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DATA REDUCTION PROCESSES FOR THE JERSEY CITY TOTAL ENERGY PROJECT

Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

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MODULAR INTEGRATED UTILITY SYSTEMS

improving community utility services by supplying electricity, heating, cooling, and water/ processing liquid and solid wastes/ conserving energy and natural resources/ minimizing environmental impact

Prepared for:
Department of Housing and Urban Development
Energy, Building Technology and Standards Division
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Washington, D.C. 20410

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Daniel E. Rorrer
William G. Rippey
Yui-May L. Chang

Center for Building Technology
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U.S. DEPARTMENT OF COMMERCE, Juanita M. Kreps, ***Secretary***

Jordan J. Baruch, ***Assistant Secretary for Science and Technology***

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, ***Director***

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Daniel E. Rorrer, William G. Rippey, Yui-May L. Chang

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ABSTRACT

The major processes used in the reduction of the data obtained from the Jersey City, New Jersey, Total Energy Site are discussed. These discussions begin with the acquisition of the raw engineering data and carry through to the final data presentation in a form from which the summary performance reports of the Total Energy Site are produced.

The major functions of the Jersey City total energy data editing and conversion software program developed by the National Bureau of Standards are described in some detail. Included are descriptions of the command structure, overall data flow, data editing, data conversions, error processing, and the creation of data output tapes for use in further analysis. The more important subroutines which are used to handle the individual operations are also discussed. The equations used in the calculation of engineering units are described, along with their derivations where appropriate.

The report assumes that the reader has a basic familiarity with computer and engineering terminology.

Key Words: Computerized processing; data editing; data flow; data reductions; data processing; raw data conversion to engineering units; total energy; total energy data flow.

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1. INTRODUCTION

During the normal generation of electrical power, a considerable amount of energy is lost in the form of waste heat. The total energy concept makes use of this waste heat to supplement the energy required for other purposes such as the heating and cooling of buildings and the generation of domestic hot water. In order for this to be a viable concept, the point of use of the waste heat must be close to the point of generation of the electrical energy. Thus, the single plant generation of electrical energy as well as thermal energy is encouraged. Such a plant is a total energy plant [1]*.

1.1 BACKGROUND

The Department of Housing and Urban Development (HUD) has sponsored the Jersey City, New Jersey, Total Energy study with the National Bureau of Standards (NBS) having the responsibility for the evaluation of the effectiveness of the Total Energy plant in a building complex. Extensive engineering and economic data are being continually collected and analyzed by NBS to determine the energy savings, costs, reliability, and environmental impact of an actual total energy system.

1.1.1 Site Description

The Jersey City Total Energy system consists of a Central Equipment Building (CEB) which supplies all electrical and thermal energy to a 6.35 acre (2.6 hectare) site which has 4 medium to high-rise apartments housing 1300 people in 485 apartments, an elementary school, a swimming pool, a 46,000 ft^2 (4300 m^2) commercial building, and parking space for the site tenants. Figures 1 and 2 show an aerial view and a site plan respectively.

The Central Equipment Building (CEB) is a three-story structure which houses five 600 kW diesel engine generators, two 13.4 MBtu/hour (4.0 MW) hot water boilers, and two 546 ton (6.6 MBtu/hour or 1.9 MW)

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*Numbers in brackets refer to reference numbers.

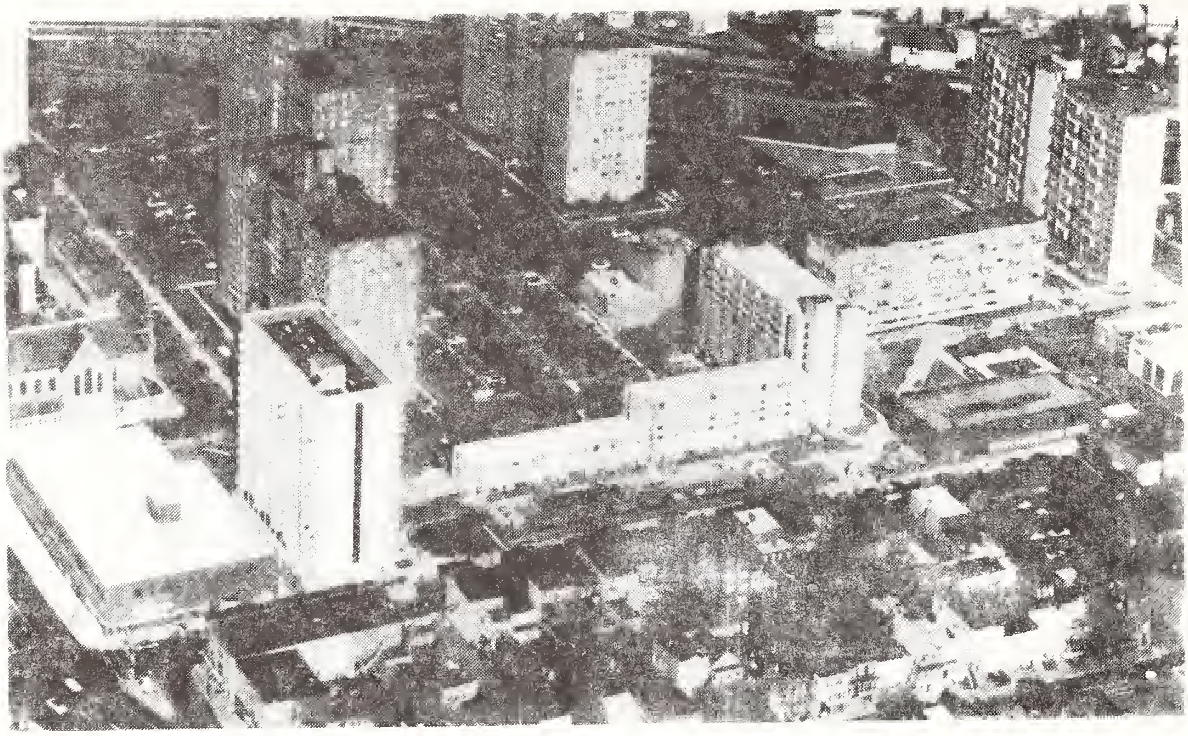

FIGURE 1. Aerial view of the total energy site

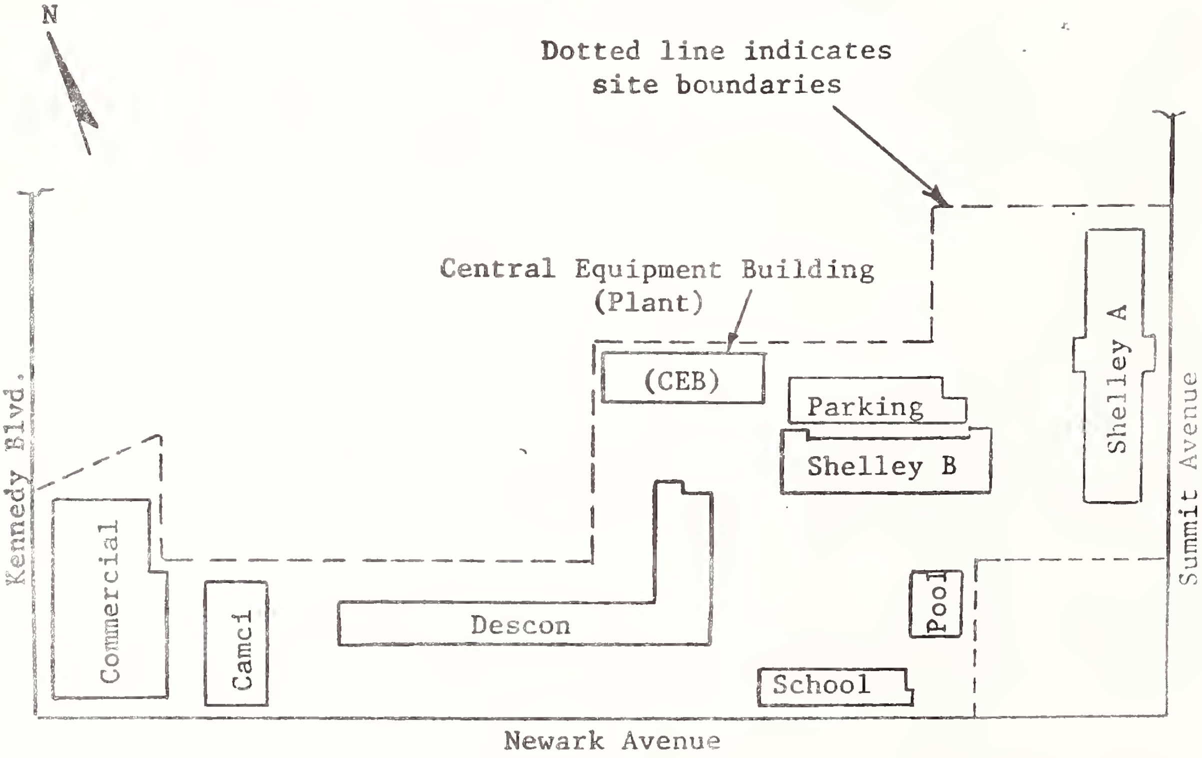

FIGURE 2. Plan layout of the total energy site

absorption chillers. The engines and boilers burn #2 fuel oil which is stored in three 25,000 gallon (95 m^3) underground tanks. The total energy plant is completely automatic, allowing unattended overnight and weekend operation. The plant is operated by a private contractor under contract to HUD.

Heat is recovered from the engine-generators and utilized by a primary hot-water (PHW) loop (see Fig. 3). Primary hot water at a temperature ranging from 180°F to 230°F (82°C to 110°C) is pumped at an approximate rate of 11000 pounds (5000 kg) per minute, transferring heat from the engines and boilers to the chillers and site hot water system. From the engines, the PHW passes through two 25 hp (19 kW) circulation pumps and then through the boilers where additional heat can be added if necessary. During the summer the PHW is routed through two 546 ton (1.9 MW) absorption chillers which provide 45°F (7°C) chilled water for the site. The PHW then passes through two water-to-water heat exchangers transferring heat to the site secondary hot-water system. In the rare event that both heating and cooling demands are extremely low, a forced circulation, dry surface heat exchanger (dry cooler) releases the excess PHW heat to the atmosphere as a control on the upper limit of the PHW temperature. Figure 3 depicts schematically the major components of the CEB.

Electric power, hot water, and chilled water are delivered to the site via underground conduits. Two sets of 480-volt, three-phase feeders (normal and essential) are used for eletrical power distribution. In the event of an electrical plant outage, power is automatically supplied to the essential feeder (only) from the local utility company to preserve certain operations (emergency lighting, fire protection systems, and hot water supply and return, and chilled water supply and return). Heat exchangers in the individual buildings transfer heat to and from the building loops which are designed for space heating, cooling, and domestic hot-water production.

The site is also equipped with a pneumatic trash collection system (PTC) which collects refuse from the site buildings into a single, compactor-type receptacle located in the central equipment building.

1.1.2 Instrumentation System Description

Evaluation of the performance of the total energy plant and its components and the determination of building utility loads are being accomplished by analyzing data obtained from transducers which are located throughout the CEB and site buildings. These specialized transducers translate physical variables into analog voltages that are sampled and recorded electronically on magnetic tape in a digital format. All measurments are directly related to physical and electrical parameters (such as flow rate, temperature, pressure, power, voltage, frequency, etc). The Data Acquisition System (DAS) (see Fig. 4) is the engineering tool that accomplishes the task of recording these measurement data every five minutes on a 24-hour, year round basis [2]. These

