAR*((TAN(RMAR/2.0))**2))) * @DUFF-
02105 1128*          & ((-1.0/(3.0*(S**3)+C))+(2.0/(3.0*(S**3)))+(2.0/S)- @ LAMEIRO
02105 1129*          & (C/(3.0*(S**3)))-(2.0*C/S)+((4.0*S)/(3.0*C))- @ SPREAD
02105 1130*          & ALOG(TAN(P4+RMAR/2.0))+ALOG(TAN(P4-RMAR/2.0))) @ FUNCTIONS.
02106 1131*      ELSE
02107 1132*          SIG2DF=2.0*DELT SQ*(1.0+2.0*(C**2))/(3.0*RMAR+C*S)
02110 1133*      ENDIF                                @ENDIF PARAB

02111 1134*      IF (MAXPHI.AND.(.NOT.MAXC)) THEN

02113 1135*          PHI1=1.0-EXP(-1.0/(C1*SIG2DF))
02114 1136*      ELSE
02115 1137*          IF (PHI1.LT. 1.0) THEN

02117 1138*              PHI1FC=-ALOG(1.0-PHI1)
02120 1139*          ELSE
02121 1140*              PHI1FC=VF
02122 1141*          ENDIF                                @ENDIF PHI1

02123 1142*          C1MAX= 1.0/(SIG2DF*PHI1FC)
02124 1143*          IF (MAXC) THEN

02126 1144*              C1=C1MAX
02127 1145*          ELSEIF ((.NOT.MAXPHI).AND.(C1.GT.C1MAX))
02131 1146*              ERPRINT , 'WARNING! C1 GREATER THAN OPTICALLY POSSIBLE.'
02136 1147*          ENDIF                                @ENDIF MAXC

02137 1148*      ENDIF                                @ENDIF MAXPHI

02140 1149*      IF (SECONC)

02141 1150*          IF (MAXPHI.AND.(.NOT.MAXC)) THEN

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02143 1151*      PHI1S=1.0-EXP(-1.0/(C1S*SIG2DF))
02144 1152*      ELSE
02145 1153*      IF (PHI1S.LT. 1.0) THEN
                                04700
                                04713
                                04717
                                04727
                                04731
                                04736
                                04740
                                04743
                                04754
                                04761
02147 1154*      PHI1SF=-ALOG(1.0-PHI1S)
02150 1155*      ELSE
02151 1156*      PHI1SF=VF
02152 1157*      @ENDIF PHI1S
02153 1158*      C1SMAX= 1.0/(SIG2DF*PHI1SF)
02154 1159*      IF (MAXC) THEN
                                04736
                                04740
                                04743
                                04754
                                04761
02156 1160*      C1S=C1SMAX
02157 1161*      ELSEIF ((.NOT.MAXPHI).AND.(C1S.GT.C1SMAX))
02161 1162*      ERPRINT , 'WARNING! C1S GREATER THAN OPTICALLY POSSIBLE.'
02166 1163*      @ENDIF MAXC
02167 1164*      @ENDIF MAXPHI
02170 1165*      IF ((C2.LE. 0.0).AND.(.NOT.MAXSEC)) THEN
                                04771
                                04776
                                05002
02172 1166*      ERPRINT , 'C2 MUST BE POSITIVE'
02177 1167*      RETURN 1
02200 1168*      @ENDIF C2
02201 1169*      IF ((PHI2.LE. 0.0).OR.(PHI2.GT. 1.0)) THEN
                                05015
                                05022
                                05027
                                05031
02203 1170*      ERPRINT , 'WARNING! PHI2 MUST BE POSITIVE AND NOT OVER 1.0'
02210 1171*      ERPRINT , 'SETTING PHI2=1.0'
02215 1172*      PHI2=1.0
02216 1173*      @ENDIF PHI2
02217 1174*      DELT=SQRT(DELT0)
02220 1175*      C2MAX=1.0/(C1S*((SIN(DELT))**2)*PHI2)
02221 1176*      IF (PHI1S.LT.1.0) C2MAX=C2MAX*VF/(-ALOG(1.0-PHI1S))
02223 1177*      C2MAX=AMIN1(C2MAX,1.0/(((SIN(CMAR*DELT))**2)*PHI2))
02224 1178*      IF (MAXSEC) THEN
                                05035
                                05046
                                05064
                                05103
                                05105
                                05110
                                05115
                                05122
02226 1179*      C2=C2MAX
02227 1180*      ELSEIF (C2.GT.C2MAX)
02231 1181*      ERPRINT , 'WARNING! C2 GREATER THAN OPTICALLY POSSIBLE.'
02236 1182*      @ENDIF MAXSEC
02237 1183*      @ENDIF SECONC
02240 1184*      RETURN
02241 1185*
02241 1186*      C
02241 1187*      C
02241 1188*      C * * * * *
02241 1189*      C * * * * *
02241 1190*      C
02241 1191*      C BLOCK E.2
02241 1192*      C OPTICAL CHECKS AND CALCULATIONS.
02241 1193*      C
02241 1194*      C CALLED IF OPTIMIZATION OF RECEIVER APERTURE IS REQUESTED.
02241 1195*      C PERFORMS SAME TASKS AS STATED FOR ENTRY CKNOPT (BLOCK E.1).