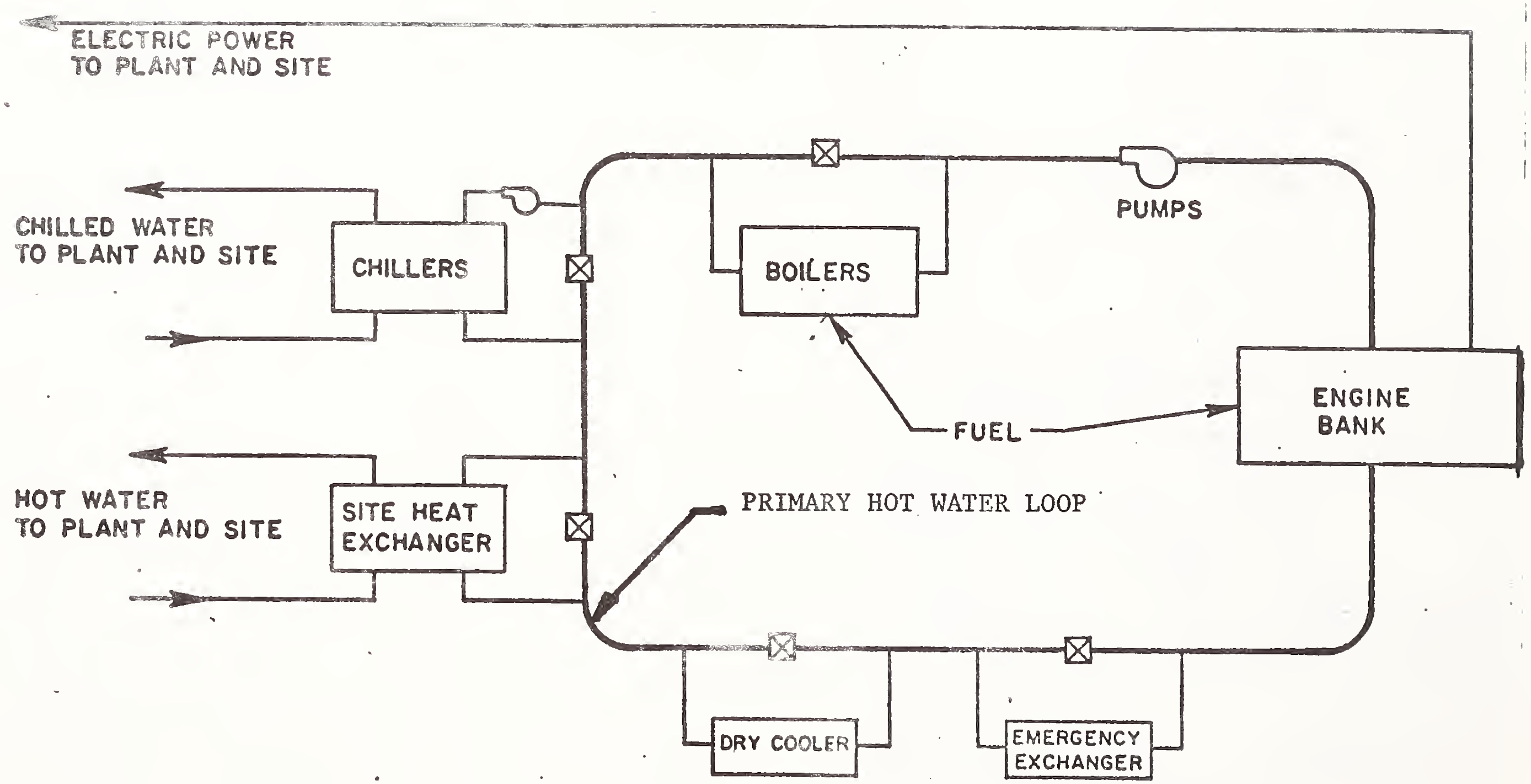

FIGURE 3. Total energy plant schematic

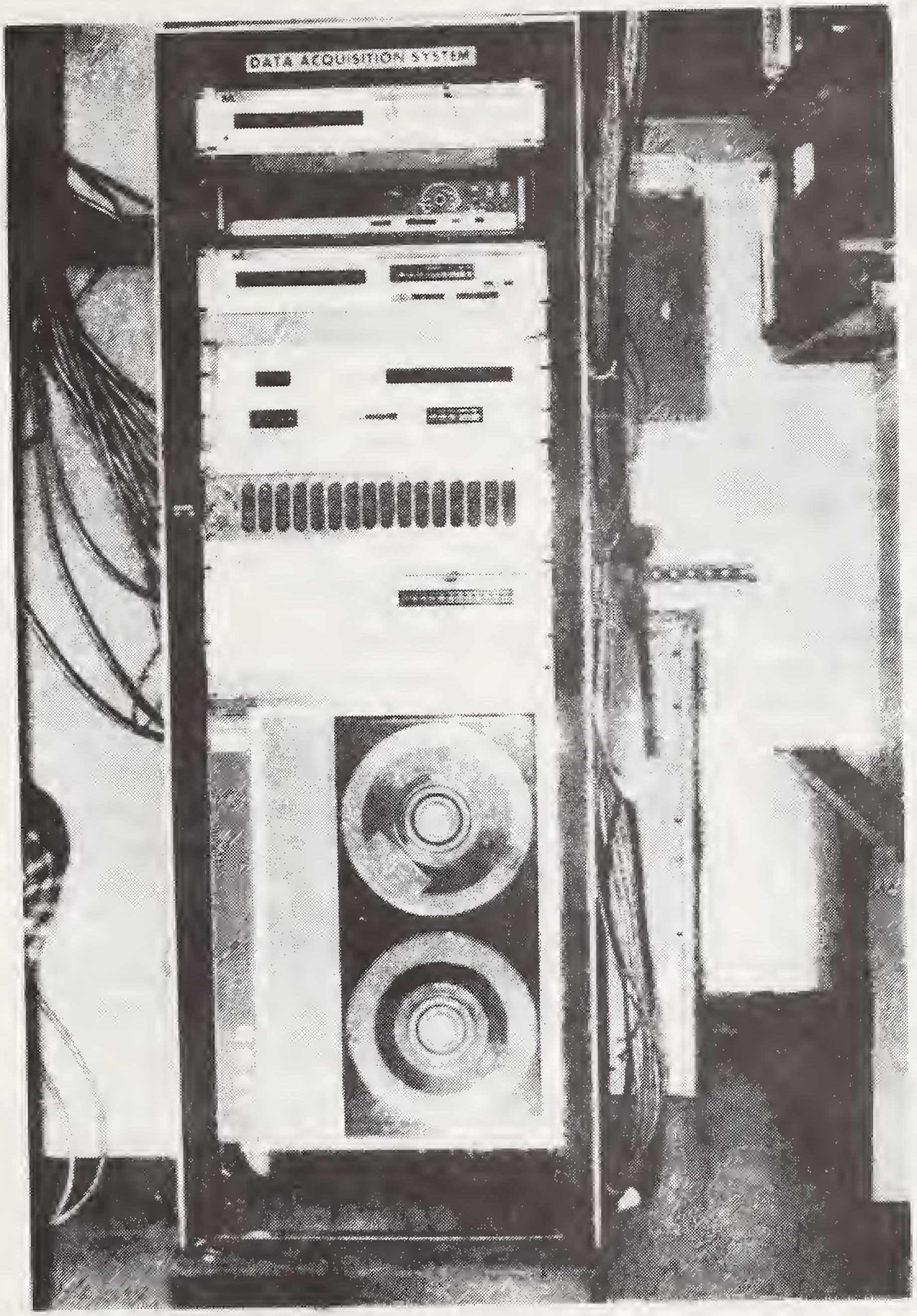

FIGURE 4. Photograph of the total energy data acquisition system

5-minute recording intervals (scans) are short enough to reflect changes in plant status and to measure accurately the changing physical quantities.

The instrumentation consists of a variety of transducers which measure both thermal and electrical variables. Water flow and fuel flow are measured by either turbine or nutating disk meters with integrating circuitry, or by venturis with differential pressure cells. Temperature measurements are obtained by either copper/constantan or iron/constantan thermocouples. Temperature differentials are measured by multi-junction copper/constantan thermopiles. Potential and current transformers placed on the electrical buses feed signals to watt transducers and voltage transducers. The DC output of the watt transducer is then amplified for use as an instantaneous power signal which is integrated over time to obtain plant electrical frequency, electrical power factor, and system voltage[2,3].

Signal lines from plant (CEB) transducers are hardwired to the DAS scanning equipment. This equipment selects one line at a time to feed the system digital voltmeter. Each of the site buildings has a remote station which is controlled by the central DAS. These remote stations have relays which select each remote transducer signal to be sampled by the DAS. A system clock initiates data scans to begin at selected time intervals (currently, every 5 minutes). In the scan mode, the DAS selects data channels sequentially and routes the analog signal to the digital voltmeter. The digital voltmeter digitizes the analog voltages which are then written with their respective channel numbers (in EBCDIC* format) on an incremental 9-track magnetic tape drive. A data scan includes the recording of information from all channels in the central equipment building plus all of the sub-channels in each of 8 remote locations (Six buildings, swimming pool, and weather station). The entire data scanning process for a single scan requires less than 30 seconds.

A ten inch (25.4 cm) diameter magnetic tape is sufficient for recording up to 2 weeks of raw (unprocessed) data. "Real time" transmission is on a character by character basis (in ASCII** format) at a BAUD*** rate of 300.[5] Figure 5 illustrates the basic data flow through the data acquisition system. It should be noted that channel 13 on each of the remote scanners is a reference channel. This reference channel is used by the computer software for the determination of the remote amplifier bias.

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*EBCDIC - Extended Binary coded decimal interchange code.

**ASCII - American Standard Code for Information Interchange. Established as an American Standard by the American Standards Association (ANSI).

***BAUD - A unit of data transfer rate where 1 binary digit equals 1 BAUD.

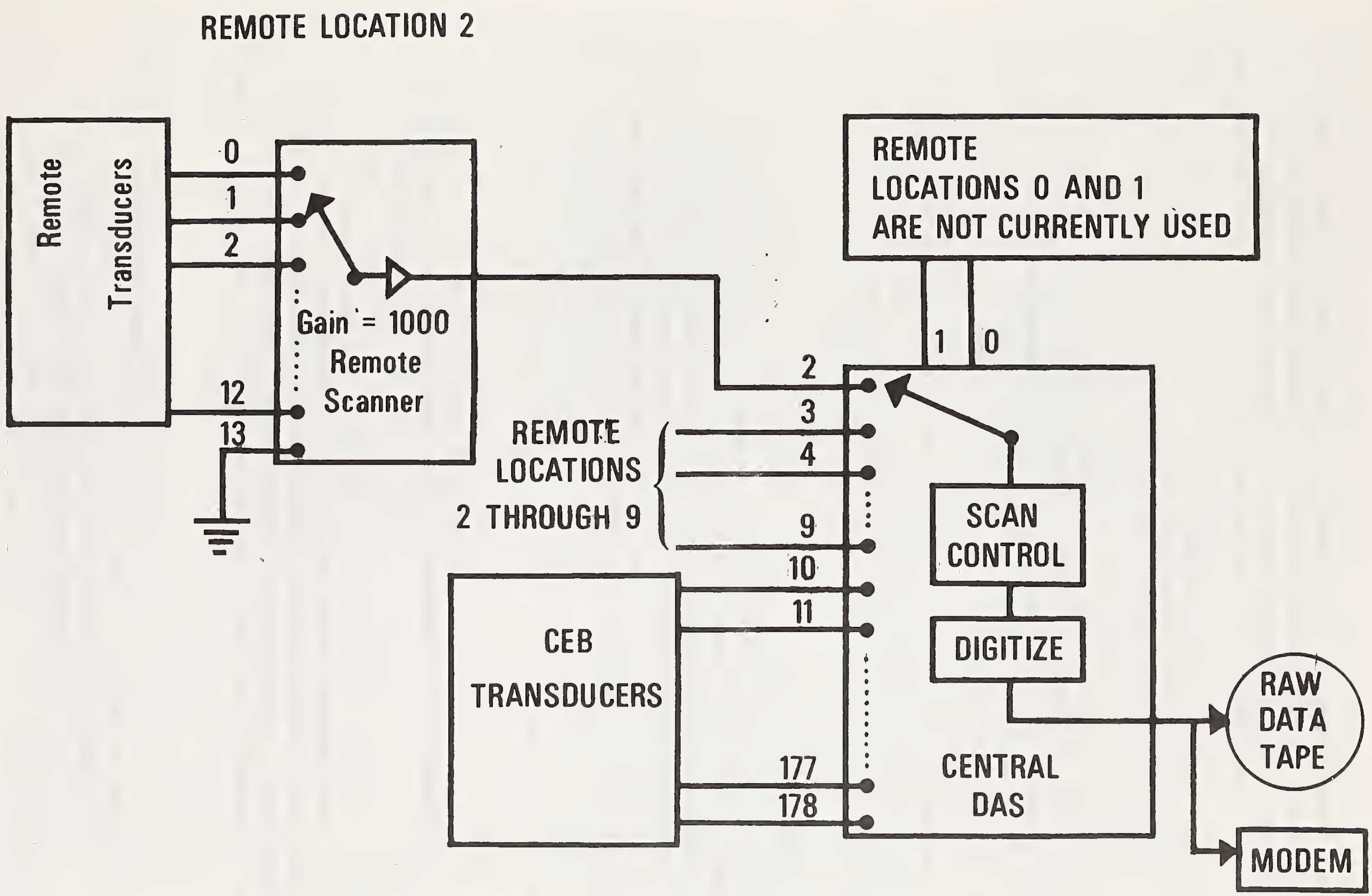

FIGURE 5. Basic data flow through the total energy data acquisition system

The DAS began monitoring and recording CEB data in April, 1975. The first remote building data were recorded in November 1975, and the remaining remotes were placed on-line in conjuction with building construction and equipment calibration schedules.

1.1.3 Data Acquisition System Outputs

1.1.3.1 Raw Data Tape

The DAS is currently operated in an automatic mode whereby a magnetic tape record (scan) is produced every 5 minutes. Each record on the tape contains information concerning the total energy site physical parameters for the previous 5-minute period. A 5 minute data collection interval was chosen based on accuracy considerations of integration-type measurements, thermal response of the total energy plant, desired time resolution for later systems analysis, and the number of scans a single magnetic tape could contain. After a raw data tape is sufficiently filled with data (approximately each week) it is shipped to NBS for computerized editing and analysis.

1.1.3.2 Modem Transmission

During the time periods in which magnetic tape records are not being written, data scans are transmitted to NBS using a telephone data-link in an ASCII format. Through the use of computerized techniques, a "pseudo" raw data magnetic tape in EBCDIC format can be created. This capability has the advantage of near real-time processing and allows for daily checks of the data acquisition and instrumentation system operation.

1.1.4 Data Processing

Raw data tapes are processed at NBS by a Raytheon 704 mini-computer in order to obtain the engineering information needed for system analysis. The software program that processes the raw data tapes is called TEREVIEW. TEREVIEW is an operator interactive set of subroutines which are utilized in the editing of the raw data, its conversion to engineering units, and the production of an output tape for the purpose of data, or, total energy system analysis. The software program, TEREVIEW, is the major program used in the processing of all Jersey City total energy data. All subsequent data processing and data analysis are directly dependent upon the output of TEREVIEW.

1.1.5 Mini-Computer Configuration

All data which are received by NBS from the Total Energy site in the form of DAS-generated magnetic tapes or modem transmissons, are processed by a Raytheon 704 mini-computer.[4] This computer system consists of a (16 bit word) central processing unit (CPU), two disk memories of 128K words each, a 7-and a 9-Track magnetic tape drive, a 9600 BAUD Cathode Ray Tube (CRT) terminal and keyboard with "hard copy" unit, a teletype (110 BAUD) terminal, a high speed paper tape reader and punch, and a full-duplex modem. The CPU has 32K words of 1.0 micro-second core memory, hardware multiply-and-divide capability, 16 priority interrupt levels, and a power-fail-safe provision. Communication between the two disk memories and the CPU is by Direct Memory access with control of the disk drives taking place over a Direct Input/Output (DIO) bus. Signals from the CRT and modem are converted from serial to parallel and are preconditioned through the use of a 4-channel serial line multiplexer with control and output taking place over the DIO bus. All other peripherals have their own electronic hardware controllers and signal conditioners which communicate with the CPU over the DIO bus. The two magnetic tape drives operate at 25 inches per second in a synchronous mode with selectable density and parity. Figure 6 is a photograph of the minicomputer system.

1.2 PURPOSE AND SCOPE

The purpose of this report is to describe the basic data flow from its receipt at NBS through the software system that processes it into its final "report ready" condition of charts, graphs, and numbers.

This report describes in some detail the total energy data editor and engineering units conversion program (TEREVIEW) including the command structure, overall data flow, data editing, data conversions, error processing, and the creation of data tapes to be used in further analysis. The more important subroutines which are used to handle the individual operations are also discussed. The equations which are used in the engineering unit conversions are described, along with their derivations where appropriate. The format of the output data tape is also discussed. This report assumes that the reader has a basic familiarity with computer and engineering terminology.

2. DESCRIPTION OF DATA FLOW THROUGH THE OVERALL DATA REDUCTION SOFTWARE SYSTEM

For the following discussion it will prove helpful to refer to Figure 7. Each of the instrumented engineering parameters arrive at the DAS as an analog voltage input (some of the basic instrumentation has a digital output format initially; however, in every case, conversion to analog takes place before presentation to the DAS). The DAS then converts these analog voltages to digital values prior to output.

Three options exist with respect to the DAS handling of the raw digital data outputs for transfer to NBS:

1. Production of a magnetic tape in an EBCDIC format for subsequent land/air transport to the NBS.

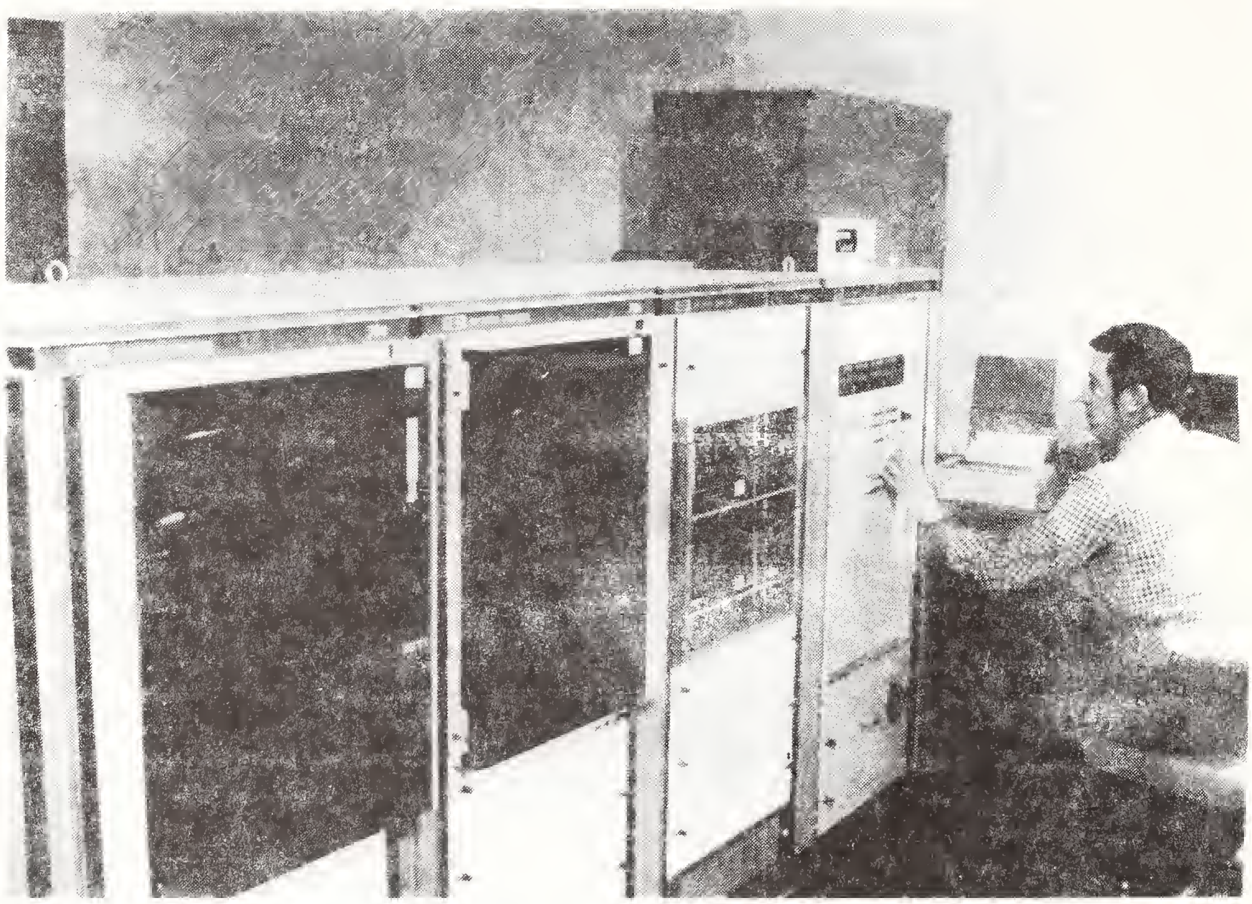

Figure 6. Photograph of mini-computer system

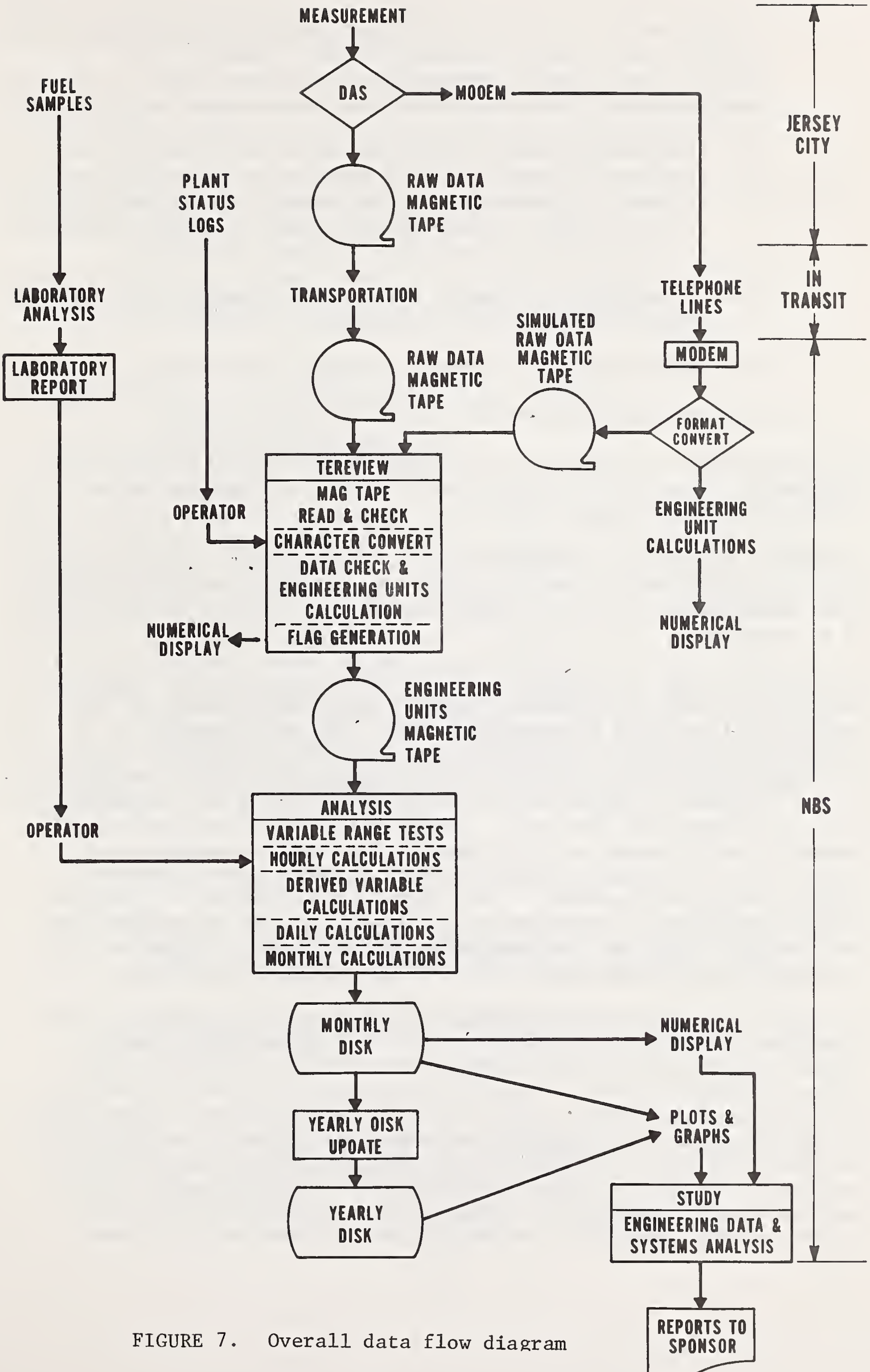

FIGURE 7. Overall data flow diagram

2. Transmission of the data in an ASCII format over telephone lines to NBS where it is received and reformatted into EBCDIC. Once format conversion has occurred, three additional options are available to the computer operator:

   (a) Engineering unit conversions can be performed and the resultant answers compared against their "normal range values." A numerical display summary of the plant and instrumentation status is also made. A sample printout of this option is contained in Appendix VII-2.

   (b) A magnetic tape can be produced to simulate the magnetic tape which is normally obtained by option 1.

   (c) Both (a) and (b) can be performed simultaneously.

3. Options 1 and 2 above are available simultaneously.

The normal mode of operation for receipt of raw data at NBS is to utilize option 1 above, with a daily verification of plant operation through the use of option 2(a).

Additional engineering information concerning the site fuel oil analysis is received twice a month at NBS from a private testing laboratory. This information is manually input into the data flow at a later stage of processing.

The raw data tape in conjunction with a site status log serve as the basic data inputs to an operator interface and data editor software program (this program is named TEREVIEW). The prime purpose of TEREVIEW is to produce another magnetic tape which is both electrically and mechanically acceptable to the computer and which consists of the millivolt readings as well as the engineering unit parameters for each channel for each scan. Additionally, this "engineering unit" magnetic tape contains a set of flags for each scan (one flag per channel) indicating the software as well as the operator assessment of the quality of the data. A more detailed description of the functions of TEREVIEW is contained in section 3.1. When the engineering unit magnetic tape has been completed and verified, the raw data tape is erased and returned to the site for use again by the DAS.

In order to produce the engineering parameters which consist of relationships or calculations involving two or more data measurements (these parameters are called Derived Variables), a software program called ANALYSIS is used. ANALYSIS utilizes as its input the engineering unit magnetic tape, as well as the operator's input of such items as the site fuel oil laboratory analysis, plant status, and data dates. The basic function of ANALYSIS is to produce a cartridge disk (for each month of the year) which contains all of the information necessary to analyze properly the engineering performance of the total energy system. ANALYSIS is actually a set of three main software programs which handle the data sequentially in a logical order such that the required result is achieved. A more detailed discussion of ANALYSIS is contained in section 3.2.

The monthly disk produced by the ANALYSIS software is used in the accumulation of seasonal trends on a yearly disk (see paragraph 3.3) as well as for input to numerical and graphical display software.

Ultimately, the engineering reports concerning the total energy system operation are written on the basis of a careful study of all data stored on the monthly and yearly disks.

Both the monthly and yearly disks are copied to magnetic tape (as a backup storage media) and saved for future reference.

3. DESCRIPTION OF DATA REDUCTION SOFTWARE FUNCTIONS

3.1 RAW DATA TAPE EDITING (TEREVIEW)

Past experience with the raw data tapes produced by the DAS has shown that it is not feasible to assume that the tape will be both electrically and mechanically "perfect". Such common anomalies as parity errors, scratched oxide base, interspaced inter-record gaps, intermittent ends-of-file, extraneous bits and characters, and missing bits and characters have been frequently experienced. The first job of TEREVIEW is to read a complete raw data record (scan) and check it for proper format and structure. In the event an error is found which cannot be corrected by software, the operator is informed of the error and is given many options to use in its correction. A complete list of the command codes and error displays which are available to the operator is contained in Sections 6.7 and 6.8. Once a corrected record has been placed in computer memory, the following operations are performed.

1. Conversion of the label information (see Section 5.1), date, and time from EBCDIC to binary real* numbers.

2. Conversion of the EBCDIC, 13-character groupings (see APPENDIX VIII (1)) to a DAS channel-ordered array of binary real numbers representing the millivolt readings of each channel.

3. Conversion of the millivolt readings to their respective engineering units.

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* A real number, for purposes used in this report, is a computer compatible, signed, floating point, decimal number.

4. Verification of millivolt and engineering unit values to be within broad practical operation limits.

5. Setting of flags for each channel to indicate such information as: no error detected, error detected and not corrected by operator, and converted value inserted by operator.

6. Production of a temporary disk based (scratch) file.

7. Further editing and checking of the scratch file (if required) with complete operator interaction.

8. Creation of the engineering unit tape from the scratch file.

9. Verification of the engineering unit tape.

The raw data tape edit (and creation of the engineering unit tape) function is performed on each tape which is received from the total energy site. Approximately four raw data tapes are processed each month and the resultant engineering unit tapes (one to four per month) are stored for future processing and reference. Since the engineering unit tapes contain the raw millivolt values, they serve as a direct link back to the primary measurements. A listing of a representative scan as ouput by TEREVIEW is contained in Appendix IV.

It should be noted that although the intention is to gather data every five minutes, this is not always the case. In reality, due to DAS system calibration verifications, occasional transducer malfunctions, and various other reasons, there are time periods for which no data exists. These time periods of no data are taken into account by the ANALYSIS software as described in the following section.

3.2 CREATION OF THE MONTHLY DISK (ANALYSIS)

3.2.1 Hourly Accumulation of Engineering Units

In order to create a monthly disk which contains engineering parameters representing the total energy plant operation, it is first necessary to compress the five-minute data prior to the calculation of derived variables. In this stage, a five-minute data scan is read into the computer and each data flag is checked for the validity of the data. If the flag indicates that the data are not acceptable, then no further action is taken; however, if the data is apparently good, the data value is further verified to be within a range of values. The particular verification range for which the data is tested is based on the status of the plant at the time the measurement value was recorded. The selection of the actual verification range value was made based on analysis of all data recorded during a time period in excess of a year. If the data does not check out under the last test, then no action is taken. If the data does check out under the last test, then it is accumulated into an accumulation buffer and a "time of good data" counter is incremented. At the end of each data hour, the average value of the data (over the time for which acceptable data were present) is calculated and written, along with the time for which the data channel was present, into its respective hour sector on the disk. The above continues on a channel by channel and scan-by-scan basis until all hours in the month have been processed. At this point, the second phase of ANALYSIS is called into operation.

3.2.2 Calculation of Hourly Derived Variables

All derived variables are calculated based on the hourly average of the required engineering units. If any required variable is indicated (by its time parameter) as not being present, then no calculation is made. A time for which the derived variable is considered to be good is also calculated. This time is normally the smallest time of all of the engineering units used in the calculation. Once the hourly derived variables (and their associated times) are calculated, they are written to the disk on the appropriate derived variable hourly time sector. The above calculations take place for each hour of the month for which any data existed. At this point, all of the engineering units and derived variables (with their associated times) for each hour of the month are on the disk.

3.2.3 Calculation of Daily and Monthly Summaries

The third and final phase of ANALYSIS is to calculate the daily and monthly summary for each of the engineering units and derived variables. The daily summaries are averages over time of all of the hours in the day and are written on the disk (with their effective time) in specific daily sector locations. The monthly summary is also an average over time; however, it is based on the daily values. Once this third phase is completed, selected data can be displayed either graphically or numerically and an operator can assess the validity of the entire process.

3.2.4 Monthly Disk Editing

If, after the creation of the monthly disk, it is learned that conditions at the total energy site were different from that which was originally thought, a software program called DISKUPDT will allow for a knowledgeable operator to have access to the hourly engineering units (only) in order to modify or update them. Once DISKUPDT has been used on a particular disk, then the second and third phases of ANALYSIS must also be reexecuted. An example of where this program has been used is in the deletion of a data channel when it was discovered that the channel was malfunctioning.

A typical listing of an hourly, daily, and a monthly summary is contained in Appendix V. Definitions for each engineering unit and derived variable are contained in Appendices II and III.

3.3 CREATION OF YEARLY DATA SUMMARY DISK

The name "yearly data summary disk" is a misnomer; in reality, the disk is a 20-month disk. The number 20 was arrived at based on the space which was available on a single disk cartridge. This disk is nothing more than a logically ordered copy of all of the daily and monthly summaries for up to 20 sequential months. This disk is only used for graphical presentation such that "smoothed" trends can be easily observed. The presentation is "smoothed" by eliminating the normal diurnal hourly fluctuations and by using the average daily values.

4. DESCRIPTION OF OUTPUT AND DISPLAY SOFTWARE CAPABILITIES

Provisions for displaying all calculated data in a graphical and/or a numerical format is dependent not only on the desires of the operator, but also upon the type of media from which the data are obtained. Graphical presentation of information is available only for data which exists on either a monthly or yearly disk. Numerical information display is available for data existing on a monthly disk or for data which are being obtained from the direct modem telephone link with the site. The reason that numerical data lists are not available from the yearly disk is that the yearly disk is simply a reduced copy of the several monthly disks comprising it. If the operator desires numerical listing of information contained on a yearly disk, then it is obtainable in greater detail from one or more of the monthly disks (which were used in the creation of the yearly disk).

4.1 GRAPHICAL PRESENTATIONS

The software used in the preparation of plots (or graphs) of monthly information is call PLOTDISK. PLOTDISK is a program that requires the operator to enter the current date, data code (or codes), data range, and time domain. Additionally, options exist for the operator to display different types of data, insert title and/or sub-title, and to vary the number of divisions of the data range along the Y-axis. Simple arithmetic operations involving two variables are also available for display. In order to maintain a consistent history, each plot has printed on it a code number. From this code number, the particular disk from which the data were obtained, the current date, and the data code which was plotted can all be determined. A summary of the capabilities of PLOTDISK which are available to the operator follows.

Number of Plotted Variables - one to five per display.
Type of Variable - hourly raw data, hourly derived variables, time history for which data were considered acceptable, hourly information concerning constants and other data which have no established data code, and arithmetic operations involving two variables.
Main Title - either automatic or selectable by operator.

Sub-Title - operator choice only.
Variable Range - maximum and minimum values selectable by operator.
Divisions of Range on Y-axis - selectable by operator.
Unit titling of x and y axes - automatic with no operator choice.
Time period of plot - selectable by operator by first and last hour or first and last day of month to plot. If no data existed for a part of a requested time period for reasons previously described, then no data will be plotted. If data existed but was not used in calculations, it is either not displayed or, at the operators option, will be plotted with appropriate code marks.

The software which is used in the graphical display of yearly information is called PLOTYEAR. PLOTYEAR is essentially identical to PLOTDISK with the only exceptions being:

(1) daily information points are presented instead of hourly;
(2) the time period of the plot is based on the first month and day and the last month and day; and
(3) no option exists for display of unused data.

Examples of several of the available modes of graphical presentation are presented in Appendix VI.

4.2 NUMERICAL PRESENTATIONS

4.2.1 Monthly Disks

Numerical listings of the monthly disk values of hourly, daily, and monthly variables are available through the use of a software program called ANALYSPT. The particular listing which is presented is left to the desire of the operator. Examples of each option are contained in Appendix V.

4.2.2 Modem Data

Current millivolt and engineering unit values of raw data are available to the operator on a "real-time" basis. Additionally, these listings contain a software assessment as to the quality of the received data. The program which is used for this listing is called MODMCHEK. Another program called MODMLIST will only print each raw character as received by the electronic hardware. Examples of both types of output are contained in Appendix VII.

5. FORMAT DESCRIPTIONS

5.1 RAW DATA

All data transmission (which is either recorded on magnetic tape or sent to NBS over telephone lines) takes place serially on a character-by-character basis. The only alphanumeric characters which are used are:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, +, -, B, M, N, S, V, blank.

A character-by-character description for a typical scan is contained in Appendix VIII (1).

5.1.1 Magnetic Tape Format

Each magnetic tape as generated by the DAS contains a series of data records (1 record per data scan), inter-record gaps, and end-of-file marks. After each data record (of 3672 characters) is an inter-record gap followed by either another data record (for the next data scan) or an end-of-file mark. An end-of-file mark is used to indicate either the physical end of data recording for the tape, or that the DAS has not been recording continuously. The DAS does not record data scans when it is being used for transducer calibration or if it is "down" because of some malfunction or other reason.

Each character which is placed on the tape consists of 8 binary digits (BITS) and a parity BIT which make up a single 9 BIT incremental frame. There are 800 frames or BITS per inch (BPI) and both the lateral and longitudinal parity is odd. The individual character BIT configurations for the magnetic tape are given in Appendix VIII (2).

5.1.2 Modem Format

All characters which are transmitted (and received) over the modem data link are continuous with no breaks or gaps between individual data scans. The only time that a break in the data flow occurs is when the DAS is recording on magnetic tape and this is represented by a complete loss of the modem transmission carrier. An individual character is transmitted serially as a string of 10 pieces of information which consist of 8 data BITS and 2 control functions. These BITS are transmitted at a rate of 300 per second and determine a character transfer rate of 30 characters per second. The individual character BIT configurations for the modem are given in Appendix VIII (3).

The only other difference in the modem and the magnetic tape format is that an extra blank is added by the modem before the label and before each data signal group of 13.

6. DATA CONVERSION AND EDITING

6.1 EDITING CONSIDERATIONS

The program TEREVIEW was developed by NBS* to operate with a raw data magnetic tape as input, a magnetic tape for output, and a disk for use as a temporary storage (scratch) media.

It was desired that maximum human operator interaction be available and that operator inputs and commands be simple and flexible. It was required that the input and output operations controlling the flow of data through TEREVIEW be operable in either an automatic or a manual, scan-by-scan mode. Input operations include the reading of the input raw data tape, format conversion, millivolt calculation, conversion of the millivolt data to engineering units, error test, data sorting and cataloging, setting of status flags, etc., while output is the recording of the information on a magnetic tape. In addition, it was necessary that the operator have access to a sufficiently large volume of converted data (covering a long data time period) in order for realistic decisions to be made as to the acceptability of the data. Of secondary importance were such functions as audible error alarms, operator input variable assignments, capability for operator termination of certain error listings, automatic carryover of calculations from one day to another, and automatic correction of certain repetitive logical errors in the raw data. Since raw unprocessed data records (approximately 250 measurements per record) were to be processed for each 5 minute time period over a two-year span or more, the execution time (time required to process a data record or scan) was of prime importance. All of the required and desired conditions for this major editing and conversion computer program were met.

The TEREVIEW program requires approximately 24000 (16 BIT) words (out of 32000 available) of core storage (memory) and has been written to operate as a library program on a Raytheon 704 mini-computer. The subroutines which comprise TEREVIEW were written in either FORTRAN-4 or in machine (symbolic) language [4,5]. If a particular subroutine was normally used enough times to justify the potential processing time savings, then the routine was written in machine language; otherwise, it was written in FORTRAN-4. As a result, the automatic execution time required to process completely (from input tape to output tape) a single (error free) scan of data is approximately 3 1/4 seconds.

6.2 INITIALIZATION AND COMMAND DECODING

When TEREVIEW is first brought into execution, all variables are initialized to their required first values, all working buffers are cleared, all constants are initialized, and a command structure table is set up to include a unique reference number and pointer set for each command.

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* For a description of the early stages of program development, including original design philosophy, see [15].

Initialization of the scratch disk file [5] and its associated time and scan reference table, if desired, must be done through an operator initialization command. A textual reminder is provided (at first command input time only) such that the operator will not forget that a decision is necessary concerning the mode of disk initialization. The operator options are to begin processing where it was terminated last, or to start processing data as if no previous processing had been done.

All operator input commands are processed by a command decode processor set of routines which return (to the calling routine) a unique integer number (1-39) for each command, a disk vector pointer, and all operator-entered arguments. Command arguments (24 maximum) are placed in an argument table in the order in which the operator entered them and the first location of the table is set to the total number of arguments entered. If the argument entered is a variable name, then the last previously defined numerical value of the variable is retrieved and placed in the table. Command legality, as well as command argument count correspondence, are checked and appropriate error codes are provided. In addition, certain commands require that arguments be related directly to each other or that they meet closely defined criteria; these conditions are also verified. Figure 8 illustrates the initialization and command decoding sequence. Once a command (with its associated arguments) is verified as acceptable, control is passed to the command processor part of the software. It is in the command processor that a final determination is made as to what has been requested by the operator.

6.3 DATA FLOW IN NORMAL OPERATION

In order to utilize the full capabilities of TEREVIEW, it is essential that the data flow through the various data handling buffers be understood. If a normal operation does in fact exist, then it would be defined as those operations that take place when two or more error-free raw data scans are converted. Two sequential scans are necessary in order to reduce properly certain ramp-type measurement data. In reality many data scans have been found to contain errors of some type, most of which are corrected by the software without any decision required (or desired) by the operator. The basic sequence of data flow is as follows.

1. One scan (record) from the raw data magnetic tape containing EBCDIC characters is read into an input buffer.

2. The first 19 EBCDIC characters of the input buffer are subdivided into groups of 4, 4, 4, 3, 2, 2 characters which are converted to 6 integer numbers and placed in a label buffer. The label buffer contains:

   Label - 3 four-digit numbers (The characters "NBS" are replaced by zeros);
   Day - 1 three-digit number;
   Hour and Minute - 1 four-digit number [(Hour x 100) + Minute)];
   Minute - 1 two-digit number.

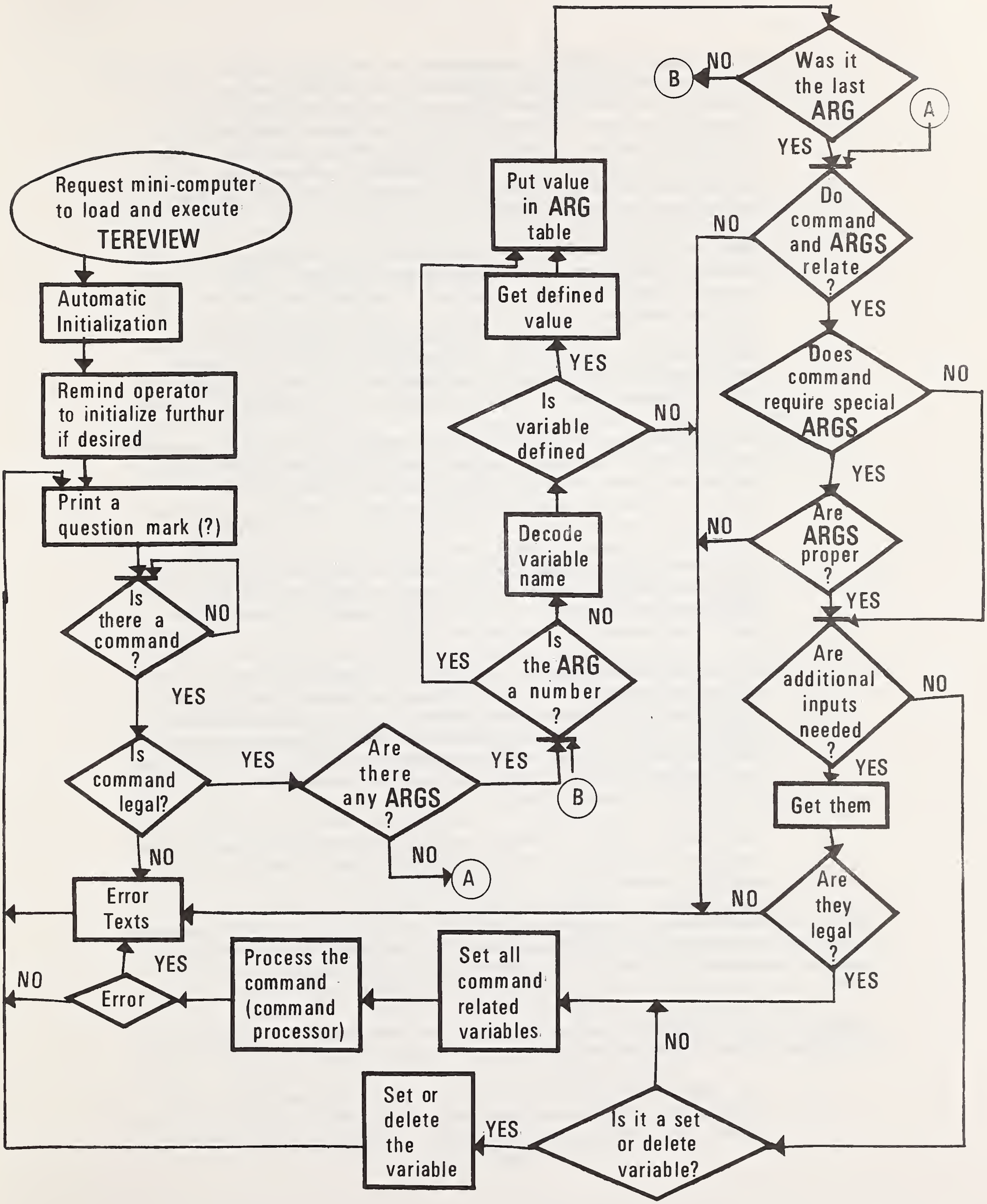

FIGURE 8. Initialization and command decoding flow diagram

3. The remaining EBCDIC characters in the input buffer array are divided into groups of 13 and are converted, one group at a time, into two integers representing DAS channel and subchannel, and one real floating point number representing millivolt value. A unique location index number is calculated using the channel and subchannel numbers, and the millivolt value is placed in a millivolt buffer location as determined by the index.

4. The millivolt buffer is transferred to a working buffer which contains the last known good millivolt values. The working buffer is only updated if the millivolts are known (by the software from previously defined criteria) to be good and if the operator has made no entries which would disallow it. Any changes to input data which are made by the operator, in reality, are made to the working buffer. The millivolt buffer is not allowed to be changed.

5. All engineering units (pressure, temperature, etc.) are calculated in an optimum, logical order using the millivolt value contained in the working buffer. The engineering units are placed in an engineering units buffer. The order of calculation of the engineering units is such that a practical minimum of duplicate calculations is required. For example; since the temperature of various points throughout the system is required in many of the calculations (for differential temperature, viscosity, density, etc.), then all temperatures are calculated first.

6. A status flag buffer is continuously updated during all of the above operations. These flags consist of one integer number per DAS channel and indicate such information as: data is good, data is bad, data was set by operator to be used in all subsequent calculations, data was set by operator to be used only in certain subsequent calculations, data was deleted by operator, etc.

7. The label, flag, millivolt, and engineering units buffers are written to a scratch disk utilizing a data time based file control system [5].

In the automatic mode, the above operations continue, if not interrupted by either the operator or the occurance of a major error requiring an operator assisted fix, until the scratch disk file is full (700 data scans).

Additional editing of the scans contained on the disk can be made at this time if the operator so desires.

8. The engineering units output tape is next created by transferring the data scans (one scan per record) from the scratch disk file to the output tape unit. The only data difference

in an output tape record and a scratch disk scan is that the integer label information is deleted (it is contained, along with other processing status information, within the first nine locations of all buffers) and certain checksum calculations are made.

If for some reason the disk file is not available for use, a program called TEEDITOR is available which performs the same functions as TEREVIEW except that the engineering units output tape is created at step 7 above. The disk file would not be available for use at times of malfunction of either the disk hardware, disk controller, or the computer direct memory access capability.

6.4 CHARACTER GROUP CONVERSION

All EBCDIC characters representing numerical digits contained on a raw data input magnetic tape must be broken down into their respective integer numbers before they are computer usable. Once the individual digits are obtained, these must be combined logically into computer numbers representing 1 or more digits. Useful computerized processing can take place only after the above is completed.

6.5 ENGINEERING UNIT CONVERSION

After character group conversion, each measurement channel is identified by its DAS channel number (and its assigned NBS number) and is converted to a real millivolt number which is placed in a holding buffer. Each measurement channel is further categorized into one of seventeen types in which there is also one and only one reference value. Each category type has associated with it a unique engineering unit conversion routine and each reference channel number (within a specific type family) has associated with it a particular set of calibration constants. A sub-subroutine is used to set up the NBS number, type of measurement, and reference value (when given the DAS channel). The subroutine which performs these functions is called LOCTED. Engineering unit conversions take place according to the type of measurement. A brief discussion of the equations applied and the name of the conversion routines which are used is contained below.

During the initial TEREVIEW planning and transducer calibration phases of the Total Energy program, the metric system of measurement (SI) was just beginning to be used in the United States. As a consequence, all transducer calibrations were received by NBS and all software was developed by NBS in English units. To convert the TEREVIEW software to the SI system would have represented a major effort. The derivations and textual discussions which follow are therefore as originally done at NBS and are not described in the SI system (except where appropriate). If the reader desires further information concerning the SI measurement system, reference 6 has been found to be appropriate.

6.5.1 Non-Existing Measurement (Type 1):

Since the DAS is designed to take measurement data sequentially from all channels beginning with the first programmed channel and ending with the last, there are necessarily some channels which do not contain measurements. In addition, there are some channels which are reserved as spares to be used if they are required for future system analysis purposes. When a type 1 measurement is encountered, no further processing takes place; however, the millivolt value for the channel is maintained for possible future reference.

6.5.2 Pressure (Type 2): PRESS1*

There are two kinds of pressure measurement. The first is for measuring liquid pressure such as system water (pump discharge) and lubrication oil for an individual engine. The second is for measuring exhaust gas back pressures from individual engines.

For the first kind; the measured voltage is calibrated to be between 2 and 10 volts while the pressure varies from 0 to 100 pounds per square inch (PSI). The linear equation for the pressure is:

$$p = \frac{(M - 2000)}{80}, \qquad (1)$$

where

M is the measured voltage in millivolts (mv), and
p is the pressure in PSI.

For the second kind, the measured voltage is calibrated to be between 2 and 10 volts while the pressure varies from 0 to 30 inches of water column. The linear equation is

$$h = 0.00375\ (M - 2000), \qquad (2)$$

where

M is the measured value in mv, and
h is the pressure in inches of water.

The gas pressure in PSI is

$$p = \left(\frac{h}{12}\right)(\gamma), \qquad (3)$$

* PRESS1 is the name of the subroutine which converts pressure (type 2) data to engineering units.

where

γ is the water density in (lb/ft^3), which is taken as 62.3664 lb/ft^3 (at 60°F).

By combining (2) and (3) and inserting the value for γ, the pressure at 60°F will be

$$p = 0.0194895\ (M - 2000)\ lb/ft^2. \tag{4}$$

The constant volume relationship for a perfect gas as given in reference 7 is:

$$p_2 = \frac{p_1}{T_1}\,(T_2), \tag{5}$$

where

p_1 is pressure at temperature T_1,
p_2 is pressure at temperature T_2,
T_1 and T_2 are absolute temperatures,

$$\text{i.e., } T = (459.63 + T°F). \tag{6}$$

Therefore, by combining (4), (5), and (6), the equation for the gas pressure being measured is

$$p = 3.75\ (M - 2000)\ (459.63 + T°F)\ (10^{-5}). \tag{7}$$

6.5.3 Venturi (Type 3): VENTRI

Flow rate is measured at many points throughout the total energy system by venturis. Their basic equation as given in Reference 8 is:

$$W_c = C\alpha\gamma\sqrt{\frac{1}{1 - \beta^4}}\ \sqrt{2g_L h}, \tag{8}$$

$$\text{with}\quad \alpha = \frac{\pi}{4}\left(\frac{d}{12}\right)^2 F_a, \tag{9}$$

$$\beta = \frac{d}{D}, \tag{10}$$

$$h = \frac{\Delta P}{\gamma}, \tag{11}$$

where

W_c = the flow rate of fluid in lb/sec,
C = the coefficient of discharge,
γ = specific weight of fluid in lb/ft^3,
g_L = gravitational constant at site = 32.16 ft/sec^2 at latitude 40°45',
d = venturi throat diameter in inches,
D = internal pipe diameter in inches,
Δp = differential pressure in lb/ft^2, and
F_a = bore temperature correction factor.