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02241 1196* C ALSO SETS UP RECEIVER APERTURE OPTIMIZATION.
02241 1197* C
02241 1198* ENTRY CKOPT ($)
02241 1199* C
02241 1200* C * * * * *
02241 1201* C BLOCK E.2.1
02241 1202* C CHECKS INPUT OF COLLECTOR CHARACTERISTICS.
02241 1203* C CALCULATES CONCENTRATOR RIM ANGLE OR FOCAL RATIO.
02241 1204* C
02242 1205* C1=0.0 @TO CLARIFY PRINTOUT.
02243 1206* PHI1=0.0 @THESE WILL BE DIFFERENT FOR 05125
02244 1207* @ EACH TEMPERATURE. 05126
02244 1208* C1S=0.0
02245 1209* PHI1S=0.0 05127
02246 1210* IF (MAXC.OR.MAXPHI) THEN 05130
02250 1211* ERPRINT , 'WARNING: CANNOT OPTIMIZE AND MAXIMIZE C SIMULTANEOUSLY'
02255 1212* ERPRINTO, ' WILL IGNORE MAXIMIZATION.' 05133
02262 1213* ENDIF @ENDIF MAXC/MAXPHI 05140
05145
02263 1214* IF (RMA.LE. 0.0) THEN @NO RMA INPUT
02265 1215* IF ((F.LE. 0.10).OR.(PARAB .AND. (F.LE. 0.25))
02265 1216* & .OR.(F .GT. 25.0)) THEN 05151
02267 1217* ERPRINT , ' TO OPTIMIZE MUST PROVIDE ACCEPTABLE RIM ANGLE OR FO
02267 1218* &CAL RATIO' 05171
02274 1219* RETURN 1 05176
02275 1220* ELSEIF ((PARAB).AND.(F.LE. 10.0)) @F INPUT 05202
02277 1221* IF (.NOT. IRFLG) THEN @PREPARES RMARAY IF NOT 05210
02301 1222* DO I=1, 90 @ ALREADY PREPARED
02304 1223* RMARAY(I)=I
02305 1224* ENDLOOP @ENDLOOP I 05215
05227
02307 1225* IRFLG=.TRUE.
02310 1226* ENDIF @ENDIF IRFLG 05231
02311 1227* CALL SLUP(F,RMA,DUMMY,FRAY,RMARAY,90,2)
02312 1228* @TABLE LOOKUP AND INTERPOLATION 05242
02312 1229* @ TO GET RIM ANGLE FOR
02312 1230* @ PARABOLOIDAL CONTOUR.
02312 1231* @CONVERT TO RADIAN 05247
02313 1232* ELSE
02314 1233* RMAR=ATAN2(1.0,(2.0*F)) @FOCAL LENGTH OUTSIDE
02315 1234* RMA=RMAR/(PI/180.0) @ OF TABLE RANGE,
02316 1235* @ OR PLANAR CONTOUR. 05257
05264
02316 1236* ENDIF @ENDIF F
02317 1237* ELSE IF (RMA.GE. 90.0)
02321 1238* ERPRINT , 'RIM ANGLE TOO LARGE' 05270
02326 1239* RETURN 1 05275
02327 1240* ELSE @RMA BETWEEN 0.0 AND 90.0 05301
02330 1241* RMAR=RMA*(PI/180.0)
02331 1242* IF (PARAB) THEN 05305
05305

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02333 1243*      F=(1.0+C)/(4.0+S)
02334 1244*      ELSE
02335 1245*      F=1.C/(2.0*T)
02336 1246*      ENDIF
                                @ENDIF PARAB
                                :: 05307
                                :: 05323
                                ::
                                :: 05332
                                -----
02337 1247*      ENDIF
                                @ENDIF RMA
                                ::
02337 1248*      C
                                ::
02337 1249*      C *
                                ::
02337 1250*      C
                                ::
02337 1251*      C
                                ::
02337 1252*      C
                                ::
02337 1253*      C
                                ::
02337 1254*      C
                                ::
02337 1255*      C
                                ::
02337 1256*      C
                                ::
                                -----
02340 1257*      DELTSQ=(2.0*SLOPER/1000.0)**2+(SPECUL/1000.0)**2+(SOLSC/1000.0)**2
                                @VARIANCE OF GAUSSIAN ANGULAR
                                @ DISTRIBUTION OF SUNLIGHT
                                @ LEAVING A LOCAL AREA OF MIRROR
                                @ OR LENS.
                                :: 05347
02341 1258*
02341 1259*
02341 1260*
02341 1261*
02341 1262*      IF ((C .LE. 0.0) .OR. (S .LE. 0.0)) THEN
                                @TO PREVENT DIVIDE
                                -----
02343 1263*      ERPRINT , 'NOTE* RIM ANGLE OUTSIDE OF RANGE.'
                                @ BY ZERO OR LOG
                                :: 05371
02350 1264*      RETURN
                                @ OF NEGATIVE NUMBER.
                                :: 05376
02351 1265*      ENDIF
                                @ENDIF C,S
                                :: 05402
                                -----
02352 1266*      IF (FARAB) THEN
                                -----
02354 1267*      SIG2DF=2.0*DELTSQ*(1.0/(RMAR*((TAN(RMAR/2.0))**2)))*
                                @DUFF-
02354 1268*      & ((1.0/(3.0*(S**3)*C))+2.0/(3.0*(S**3)))+(2.0/S)-
                                @ LAMEIRO
02354 1269*      & (C/(3.0*(S**3)))-(2.0*C/S)+((4.0*S)/(3.0*C))-
                                @ SPREAD
02354 1270*      & ALOG(TAN(P4+RMAR/2.0))+ALOG(TAN(P4-RMAR/2.0))
                                @ FUNCTIONS.
                                ::
02355 1271*      ELSE
                                :: 05522
02356 1272*      SIG2DF=2.0*DELTSQ*(1.0+2.0*(C**2))/(3.0*RMAR*C*S)
                                :: 05525
02357 1273*      ENDIF
                                @ENDIF PARAB
                                :: 05546
                                -----
02360 1274*      IF (SECONC) THEN
                                -----
02362 1275*      IF ((C2 .LE. 0.0).AND.(.NOT.MAXSEC)) THEN
                                :: 05550
                                -----
02364 1276*      ERPRINT , 'C2 MUST BE POSITIVE.'
                                :: 05560
02371 1277*      RETURN
                                :: 05565
02372 1278*      ENDIF
                                @ENDIF C2
                                :: 05571
                                -----
02373 1279*      IF ((PHI2.LE. 0.0).OR.(PHI2.GT. 1.0)) THEN
                                -----
02375 1280*      ERPRINT , 'WARNING! PHI2 MUST BE POSITIVE AND NOT OVER 1.0'
                                :: 05604
02402 1281*      ERPRINT , 'SETTING PHI2=1.0'
                                :: 05611
02407 1282*      PHI2=1.0
                                :: 05616
02410 1283*      ENDIF
                                @ENDIF PHI2
                                :: 05620
                                -----
02411 1284*      DEL1=SQRT(DELTSQ)
                                ::
02412 1285*      C2MAX=1.C/(((SIN(RMAR+DEL1))**2)*PHI2)
                                :: 05624
02413 1286*      IF (MAXSEC) THEN
                                :: 05636
                                -----
02415 1287*      C2HOLD=C2MAX
                                :: 05640
                                -----