By combining equations (8), (9) and (11) we obtain

$$Wc = C \frac{\pi}{4} \left(\frac{d^2}{12} \right) Fa \; (\alpha \gamma) \sqrt{\frac{1}{1 - \beta^4}} \sqrt{2g_L \frac{\Delta P}{\gamma}}. \qquad (12)$$

The pipe Reynolds number as given in references 8 and 9:

$$R_D = \frac{22752}{D} \left(\frac{Wc}{\mu cp} \right) \qquad (13)$$

where

cp = the line fluid viscosity in centipoises.

The expression representing coefficient of discharge (C) as a function of pipe Reynolds number (R_D) is expressed as

$$C = a + \frac{b}{R_D}, \qquad (14)$$

where a and b are constants which are obtained by laboratory tests for each venturi.

Let

$$c_a = \frac{\pi \sqrt{2gL}}{22752 \; (12)^2} = 7.690279 \times 10^{-6}, \qquad (15)$$

$$c_b = \frac{\pi \sqrt{2gL}}{4 \; (12)^2} = 4.374230 \times 10^{-2}, \qquad (16)$$

$$c_c = \frac{\pi \, d^2}{\sqrt{1 - \beta^4}}, \qquad (17)$$

$$C_d = \frac{d^2 D}{\sqrt{1 - \beta^4}}. \qquad (18)$$

By combining equations (12), (13), and (14) and by substitution of definitions (15) through (18), the following is obtained:

$$W_c = C_e \pm \sqrt{C_e^2 + C_f}, \qquad (19)$$

where

$$C_e = \frac{a}{2} \; C_b \; C_c \; F_a \sqrt{\gamma \Delta p}, \qquad (20)$$

$$C_f = b \; C_a \; C_d \; \mu_{cp} \; F_a \sqrt{\gamma \Delta p}. \qquad (21)$$

Classification of terms necessary to solve equation (19) is as follows:

true constants: C_a and C_b;

venturi specific constants: a, b, C_c, and C_d; and

system variables: μ_{cp}, γ, F_a, and Δp.

The specific weight of water (γ) as a function of temperature (reference 10) can be plotted and a curve fit to the resulting points. The resulting expression is:

$$\gamma = A + B(T°F) + C(T°F)^2 + D(T°F)^3 + E(T°F)^4, \qquad (22)$$

where

$A = 62.21161$,
$B = 1.198719 \times 10^{-2}$,
$C = -1.820609 \times 10^{-4}$,
$D = 4.684719 \times 10^{-7}$,
$E = -6.036029 \times 10^{-10}$.

The viscosity, $\mu_{cp} = 0.029e^{\left(\frac{510}{T°K - 150}\right)}$, (23)

where T°K is the temperature in degree Kelvin (reference 11), or

$$\mu_{cp} = 0.029e^{\left(\frac{918}{T°F + 189.688}\right)}. \qquad (24)$$

Each differential pressure transducer was calibrated to produce a voltage drop across a 500 Ω resistor. The voltage range is 2 to 10 volts, corresponding to a differential pressure of 0 to 150 inches water column. The differential pressure is determined by

$$h = 0.01875\ (m - 2000)\ \text{in.},$$

$$\text{or} \qquad h = 1.5625 \times 10^{-3}\ (M - 2000)\ \text{ft}, \tag{25}$$

where M is the measured voltage across the 500 Ω resistor in mv. The transducer was also calibrated at 60°F with γ =62.3664 lb/ft^3, therefore

$$\Delta p = .0974475\ (M - 2000)\ \text{lb/ft}^2. \tag{26}$$

The venturi temperature correction factor, F_a, can be calculated by a linear approximation as follows:

$$\frac{(F_a - 1)}{(T - T_c)} = \frac{(F_a' - 1)}{(T' - T_c)} . \tag{27}$$

Then

$$F_a = 1 + (F_a' - 1)\ \frac{(T - T_c)}{(T' - T_c)}, \tag{28}$$

where F_a' is the temperature correction factor at temperature T',
F_a is the temperature correction factor at temperature T,
T_c is the temperature when F_a = 1.

In order to calculate F_a for each venturi, T_c must be determined first. Once T_c is known, a set of known calibrations, F_a' and T', is used to obtain F_a by equation (28). The calculation of T_c is based on the Flow Calibration Report (reference 8) as follows:

Two sets of temperatures and corrections are needed in order to determine T_c. One set is at operation condition, T_{op} and F_{op}, given by the Flow Data Calibration Sheet for each venturi. Another set is calculated from actual flow calibrations. The velocity of approach factor, F, given by the physical dimensions of an individual venturi, corresponds to the particular temperature T_1. T_1 equals the temperature for which the discharge coefficient has an approximate zero percentage deviation from the fitted expression over the calibrated range. By using these values and equation (27) to solve for T_c, we have

$$T_c = \frac{(BT_1 - T_{op})}{(B - 1)}, \tag{29}$$

where

$$B = \frac{(F_{op} - 1)}{(F - 1)} \quad . \tag{30}$$

Therefore, equation 28 becomes

$$F_a = 1 + CFF(T_{op} - T_c), \tag{31}$$

where

$$CFF = \frac{(F_{op} - 1)}{(T_{op} - T_c)} = \frac{(F - 1)}{(T_1 - T_c)} \quad . \tag{32}$$

F_a can now be determined through the use of the venturi specific constants CFF and T_c when the system temperature T°F is known.

The actual flow rate calculation for a venturi is performed by the subroutine VENTRI as follows.

1. Calculate $\Delta p = h$ using equation (25).
2. Calculate γ using the subroutine DENSTY (which uses equation 22).
3. Calculate μ_{cp} using the subroutine VISCOS (which uses equation 24).
4. Calculate F_a using equation (31).
5. Calculate C_e and C_f using equations (20) and (21).
6. Calculate the flow rate, W_c in lb/sec using equation (19).
7. Convert W_c to lb/min.

6.5.4 Integrated Pulse Type (Types 4, 9, and 13): INTEGR

Several types of measurement are being made which depend on the change in the value of the measurement from one scan to the next. In all cases of this type, the primary parameter (which is a rate) produces a series of pulses which are electronically counted (integrated) and then presented to the DAS as a voltage level which represents the number of pulses which have currently been counted. Since an infinitely large voltage would be obtained if this process were allowed to continue indefinitely, it is necessary to reset to a zero value and start over when the counters reach their limiting value. The parameters which are being measured through the use of this technique are fuel flow rate (turbine meters with pulses representing gallons), electrical power (kilowatt hour meters with pulses representing kilowatts), and time (frequency with pulses representing minutes). In order to calculate accurately the number of pulses which were counted during a given time period, it is necessary to know if the counter reset to zero during the period. It is also necessary to be absolutely certain that the counter only reset once (if at all). This condition is met by dividing the number of pulses presented to the counter by a power of two such that no reset will occur during a time period less than or equal to the DAS scan time when the physical parameter being measured is at its maximum value. This division is controlled by the semi-permanent manual setting of a thumbwheel. A representation of the process is contained in Figure 10.

For a given thumbwheel setting, N, and a physical parameter count output of C, the counters will contain a value, C_N, of

$$C_N = \frac{C}{2^N} \quad . \tag{33}$$

Since the digital to analog converter (DAC) is electronically wired to the most significant bits of the counter, the Digital Count is effectively divided by 32 (or 2^5). Therefore, the input to the DAC, C_D is equivalent to

$$C_D = \frac{C_N}{2^5} = \frac{C}{2^{N+5}} \quad . \tag{34}$$

The voltage output of the DAC (and therefore, the voltage which will be recorded by the DAS) is

$$M = \frac{M_{max}\, C_D}{256} \,, \tag{35}$$

where

M = the voltage as recorded by the DAS,

M_{max} = the full scale voltage output of the DAC.

Since we are converting an analog step to a digital value, the value

$$C_D = \frac{256\ M}{M_{max}} \tag{36}$$

must be taken as an integer;

i.e., $C_{D_I} = \left(\frac{256\ M}{M_{max}}\right)$ Forced to be integer between 0 and 255 (37)

Applying (37) to (34) produces the pulse count integration as a function of DAS voltage:

$$C = C_{DI}\ (2^{N+5}). \tag{38}$$

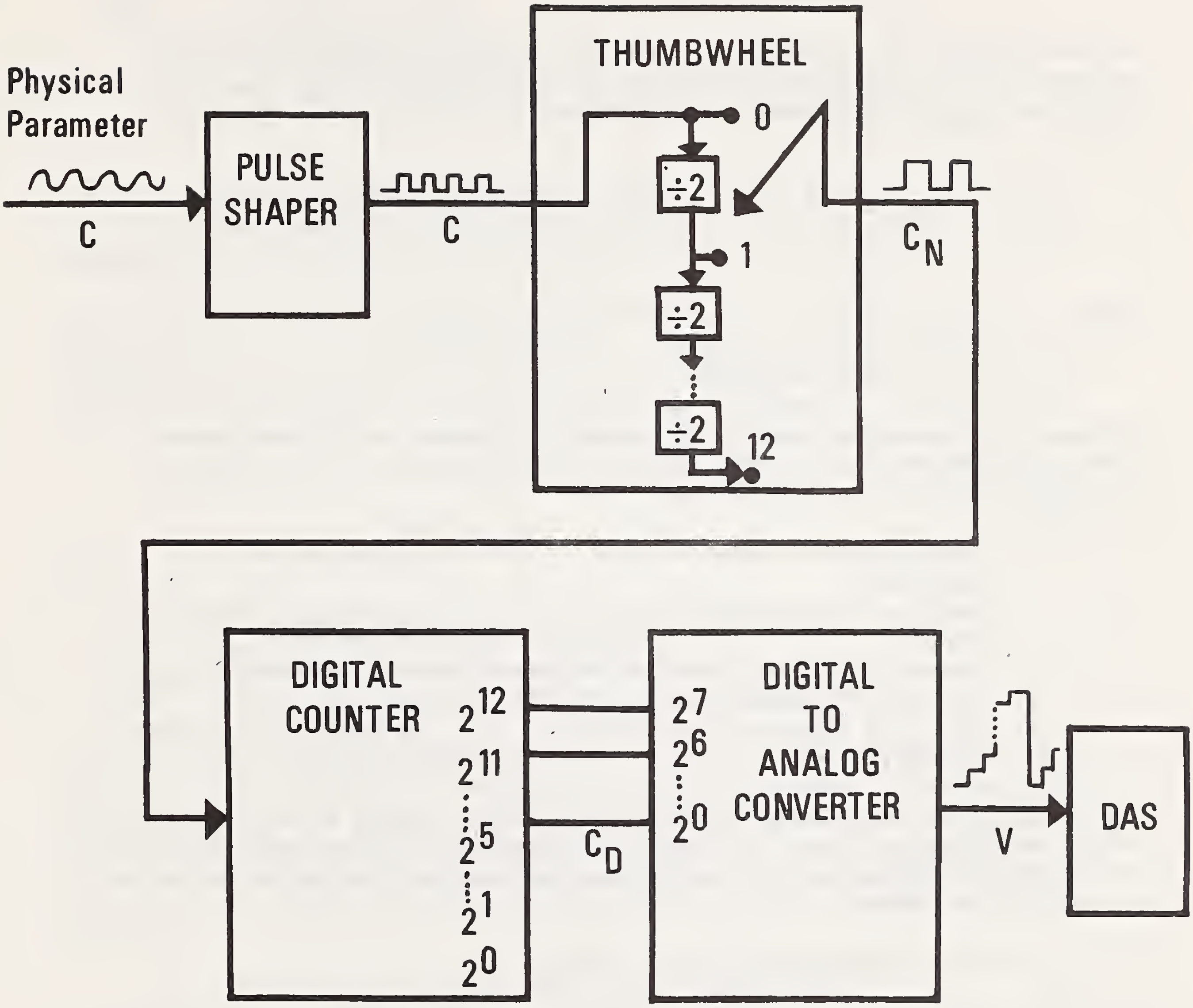

Figure 9. Pulse Counter Sequence

During any given time period, the integration of the number of pulses over time is

$$C_I = C_2 - C_1. \tag{39}$$

If the quantity C_I is negative, then the digital counter reached its maximum (and reset) during the time period between the two samples. The value C_{I_R} in this case would then be

$$C_{I_R} = C_2 - C_1 + ((2^{12})\ (2)\ (2^N)), \text{ or}$$

$$C_{I_R} = C_1 + R, \tag{40}$$

where

$$R = 8192(2^N). \tag{41}$$

Between two sequential scans, the number of pulses which were output from the instrument measuring the physical parameter is calculated by the INTEGR subroutine as follows.

1. Calculate the current count, $C_2 = C$ using equations (37) and (38).
2. Retrieve the previous count, C_1 from a count save buffer array.
3. Update the count save buffer array with the current count, C_1.
4. Calculate C_I using equation (39).
5. If C_I is negative, calculate $C_I = C_{I_R}$ using equations (40) and (41).

The value C_I is calculated for every measurement which is of type 4 (turbine), 9 (kilowatt), and 13 (time). This value of C_I is then utilized (by INTEGR) to calculate the actual engineering unit value of the parameter being measured.

6.5.4.1 Turbine meters (TYPE 4): INTEGR

For each turbine meter installed in the system, there is a corresponding family of curves consisting of K factor versus total flow [12, 13]. K factor is typically expressed in pulses per gallon, and is also a function of flow rate and fluid viscosity. The viscosity of #2 fuel oil, μ_o is a function of temperature. For the normal fuel oil system operating temperature range, viscosity can be approximated as

$$\mu_o = A + BT + CT^2 + DT^3 + ET^4, \tag{42}$$

where

μ_o = the viscosity of #2 fuel oil in centipoises,
A = -4.764022,
B = 6.907599×10^{-1},
C = -1.450071×10^{-2},
D = 1.159411×10^{-4},
E = -3.29042×10^{-7}, and
T = the temperature of the fuel oil in degrees Fahrenheit.

Equation (42) was obtained by using a least-squares fit (on laboratory test data) over the range of temperatures from 70°F to 110°F. The standard error of estimate is .0038 centipoises.

The flow of the fuel oil through the turbine will cause a series of pulses to be output to the DAS counters. Knowing the time between DAS scans and the total number of pulses counted between the scans, an average pulse frequency can be determined. This frequency is proportional to the average flow rate over the time period between scans.

$$H_z = \frac{C_I}{TIME}, \qquad (43)$$

where

H_z = frequency in pulses per minute,
C_I = total pulses as determined in section 6.5.4,
TIME = time over which C_I was determined (in minutes).

K factor can be expressed as a function of H_z/μ_o. The original factory (and additional laboratory) calibration points (K factor) were tabulated versus corresponding H_z/μ_o values and a series of equations were fit to the tabulated data points. Through examination of the standard error of estimates obtained, and from considerations for consistency in calculation from one turbine meter to another, the following equation was obtained:

$$K = A + BV + CV^2 + DV^3 + EV^4 + FV^5 + GV^6 + HV^7, \qquad (44)$$

where

K = K factor in pulses per gallon,
V = H_z/μ_o, (45)
A thru H = a set of unique constants for each turbine meter.

The total flow through the turbine meter during the time over which the turbine output pulses were counted is

$$\text{gallons} = \frac{C_I}{K} , \qquad (46)$$

and the average flow rate is

$$\text{GPM} = \frac{\text{gallons}}{\text{time}} . \qquad (47)$$

The subroutine INTEGR calculates the average flow rate of fuel oil through a turbine as follows.

1. C_I is calculated as described in section 6.5.4.
2. The time between scans is known.
3. The fuel oil temperature, T has been determined previously by another subroutine (DEGRSF).
4. μ_o is calculated using equation (42).
5. H_z is calculated using equation (43).
6. V is calculated using equation (45).
7. K is calculated using equation (44).
8. The average flow rate in GPM is calculated using equations (46) and (47).

6.5.4.2 Kilowatt (Type 9): INTEGR

The kilowatt transducers measure instantaneous electrical power and output a voltage which is proportional to it. This voltage is then input to a voltage to frequency converter, the output of which is input to the integrating counters described previously. Therefore,

$$\text{KW} = \frac{C_1\ (A)}{\text{Time}} , \qquad (48)$$

where

KW = kilowatts produced during the time period,
C_I = total counts over time,
A = a unique constant for each kilowatt transducer in $\frac{\text{kilowatt minutes}}{\text{pulse}}$ which has been previously obtained from laboratory calibration, and
Time = the time in minutes over which C_I was obtained.