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02416 1288*      C2=0.0                      @TO CLARIFY PRINTOUT      :: 05642
02417 1289*      ELSEIF (C2.GT.C2*MAX)      :: 05644
02421 1290*      ERPRINT , 'WARNING! C2 GREATER THAN OPTICALLY POSSIBLE.' :: 05651
02426 1291*      C2HOLD=C2                  :: 05656
02427 1292*      ENDIF                      @ENDIF MAXSEC             :: 05660
                                     -----
02430 1293*      ENDIF                      @ENDIF SECONC             :
                                     -----
02431 1294*      RETURN
02431 1295*      C
02431 1296*      C * * * * *
02431 1297*      C * * * * *
02431 1298*      C
02431 1299*      C BLOCK E.3
02431 1300*      C CALLED IF RECEIVER OPTIMIZATION IS REQUESTED.
02431 1301*      C OPTIMIZES RECEIVER APERTURE, SETTING CONCENTRATION RATIO
02431 1302*      C  $C=1/((SIG2DF*LN((INS*RHO*BS*ALPHA/$ 
02431 1303*      C  $(SIG2DF*EPS*BOLTZ*(TRK**4-TAK**4)+H*(TRK-TAK))))$ 
02431 1304*      C ENTERS CONCENTRATION RATIOS AND INTERCEPT FACTOR IN OUTPUT ARRAY.
02431 1305*      C
02432 1306*      ENTRY OPTAP ($)
02433 1307*      IF (TRMB.LE. 0.0) THEN
                                     :: 05662
02435 1308*      ERPRINT , 'CANNOT OPTIMIZE. NO RECEIVER APERTURE LOSSES.' <----- : 05666
02442 1309*      RETURN 1
                                     : 05673
02443 1310*      ENDIF                      @ENDIF TRMB
                                     ----- : 05677
02444 1311*      CINV=SIG2DF*ALOG((TRMA/(SIG2DF*TRMB))
02445 1312*      C1=AMAX1(1.0/CINV,BOUND)
02446 1313*      PHI1=AMAX1(1.0-SIG2DF*TRMB/TRMA,0.0)
02447 1314*      OPTAA(1,NTCNT)=C1
02450 1315*      IF (SECONC) THEN
                                     :: 05701
02452 1316*      CINVS=SIG2DF*ALOG((TRMAS*PHI2*C2HOLD)/(SIG2DF*TRMB))
02453 1317*      C1S=AMAX1(1.0/CINVS,BOUND)
02454 1318*      PHI1S=AMAX1(1.0-SIG2DF*TRMB/(TRMAS*PHI2*C2HOLD),0.0)
02455 1319*      C2MAX=1.0/(C1S*((SIN(DELTA))**2))
02456 1320*      IF (PHI1S.LT. 1.0) C2MAX=C2MAX*VF/(-ALOG(1.0-PHI1S))
02460 1321*      IF (MAXSEC) THEN
                                     :: 05712
02462 1322*      C2=AMIN1(C2HOLD,C2MAX)
02463 1323*      OPTAA(5,NTCNT)=C2
02464 1324*      ELSEIF (C2.GT.C2*MAX)
02466 1325*      ERPRINT , 'WARNING! C2 GREATER THAN OPTICALLY POSSIBLE'
02473 1326*      ENDIF                      @ENDIF MAXSEC
                                     ----- : 05721
02474 1327*      OPTAA(2,NTCNT)=C1S
02475 1328*      OPTAA(3,NTCNT)=PHI1
02476 1329*      OPTAA(4,NTCNT)=PHI1S
02477 1330*      ELSE
02500 1331*      OPTAA(2,NTCNT)=PHI1
02501 1332*      ENDIF                      @ENDIF SECONC
                                     ----- : 05731
02502 1333*      RETURN
02503 1334*      END
                                     ----- : 05742
                                     <----- : 05747
                                     : 05761
                                     : 05770
                                     : 06003
                                     : 06013
                                     : 06031
                                     <----- : 06033
                                     : 06041
                                     : 06052
                                     : 06057
                                     : 06064
                                     ----- : 06066
02474 1327*      OPTAA(2,NTCNT)=C1S
02475 1328*      OPTAA(3,NTCNT)=PHI1
02476 1329*      OPTAA(4,NTCNT)=PHI1S
02477 1330*      ELSE
02500 1331*      OPTAA(2,NTCNT)=PHI1
02501 1332*      ENDIF                      @ENDIF SECONC
                                     ----- : 06075
02502 1333*      RETURN
02503 1334*      END
                                     ----- : 06104
                                     : 06114
                                     ----- : 06125
                                     ----- : 06170

```

0 DIAGNOSTICS

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