6.5.4.3 Time (Type 13): INTEGR

Time measurements are made by counting the voltage (frequency) pulses which are output as a result of the normal operation of the system (or subsystem) for which operation time is desired. This frequency is 60 Hz (pulses per second). Therefore,

$$\text{Time} = \frac{C_I}{60(60)} = \frac{C_I}{3600} , \qquad (49)$$

where

Time = time in minutes, and
C_I = total 60 Hz pulses counted.

6.5.5 Special (Type 5): SPECL1

Several of the more important (for analysis purposes) kilowatt transducers described in section 6.5.4.2 have their outputs (voltage vs instantaneous electrical power) measured directly. These measurements serve as a backup (and check) for the voltage-to-frequency conversion and counter technique previously described. Of course it must be assumed that the instantaneous power being produced or used (at the time of the sample) is representative of the average electrical power produced during the time between successive samples. The instantaneous power is calculated by

$$KW_I = M(A), \tag{50}$$

where

KW_I = instantaneous power in kilowatts,
M = the measured millivolts, and
A = the kilowatt transducer calibration constant in kilowatts per millivolt.

6.5.6 Temperatures

6.5.6.1 T-Type (Type 6): DEGRSF

Measurement data obtained from all copper/constantan thermocouples referenced to 0°C (T-Type) are converted to engineering units by the use of the following equation [14]:

$$T°C = AM^4 + BM^3 + CM^2 + DM + E, \tag{51}$$

where

A = -3.550090×10^{-4},
B = 2.218164×10^{-2},
C = -6.195487×10^{-1},
D = 25.66130,
E = 0,
M = the measured millivolts, and
T°C = temperature in degrees Celsius.

Since most of the subsequent total energy work requiring temperature as a variable is expressed as degrees Fahrenheit (T°F), the value obtained above is converted to T°F using the equation:

$$T°F = T°C\,(1.8) + 32 \quad . \tag{52}$$

6.5.6.2 J-Type (Type 7): DEGRSF

Measurement data obtained from all iron/constantan thermocouples referenced to 0°C (J-Type) are converted to degrees Fahrenheit in the same manner as shown above for T-Type, the only difference being in the value of the constants used. The constants are a function of temperature range as shown in the table below.

constant	$0 < T°F < 752$ ($M < 21.84588$)	$752 < T°F$ ($21.84588 < M$)
A	-1.328057×10^{-4}	9.936448×10^{-5}
B	8.368396×10^{-3}	-1.398701×10^{-2}
C	-1.854260×10^{-1}	6.525454×10^{-1}
D	19.75095	5.445382
E	0	92.60835 .

6.5.6.3 Differential (Type 8): DEGDLF

Differential temperatures are measured between two points through the use of multi-junction copper/constantan thermopiles. Through this technique, several thermocouples are electrically connected in series such that the measured voltage is an integer multiple of the value that would have been obtained if only one set of junctions were used. This higher measured value is desired in order for the DAS to be operating in its most accurate region. An actual temperature is also being measured at one end point in the differential thermopile. This actual temperature serves as a reference and is coded (in the software) as being either the normally high or normally low side of the differential measurement. The actual differential temperature is calculated as follows.

1. T_R is calculated using equations (51) and (52) based on the reference temperature millivolt, M_R.

2. M_2 is calculated using $M_2 = M_R + \frac{M\,(J)}{N}$, (53)

   where

   M = measured millivolts for the differential temperature,
   N = the number of junctions in the thermopile,
   J = +1 if the reference is normally low,
   -1 if the reference is normally high.

3. T is calculated using equations (51) and (52) and M_2.

4. The differential temperature, ΔT is then

$$\Delta T = (T_R - T)\ J. \qquad (54)$$

6.5.7 Events (Type 10): EVENTS

Events are ON/OFF type measurements and are used as indicators for certain engine parameters, system malfunctions, and other plant alarm conditions. There are six event indicators compressed into each DAS event channel. The six events are electrically connected to an eight-bit digital-to-analog converter (DAC) as shown logically in figure 10. The output of the DAC would normally be 0 to 5 volts; however, note that the two least significant inputs are electrically set to a logical 0 (off). Thus, the least significant (logically) event has a binary weight of 4. Each step of the DAS output voltage will correspond to

$$\frac{5000}{256 - 1}\ (4) = 78.431 \text{ millivolts; and}$$

if a DAC drift of no more than two logical input bits (39.216 millivolts output) is assumed; then a number, I, from 0 to 63 representing all of the 64 input event combinations can be determined. This is accomplished as follows:

$$I + \left(\frac{M + 39.216}{78.431}\right)_{\substack{\text{integer}\\ \text{part of}}} -1 , \qquad (55)$$

where

M = the measured analog millivolts for the event channel I, forced by the software to be within the range of 0 to 63.

A simple binary decomposition is next performed on I such that the number carried forward for subsequent use is an integer power of 10 with each digit representing the status of a particular event. This number varies from 0 to 111111 and is calculated as illustrated in Figure 11.

6.5.8 Voltage (Type 12): VOLTS1

A.C. voltage is measured through the use of potential transformers. The output of the potential transformer is rectified such that a D.C. voltage is presented to the DAS. The equation which is used to reconstruct the measured voltage is:

$$V = M(A), \qquad (56)$$

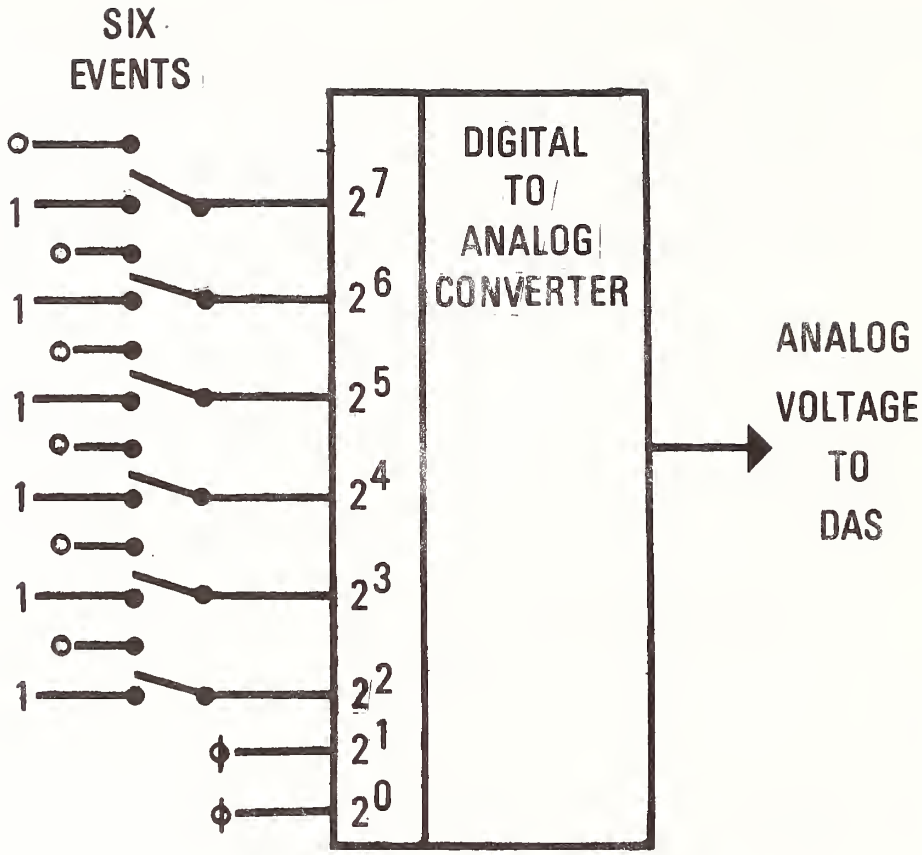

FIGURE 10. Logical Connection of event (on/off) measurements

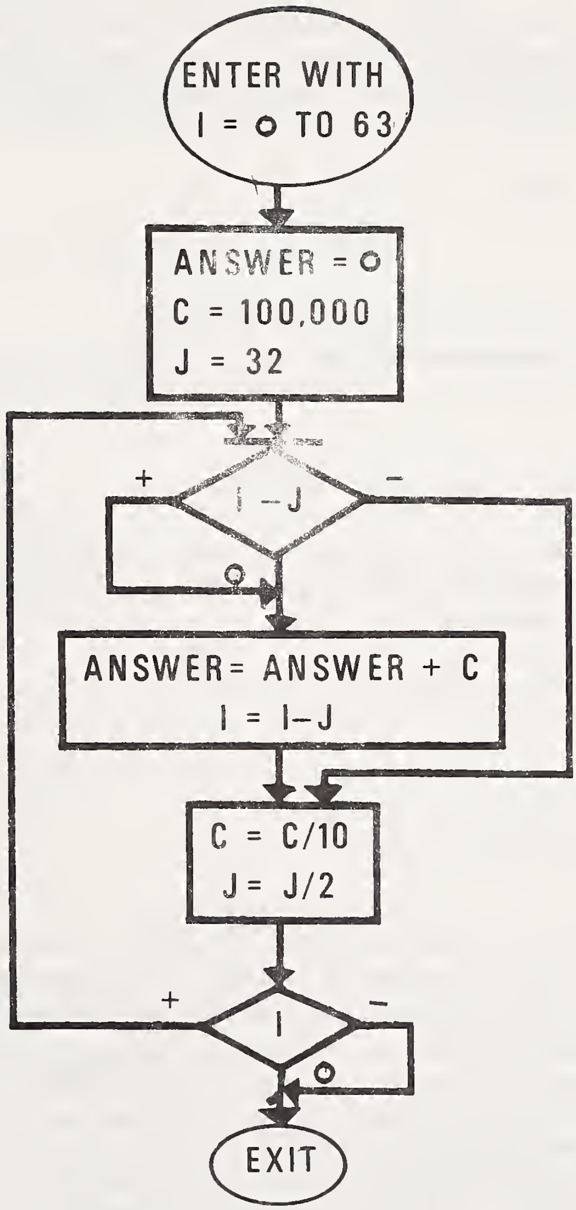

FIGURE 11. Logical diagram of the binary decomposition of a number representing six events

where

V = the AC voltage measured,
M = the millivolts as recorded by the DAS,
A = the channel calibration constant in volts AC per millivolt DC.

6.5.9 Frequency (Type 14): FREQHZ

The Total Energy Plant output frequency is measured at each scan time by the use of a transducer connected to the main power bus. The characteristics of the frequency measurement system are such that the following equation is valid:

$$HZ = 59 + M(A), \tag{57}$$

where

HZ = the system frequency in hertz,
M = the transducer output in millivolts,
A = the transducer calibration constant in HZ per millivolt.

6.5.10 Power Factor (Type 15): PWRFCT

Power factor (the ratio of the active power to the apparent power) is being measured at the main plant bus. The conversion equation for the power factor transducer is:

$$PF = (1000 - M) \times 10^{-4}, \tag{58}$$

where

PF = power factor (0 to 1),
M = measured millivolts.

6.5.11 Weather Station (Type 16): WEASTA

A weather station is installed at the Total Energy site and is instrumented to measure wind direction and velocity, direct and indirect solar radiation, barometric pressure, relative humidity, ambient temperature, and weather station electronics cabinet temperature. Since the weather station instrumentation and associated calibration factors represent a special category which generally does not fit any other particular measurement conversion technique, all of the measurements are converted within one subroutine. The linear equation used for the conversion from DAS measured millivolts to the particular weather station measured parameter along with the calibration constant for each measurement is:

$$ANS = M(A), \tag{59}$$

where

ANS = the engineering unit answer as shown below,
M = the measured millivolts,
A = the particular parameter calibration constant as shown below.

1. Direct Solar radiation:
ANS = calories per square centimeter per minute,
A = 1.329787×10^{-4}.

2. Indirect Solar radiation:
ANS = calories per square centimeter per minute,
A = 1.25×10^{-4}.

3. Wind direction:
ANS = compass heading in degrees (0 - 360°),
A = .1.

4. Wind Velocity:
ANS = miles per hour,
A = .01.

5. Barometric pressure:
ANS = inches of mercury,
A = .01.

6. Relative Humidity:
ANS = percent,
A = .01.

7. Temperature:
ANS = degrees Fahrenheit,
A = .01.

6.5.12 Deleted Measurements

Measurement types which were originally planned and have since been deleted are handled the same as a Type 1 (non-existing measurements). Currently, these are represented by Types 11 and 17.

6.6 SUBROUTINE CLASSIFICATION

All computer subroutines used in the TEREVIEW program can be classified by the type of function they perform. These functions are input or output, bookkeeping, conversion, control, and support. Appendix IX contains an alphabetical listing of each subroutine classified by type, along with a brief description of what it does.

6.7 TEREVIEW COMMANDS

Once TEREVIEW has been placed in operation, all requests for an operator command input will be solicited (by the program) with a question mark (?). The operator then has the option of selecting any one of 39 commands to be executed. A command is entered by the operator preceded by a line feed and followed by a carriage return. All commands consist of two alphanumeric characters followed by a variable length argument string. Commands and arguments are separated by either a comma or a space (or spaces). Two or more commas in a row are interpreted as containing a zero between them. Arguments can either be entered as integer numbers or as a one or two alphanumeric character name which has been previously assigned a value. Appendix X contains a listing of all TEREVIEW commands.

6.8 ERROR PROCESSING

For the purposes of TEREVIEW, all errors have been classified into two categories: those not requiring operator assistance and those that do. Detected errors which do not require operator assistance are either simple magnetic-tape-related mechanical or electronic errors which are logically correctable by the software (such as extra or missing characters, parity, intermittent record gaps, etc.), abnormalities that are known before conversions take place (such as timing errors) for which the operator has made provisions by the setting of appropriate flags, and certain minor special EBCDIC character errors which are either not used in the calculation of data or whose value is known. If an error is detected which does not require operator interaction, it is corrected by the software and, in most cases, an error message is output to the operator; however, the overall program flow will continue normally.

If an error is detected and no software provision has been made to fix it, an error message is provided to the operator followed by a question mark (?). It is then left to the operator to provide the necessary commands to either fix the error or delete the data.

In general, the error messages which are output by TEREVIEW have the following format:

```
**ERROR-NAME TYPE () "I" "J" "K" "L" "M" "HHHH"
```

Where "HHHH" is normally the hexidecimal representation of "M" and is used in those few cases where bit value or position are required in order to evaluate an error and determine its subsequent fix. "NAME" indicates the subroutine which detected the error.

Appendix XI contains a list of TEREVIEW error messages.

6.9 OUTPUT DATA TAPE

The output data tape from TEREVIEW contains the following information for each scan of data processed.

1. Label information including the data time.
2. A set of flag numbers, one flag per data point, which indicate both the software and operator assessment of quality of the respective data.
3. The input millivolt values, one value per DAS channel.
4. The converted engineering units.

The output data tape is utilized in the subsequent calculation of those variables requiring two or more data points and is the primary data set from which all further processing ultimately originates.

6.10 ADDITIONAL DOCUMENTATION AND ORIGINAL DESIGN PHILOSOPHY

For the interested reader, reference [15] contains additional documentation of TEREVIEW, including a discussion of the original design philosophy. Certain major subroutines are discussed in detail with respect to their original design, implementation, and interaction. It also contains the original listings for many of the subroutines which are given in Appendix IX.

References

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9. Flow of Fluids through Valves, Fittings, and Pipe; Crane Technical Paper No. 410, Crane Co., 4100 S. Kedzie Avenue, Chicago, Ill. 60632

10. International Critical Tables of Numerical Data, Volume III.

11. A.A. Miller, "Free Volume" and the Viscosity of Liquid Water, The Journal of Chemical Physics, Volume 38, Number 7, April 1, 1963, page 1568.

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APPENDICES

I. TYPICAL MAGNETIC TAPE SCAN - CHARACTER BY CHARACTER

```
        143093001977143093000200V+010225003 00V+156645004 00V+061995
00500V+060625006 00V+015055007 00V+034215008 00V+029965009 00V-001315
00201V+000335003 01V+084655004 01V+022635005 01V+022605006 01V+021555
00701V+021855008 01V+021495009 01V+086175002 02V+076615003 02V+113665
00402V+006165005 02V-000015006 02V+001595007 02V-003565008 02V+002435
00902V+094005002 03V+091475003 03V+057305004 03V+044005005 03V-000005
00603V+055795007 03V+020625008 03V+033145009 03V+021135002 04V+028895
00304V-004125004 04V-007335005 04V+030535006 04V+016355007 04V+034305
00804V+036855009 04V+000915002 05V+004245003 05V+020975004 05V+036685
00505V+111685006 05V+038865007 05V+053415008 05V+032955009 05V+032295
00206V+029265003 06V+028085004 06V+047685005 06V+063385006 06V+047465
00706V+040255008 06V+044325009 06V+022545002 07V+023385003 07V+022735
00407V+001415005 07V+000015006 07V+039025007 07V+039525008 07V+029125
00907V+061975002 08V+057545003 08V+027575004 08V+040975005 08V+000015
00608V+059115007 08V+061415008 08V+058735009 08V+073075002 09V+071135
00309V-002685004 09V+012775005 09V+000015006 09V+004405007 09V-000075
00809V-000205009 09V+005895002 10V+013155003 10V+026335004 10V+004765
00510V-150755006 10V+038015007 10V+013205008 10V+004545009 10V+039295
00211V+036535003 11V+009695004 11V+015455005 11V-150735006 11V+038215
00711V+038825008 11V+038275009 11V+000415002 12V+004605003 12V-000115
00412V+008285005 12V-150715006 12V-000065007 12V+038675008 12V+038115
00912V+000415002 13V+001095003 13V-000115004 13V-000015005 13V-150705
00613V-000065007 13V-000085008 13V-000315009 13V+000415010    V+075445
011   V+020595012   V+066015013   V+018105014   V+035625015   V+064545
016   V+058165017   V+054595018   V+028725019   V+048035020   V+072855
021   V+055865022   V+058515023   V+038315024   V+042415025   V+043075
026   V+065725027   V+020465028   V+042755029   V+026505030   V+035365
031   V+009455032   V+029265033   V+010165034   V+005515035   V+029895
036   V+005245037   V+028715038   V+030225039   V+011545040   V+029485
041   V+013285042   V-000185043   V+023485044   V-000445045   V+031965
046   V+012845047   V+013455048   V+007035049   V-000245050   M+038932
051   M+038842052   M+040552053   M+038522054   M+041592055   M+043962
056   M+040392057   M+039002058   M+040232059   M+038912060   M+038942
061   M+005362062   M+003622063   M+004602064   M+005262065   M+006922
066   M+012062067   M+012072068   M+012122069   M+012112070   M+013712
071   M+012202072   M-001562073   M+035742074   M+014542075   M+014512
076   M+014372077   M+014902078   M+013072079   M+013262080   M+077622
081   M+040832082   M+030602083   M+180292084   M+031232085   M+117202
086   M-001532087   M+024162088   M+002682089   M+018732090   M-002602
091   M+021262092   M-000132093   M+000852094   M+013452095   M+082292
096   M-006632097   M+056032098   M+017692099   M+004902100   M-034922
101   M+013702102   M+007462103   M+128932104   M+017522105   M+026042
106   M-001102107   M+023582108   M+000342109   M-000012110   V+043405
111   V+000515112   V+004115113   V+000005114   V+011335115   V+042465
116   V+040055117   V+006525118   V+031165119   V+028655120   V+028665
121   V+028655122   V+028655123   V+028645124   V+028635125   V+028635
126   V+028625127   V+028625128   V+028625129   V+028615130   V+028605
131   V+028605132   V+028605133   V+028605134   V+028595135   V+028595
136   V+028585137   V+028585138   V+028585139   V+028585140   V+043385
141   V+093805142   V+075785143   V+058805144   V+045555145   V+035455
146   V+030985147   V+025355148   V+024845149   V+024745150   V+024735
151   V+024735152   V+024735153   V+024735154   V+024745155   V+024745
156   V+024735157   V+024745158   V+024745159   V+024745160   V+004966
161   V+000046162   V+000006163   V+004726164   V+000006165   V-000016
166   V-000006167   V-000006168   V-000016169   V-000006170   V-000043
171   V-000043172   V+156474173   V+037085174   V+071624175   V+068404
176   V+066224177   V+0303251 7800V+024805
```

National Bureau of Standards
Jersey City Total Energy System
Data Acquisition List
Revision 9/19/77

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
		SPECIAL CATEGORY	
HEADING	100	7 characters in the heading of each scan contain clock data: date (1-365) and time (0-24 hours plus minutes)	
172	102	Time generated by plant	5 minutes (2.82V/5 min)
173	110	Eng. run time EG 1	5 minutes (2.80V/5 min) when engine is on
174	111	Eng. run time EG 2	
177	130	Power factor on CEB bus	.5 lag - 1.0 (+5.0V - 0.0V)
178	141	Frequency of total plant output	59-61 Hz (0-5.0V)
		WEATHER STATION - Remote 005	
005-00	148	Direct solar radiation	Clear Sky (7.5V)
005-01	149	Indirect solar radiation	Bright Sky (1.6V)
008-08	150	Wind Direction	0-360 deg (0-3.6V)
008-09	151	Wind velocity	0-120 MPH (0-12V)
005-04	200	Outdoor baro. pressure	27-31 inches Hg (2.7 - 3.1V)
005-05	710	Outdoor temperature	-20° to 120°F (-2.0 to 12.0V DC)
005-06	712	Outdoor humidity	0 to 100% (0 to 10V DC)
005-07	714	Data cabinet ambient temperature	

PRESSURE CATEGORY (#'s 200 to 299)

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
010	202	CEB primary hot water system pressure, at pump outlet	0 to 100 psi transducer range (2-10V DC). Normal Values: 202-55 psi (6.4V) 220, 221-50 psi (6.0V) when engine is on.
011	220	Lub. oil pressure EG-1	
012	221	Lub. oil pressure EG-2	
013	230	Exhaust gas back pressure EG-1	Transducer range 0-30 inches water (2-10V DC) Normal 20 in. (7.0V) when engine is on.
014	231	Exhaust gas back pressure EG-2	

FLOW CATEGORY (#'s 300 to 399

All flows determined by Venturi and delta pressure transducer unless a turbine meter is specified. Delta pressure cells have 0 to 150" H_2O range (2-10V DC).

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
015	301	Primary water flow to all engines	11,300 lb/min (6.1V)
016	302	Primary water flow from engine 1 jacket	2,200 lb/min (5.0V)
017	303	Primary water flow from eng. 2 jacket	2,300 lb/min (5.2V)
018	304	Primary water flow from Chiller #1	7,500 lb/min (5.1V)
019	305	SHW return from HSP East (Shelley A, Shelley B, School, Pool)	8,700 lb/min (6.3V)
020	306	SHW supply to HSP West (Business, Camci, Descon)	7,000 lb/min (8.2V)
021	307	Condenser water flow inlet to Chiller CH 1	14,000 lb/min (4.5V)
022	308	Condenser water inlet to Chiller #2	17,000 lb/min (5.9V)
023	309	Total condenser water makeup	
024	310	Total chilled water flow to both chillers	20,000 lb/min (5.5V)
025	311	Chilled water from chiller #1	10,000 lb/min (6.4V)
030	312	Chilled water or HWR ret. from plant fan coil units FC-1 thru 5 (Turbine)	

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
027	313	Chilled water return from main CEB air inlet coil CC-1	900 lb/min (4.1V)
028	314	Chilled water from HSP East zone	9,000 lb/min (5.5V)
029	315	Chilled water from HSP West zone	9,000 lb/min (3.2V)
026	316	Total raw water from all engines	3,200 lb/min (8.8V)

FUEL CONSUMPTION - DIRECT TURBINE MEASUREMENT

140	360	Engine 1	0-.6 GPM
141	361	Engine 2	0-.6 GPM
142	362	Engine 3	0-.6 GPM
143	363	Engine 4	0-.6 GPM
144	364	Engine 5	0-.6 GPM
145	365	Boiler 1	0-1.5 GPM
146	366	Boiler 2	0-1.5 GPM
147	367	Spare	0-10.24 VDC

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
		SITE BUILDING FLOW	
		Flow by venturi and delta pressure transducer unless a turbine is specified. All delta pressure cells range 0 to 150 inches water (2-10V DC).	
		CEB Secondary Hot Water to Buildings	
007-01	327	Shelley A Total Building Return	
006-01	328	Shelley B Heating Return	
003-01	330	School Heating Hot Water Return	
004-01	331	Business Building Total Building Return	
002-01	332	Pool Domestic Hot Water Exchanger Supply	
009-01	333	Descon Concordia Heating Hot Water in Winter, Chilled Water in Summer	
008-01	334	Camci Total Building Supply	
		CEB Chilled Water To Each Building	
007-03	336	Shelley A Return	
006-03	337	Shelley B Return	
003-03	339	School Return	
004-03	340	Business Building Return	
008-03	343	Camci Supply	
		CEB SHW To Building Domestic Heat Exchanger	
007-05	345	Shelley A Supply	
006-05	346	Shelley B Return	
003-05	348	School Return (turbine)	
004-05	349	Business Building Return (turbine meter)	
009-03	351	Descon Return	
008-05	353	Camci Supply	

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
		ELECTRICAL SIGNALS	
		Voltage (#'s 400 to 499)	
160	400	CBB main bus line voltage, ØA-B	480V AC (12.0V DC)
163	410	PSE&G feeder in CEB, utility side	480V AC (12.0V DC)
007-08	416	Shelley A PN5 voltage	480V AC (6.0V DC)
006-08	420	Shelley B PN4 voltage	120V AC (6.0V DC)
003-08	424	School PN3 voltage	277V AC (2.77V DC)
009-07	426	Descon-Concordia PN2 A3	480V AC (6.0V DC)
009-08	428	Descon-Concordia PN2 A1,2	120V AC (6.0V DC)
008-08	430	Camci PN1 voltage	480V AC (6.0V DC)
004-08	432	Business Bldg. PN1 voltage	277V AC (6.0V DC)
		Integrated Power (#'s 500 to 549)	
110	501	Total plant production	600-1200 KW
111	502	GEN #1 Production	200-350 KW
112	503	GEN #2 Production	200-350 KW
113	509	PTC Compactor Load	
114	510	LP-1	12-16 KW
115	511	MCC-1	100-140 KW
116	512	MCC-2	35-45 KW
117	513	MCC-3	150 KW summer
118	514	PTC	
007-07	515	Shelley A PE2	30-40 KW
007-06	516	Shelley A PN5	180-350 KW
006-07	519	Shelley B PE2	10-20 KW
006-06	520	Shelley B PN4	40-110 KW
002-04	522	Pool PN3	
003-07	523	School PE3	
003-06	524	School PN3	
009-04	526	Descon-Concordia PN2, A3	40-100 KW
009-05	527	Descon-Concordia PE1, A3	40-45 KW
009-06	528	Descon-Concordia PN2, A1,2	50-150 KW
008-07	529	Camci PE1	30-40 KW
008-06	530	Camci PN1	100-200 KW
004-07	531	Business Bldg. PE1	
004-06	532	Business Bldg. PN1	

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
		Instantaneous Power	
		DC voltage proportional to KW (0-10V DC)	
041	550	Total Plant Production	700-1200 KW
042	551	Generator #1	200-350 KW
043	552	Generator #2	200-350 KW
044	553	PTC Compactor	
045	554	LP-1	18-21 KW
046	555	MCC-1	125 KW
047	556	MCC-2	38 KW
048	557	MCC-3	150 KW summer
049	558	PTC	
		TEMPERATURE CATEGORY (#'s 600 to 799)	
		Actual temperature signals originate from a single thermocouple junction, delta (DT) measurements from a pair of multi-junction piles. Signal levels are -10 to +10 mV. All are type T copper-constantan unless otherwise noted.	
050	600 A,B,C	(Actual) PHW temp. to all engines	175-195°F
086	601	(DT) PHW between engine 1 jacket water inlet & outlet (600C & 603)	3-6°F ON -1 OFF
087	602	(DT) PHW between engine 2 jacket water inlet & outlet (600B & 604)	3-6°F ON -1° OFF
051	603	(Actual) PHW outlet from EG-1 jacket	Inlet plus 3-6°F
052	604	(Actual) PHW outlet from EG-2 jacket	Inlet plus 3-6°F
089	605	(DT) PHW supply and return all engines (600A)	3.5-6.0°F
080	612	(Actual) exhaust gas temp. in boiler 1 stack, iron constantan	300-460°F ON 160°F OFF
081	613	(Actual) exhaust gas temp. in boiler 2 stack, iron constantan	300-460°F ON 160°F OFF
090	614	(DT) PHW across EG-1 jacket plus M-1 (600A)	4.5-7.0 ON
091	615	(DT) PHW across EG-2 jacket plus M-2 (600C)	4.5-7.0 ON

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in parentheses
053	616	(Actual) PHW outlet from M-1	195-215°F
054	617	(Actual) PHW outlet from M-2	195-215°F
055	627 A,B,C	(Actual) PHW outlet of both boilers, inlet to the chillers.	195-225°F
092	628	(DT) PHW across B-2 inlet & outlet (627C)	-1 to 14°F
056	629	(Actual) PHW inlet to HX-1, 1-A, outlet of chillers	170-195°F
057	630	(Actual) PHW inlet to DCJW, outlet of HX-1, 1A	165-195°F
093	631	(DT) in PHW main line caused by DCJW (630)	.3-1.0°F
094	632	(DT) PHW across inlet & outlet of HX-1, 1A (629&630)	10-18°F winter
058	633	(Actual) PHW inlet to boilers	170-195°F
095	634	(DT) PHW across inlet & outlet, CH-1 (627B)	8-20°F
096	635		
059	636	(Actual) PHW outlet of DCJW (uses well 631)	170-185°F
097	637	(DT) PHW across inlet & outlet of both boilers (633 & 627A)	5-15°F
060	640	(Actual) mixed outlet of both SHW heat exchangers, SHW to site.	175-190°F
098	641	(DT) across East site SHW supply & return (640)	7-15°F winter
099	642	(DT) across west site SHW supply & return (640)	12-21°F winter
100	647 A,B	(DT) CHW or HW across CEB office fan coil supply & return	
101	659	(DT) across East site CHW supply and return	1-5°F
102	660	(DT) across West site CHW supply and return	1-5°F

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in Parentheses
061	661	(Actual) CHW outlet CH-1	42-50°F
062	662	(Actual) CHW outlet CH-2	42-50°F
063	663 A,B	(Actual) temp. chilled water to site West zone	42-50°F
103	664 A,B	(DT)across CC-1 supply & return	
064	665	(Actual) CHW to inlet of both chillers.	45-55°F
065	671	(Actual) condenser water makeup	65-75°F
066	672	(Actual) condenser water inlet to CH-2	75-85°F
067	673	(Actual) condenser water inlet to CH-1	75-85°F
104	674	(DT) condenser water temp between inlet & outlet CH-1 (673)	2-12°F
105	675	(DT) condenser water temp. between inlet & outlet CH-2 (672)	2-12°F
068	690 A,B	(Actual) raw water inlet to all engines	70-85°F
069	691	(Actual) raw water supply manifold after E-1 outlet, before E-2 inlet.	70-85°F
106	692	(DT) between inlet and outlet of raw water pumps. (693A)	-.2°F
070	693 A,B,C	(Actual) raw water temp. downstream of all engines--total engine outlet	75-85°F
088	694	(DT) RW across HWPS and HC-1 plus RHC-1 thru 3 (693B)	.2°F
107	695	(DT) RW between total engine outlet and DCRW outlet (693C)	6-8°F
071	696	(Actual) Raw water supply manifold after E-2 outlet, before E-3 inlet.	70-80°F
072	700	(Actual) lub. oil sump Eng. 1	120°F OFF, 180°F ON
073	701	(Actual) lub. oil sump Eng. 2	120°F OFF, 180°F ON

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in Parentheses
108	702	(DT) RW across HX-3 (690A)	
109	703	(DT) on RW supply manifold across E-1 (691 & 690B)	1.5°F ON
074	711	(Actual) engine room air temp. db	75-85°F
075	713	(Actual) engine room air temp. wb	60-75°F
076	730	(Actual) fuel oil supply to all engines	84-93°F
077	731	(Actual) fuel oil return from all engines	85-94°F
078	732	(Actual) fuel oil supply to boilers	70-81°F
079	733	(Actual) fuel oil return from boilers	71-82°F
082	750	(Actual) temp. of exhaust gas entering M-1, iron constantan	480-600°F ON 130°F OFF
083	751	(Actual) temp. of exhaust gas entering M-2, iron constantan	480-600°F ON 130°F OFF
084	752	(Actual) temp. of exhaust gas leaving M-1, iron constantan	400-500 ON 130°F OFF
085	753	(Actual) temp. of exhaust gas leaving M-2, iron constantan	400-500°F ON

WATER TEMPERATURES AT SITE BUILDINGS

(Actual) Chilled Water To Individual Buildings

006-09	643	Shelley B (well 650A)	42-50°F for all buildings
007-10	644	Shelley A (well 648A)	
008-10	645	Camci (well 654A)	
009-09	646	(Actual) Hot or chilled water for heating or cooling (well 626A)	
003-09	624	School	
004-10	625	Business Building	

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in Parentheses
		(DT) Chilled Water Between Building Supply And Return Well A is Supply, B Return	
007-02	648	Shelley A	
006-02	650	Shelley B	
003-02	651	School	
009-00	626	Descon Heating and Cooling	
008-02	654	Camci	
004-02	655	Business Building	
		(Actual) CEB SHW To Buildings	
002-08	760	Pool domestic	170-190°F for all buildings
003-10	761	School heating supply	
004-11	762	Business Bldg. Total Bldg. supply	
006-10	763	Shelley B Total Supply	
007-11	764	Shelley A Total bldg. supply (uses well 768)	
008-11	765	Camci Total bldg supply (uses well 774)	
		(DT) Between HWS and HWR	
007-00	768	Shelley A total building	
006-00	770	Shelley B total building	
003-00	771	School heating	
002-00	772	Pool domestic	
008-00	774	Camci total bldg.	
004-00	775	Business bldg. total bldg.	
		(Actual) HW Temperature Inlet To Domestic Heat Exchanger	
003-11	781	School	170-190°F for all buildings
004-12	782	Business bldg.	
006-11	783	Shelley B	
007-12	784	Shelley A	
008-12	785	Camci	
009-10	786	Descon-Concordia	
		(DT) Hot Water Inlet and Outlet of Domestic Heat Exchanger	
007-04	788	Shelley A	
006-04	790	Shelley B	
003-04	791	School	
009-02	793	Descon-Concordia	
008-04	794	Camci	
004-04	795	Business bldg.	

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in Parentheses

ALARMS AND INDICATORS (#'s 800 to 899)

DAS CHANNEL	NBS CODE	Identification	Normal Physical Range DAS mV in Parentheses
	Engines		
127	800	Engine low oil pressure, malfunction	Engine 1 -(2.58V)
	801	Engine high water temperature, malfunction	(1.29V)
	802	Engine high oil temperature, malfunction	(.65V)
	803	Engine overspeed (110%)	(.32V)
	804	Engine underspeed (90%)	(.16V)
	805	Engine excessive vibration malfunction	(.08V)
120	806	Engine high oil coolant temperature	Engine 1 -(2.58V)
	807	Circuit breaker trip	(1.29V)
	808	Engine excessive start time	(.65V)
	809	Generator overload	(.32V)
	810	Failure to parallel	(.16V)
	811	Reverse power protection	(.08V)
121	815 to 820	(Same as 800 to 805)	Engine 2
122	821 to 826	(Same as 806 to 811)	Engine 2
123	830 to 835	(Same as 800 to 805)	Engine 3
124	836 to 841	(Same as 806 to 811)	Engine 3
125	845 to 850	(Same as 800 to 805)	Engine 4
126	851 to 856	(Same as 806 to 811)	Engine 4
128	860 to 865	(Same as 800 to 805)	Engine 5
129	866 to 871	(Same as 806 to 811)	Engine 5

III. DERIVED VARIABLE DEFINITIONS AND CODES

LOC	TITLE	UNITS
1010	TIME GAIN OF SITE CLOCKS	MINUTES PER HOUR
1011	EG1 RUN TIME	MINUTES PER HOUR
1012	EG2 RUN TIME	MINUTES PER HOUR
1013	INST POWER - ALL EG	INSTANT. KILOWATT HOURS
1014	INST POWER - EG1	INSTANT. KILOWATT HOURS
1015	INST POWER - EG2	INSTANT. KILOWATT HOURS
1016	INST POWER - EG3-5	INSTANT. KILOWATT HOURS
1018	INST POWER USED - PTC COMP	INSTANT. KILOWATT HOURS
1019	INST POWER USED - LP1	INSTANT. KILOWATT HOURS
1020	INST POWER USED - MCC1	INSTANT. KILOWATT HOURS
1021	INST POWER USED - MCC2	INSTANT. KILOWATT HOURS
1022	INST POWER USED - MCC3	INSTANT. KILOWATT HOURS
1023	INST POWER USED - PTC EXH	INSTANT. KILOWATT HOURS
1025	TOTAL POWER PROD BY ALL EG	KILOWATT HOURS
1026	TOTAL POWER PROD BY EG1	KILOWATT HOURS
1027	TOTAL POWER PROD BY EG2	KILOWATT HOURS
1028	TOTAL POWER PROD BY EG3-5	KILOWATT HOURS
1030	TOTAL POWER USED BY PTC COMP	KILOWATT HOURS
1031	TOTAL POWER USED BY LP1	KILOWATT HOURS
1032	TOTAL POWER USED BY MCC1	KILOWATT HOURS
1033	TOTAL POWER USED BY MCC2	KILOWATT HOURS
1034	TOTAL POWER USED BY MCC3	KILOWATT HOURS
1035	TOTAL POWER USED BY PTC EXH	KILOWATT HOURS
1036	POWER USED BY SHELLEY A , PE2	KILOWATT HOURS
1037	POWER USED BY SHELLEY A , PN5	KILOWATT HOURS
1038	TOTAL POWER USED BY SHELLEY A	KILOWATT HOURS
1039	POWER USED BY SHELLEY B , PE2	KILOWATT HOURS
1040	POWER USED BY SHELLEY B , PN4	KILOWATT HOURS
1041	TOTAL POWER USED BY SHELLEY B	KILOWATT HOURS
1042	TOTAL POWER USED BY POOL , PN3	KILOWATT HOURS
1043	POWER USED BY SCHOOL , PE2	KILOWATT HOURS
1044	POWER USED BY SCHOOL , PN3	KILOWATT HOURS
1045	TOTAL POWER USED BY SCHOOL	KILOWATT HOURS
1046	POWER USED BY DESCON EAST , PN2	KILOWATT HOURS
1047	POWER USED BY DESCON EAST , PE1	KILOWATT HOURS
1048	TOTAL POWER USED BY DESCON EAST	KILOWATT HOURS
1049	TOTAL POWER USED BY DESCON WEST	KILOWATT HOURS
1050	TOTAL POWER USED BY DESCON	KILOWATT HOURS
1051	POWER USED BY CAMCI , PE1	KILOWATT HOURS
1052	POWER USED BY CAMCI , PN1	KILOWATT HOURS
1053	TOTAL POWER USED BY CAMCI	KILOWATT HOURS
1054	POWER USED BY COM.BLDG , PE1	KILOWATT HOURS
1055	POWER USED BY COM.BLDG , PN1	KILOWATT HOURS
1056	TOTAL POWER USED BY COM.BLDG	KILOWATT HOURS
1059	TOTAL POWER USED BY CEB	KILOWATT HOURS
1060	POWER USED BY SHWP	KILOWATT HOURS
1061	POWER ASSIGNED TO BOILERS	KILOWATT HOURS
1062	POWER ASSIGNED TO CHILLERS	KILOWATT HOURS
1063	POWER ASSIGNED TO ELECT PROD	KILOWATT HOURS
1064	POWER ASSIGNED TO AIR & HEAT	KILOWATT HOURS
1065	TOTAL POWER USED BY PTC	KILOWATT HOURS
1066	TOTAL POWER USED BY SITE	KILOWATT HOURS

LOC	TITLE	UNITS
1067	TOTAL NET POWER USED	KILOWATT HOURS
1073	TOTAL POWER USED BY PE1	KILOWATT HOURS
1074	TOTAL POWER USED BY PE2	KILOWATT HOURS
1075	TOTAL POWER USED BY ESS BUSS	KILOWATT HOURS
1076	TOTAL POWER USED BY PN1	KILOWATT HOURS
1077	TOTAL POWER USED BY PN2	KILOWATT HOURS
1078	TOTAL POWER USED BY PN3	KILOWATT HOURS
1079	TOTAL POWER USED BY PN4	KILOWATT HOURS
1080	TOTAL POWER USED BY PN5	KILOWATT HOURS
1081	TOTAL POWER USED BY NORM. BUSS	KILOWATT HOURS
1082	POWER USED BY NOR & ESS BUSS	KILOWATT HOURS
1087	HEAT ADDED BY CH1 TO COND H20	KILO B.T.U. PER HOUR
1088	HEAT ADDED BY CH2 TO COND H20	KILO B.T.U. PER HOUR
1089	TOTAL HEAT ADDED TO COND H20	KILO B.T.U. PER HOUR
1090	COND H20 HEAT REMOVED BY TOWERS	KILO B.T.U. PER HOUR
1091	COND H20 HEAT REMOVED BY MAKEUP	KILO B.T.U. PER HOUR
1092	COND H20 HEAT REMOVED BY RAW	KILO B.T.U. PER HOUR
1093	HEAT REMOVED FROM COND H20	KILO B.T.U. PER HOUR
1100	PHW HEAT ADDED BY EG1 MUF (1)	KILO B.T.U. PER HOUR
1101	PHW HEAT ADDED BY EG1 MUF (2)	KILO B.T.U. PER HOUR
1102	PHW HEAT ADDED BY EG1 MUF (3)	KILO B.T.U. PER HOUR
1103	PHW HEAT ADDED BY EG2 MUF (1)	KILO B.T.U. PER HOUR
1104	PHW HEAT ADDED BY EG2 MUF (2)	KILO B.T.U. PER HOUR
1105	PHW HEAT ADDED BY EG2 MUF (3)	KILO B.T.U. PER HOUR
1106	PHW HEAT ADDED BY EG1 JAC (1)	KILO B.T.U. PER HOUR
1107	PHW HEAT ADDED BY EG1 JAC (2)	KILO B.T.U. PER HOUR
1108	PHW HEAT ADDED BY EG1 JAC (3)	KILO B.T.U. PER HOUR
1109	PHW HEAT ADDED BY EG2 JAC (1)	KILO B.T.U. PER HOUR
1110	PHW HEAT ADDED BY EG2 JAC (2)	KILO B.T.U. PER HOUR
1111	PHW HEAT ADDED BY EG2 JAC (3)	KILO B.T.U. PER HOUR
1112	HEAT ADDED BY EG1 TO PHW (1)	KILO B.T.U. PER HOUR
1113	HEAT ADDED BY EG1 TO PHW (2)	KILO B.T.U. PER HOUR
1114	HEAT ADDED BY EG1 TO PHW (3)	KILO B.T.U. PER HOUR
1115	HEAT ADDED BY EG2 TO PHW (1)	KILO B.T.U. PER HOUR
1116	HEAT ADDED BY EG2 TO PHW (2)	KILO B.T.U. PER HOUR
1117	HEAT ADDED BY EG2 TO PHW (3)	KILO B.T.U. PER HOUR
1118	HEAT ADDED BY EG3-5 TO PHW (1)	KILO B.T.U. PER HOUR
1119	HEAT ADDED BY EG3-5 TO PHW (2)	KILO B.T.U. PER HOUR
1120	HEAT ADDED BY EG3-5 TO PHW (3)	KILO B.T.U. PER HOUR
1121	HEAT ADDED BY ALL EG TO PHW	KILO B.T.U. PER HOUR
1122	HEAT ADDED BY B1 TO PHW (1)	KILO B.T.U. PER HOUR
1123	HEAT ADDED BY B1 TO PHW (2)	KILO B.T.U. PER HOUR
1124	HEAT ADDED BY B1 TO PHW (3)	KILO B.T.U. PER HOUR
1125	HEAT ADDED BY B1 TO PHW (4)	KILO B.T.U. PER HOUR
1126	HEAT ADDED BY B2 TO PHW	KILO B.T.U. PER HOUR
1127	PHW HEAT ADDED BY BOILERS (1)	KILO B.T.U. PER HOUR
1128	PHW HEAT ADDED BY BOILERS (2)	KILO B.T.U. PER HOUR
1129	PHW HEAT ADDED BY BOILERS (3)	KILO B.T.U. PER HOUR
1130	HEAT REMOVED BY CH1 TO PHW	KILO B.T.U. PER HOUR
1131	HEAT REMOVED BY CH2 TO PHW	KILO B.T.U. PER HOUR
1132	HEAT REMOVED BY CHILLERS TO PHW	KILO B.T.U. PER HOUR
1133	HEAT REMOVED BY PRI/SEC HX (1)	KILO B.T.U. PER HOUR

LOC	TITLE	UNITS
1134	HEAT REMOVED BY PRI/SEC HX (2)	KILO B.T.U. PER HOUR
1135	HEAT REMOVED BY PRI/SEC HX (3)	KILO B.T.U. PER HOUR
1136	HEAT REMOVED BY DRY COOL (1)	KILO B.T.U. PER HOUR
1137	HEAT REMOVED BY DRY COOL (2)	KILO B.T.U. PER HOUR
1138	HEAT REMOVED BY DRY COOL (3)	KILO B.T.U. PER HOUR
1139	HEAT REMOVED BY EMER HX	KILO B.T.U. PER HOUR
1140	HEAT ADDED BY PHWP	KILO B.T.U. PER HOUR
1141	TOTAL HEAT ADDED TO PHW (1)	KILO B.T.U. PER HOUR
1142	TOTAL HEAT ADDED TO PHW (2)	KILO B.T.U. PER HOUR
1143	TOTAL HEAT ADDED TO PHW (3)	KILO B.T.U. PER HOUR
1144	HEAT REMOVED FROM PHW (1)	KILO B.T.U. PER HOUR
1145	HEAT REMOVED FROM PHW (2)	KILO B.T.U. PER HOUR
1146	HEAT REMOVED FROM PHW (3)	KILO B.T.U. PER HOUR
1147	HEAT LOSSES TO PHW (1)	KILO B.T.U. PER HOUR
1148	HEAT LOSSES TO PHW (2)	KILO B.T.U. PER HOUR
1149	HEAT LOSSES TO PHW (3)	KILO B.T.U. PER HOUR
1155	HEAT REMOVED BY SEC HX	KILO B.T.U. PER HOUR
1156	HEAT REMOVED BY CC1 IN SHW	KILO B.T.U. PER HOUR
1157	HEAT REMOVED BY FC IN SHW	KILO B.T.U. PER HOUR
1158	HEAT REMOVED BY WEST ZONE SHW	KILO B.T.U. PER HOUR
1159	HEAT REMOVED BY SITE E SHW	KILO B.T.U. PER HOUR
1160	HEAT REMOVED BY EAST ZONE SHW	KILO B.T.U. PER HOUR
1161	HEAT LOSSES THRU PRI/SEC HX (1)	KILO B.T.U. PER HOUR
1162	HEAT LOSSES THRU PRI/SEC HX (2)	KILO B.T.U. PER HOUR
1163	HEAT LOSSES THRU PRI/SEC HX (3)	KILO B.T.U. PER HOUR
1170	SCW HEAT REMOVED BY CH1	KILO B.T.U. PER HOUR
1171	SCW HEAT REMOVED BY CH2	KILO B.T.U. PER HOUR
1172	SCW HEAT REMOVED BY CHILLERS	KILO B.T.U. PER HOUR
1173	HEAT REMOVED BY CC1 IN SCW	KILO B.T.U. PER HOUR
1174	HEAT REMOVED BY FC IN SCW	KILO B.T.U. PER HOUR
1175	SCW HEAT REMOVED BY W ZONE (1)	KILO B.T.U. PER HOUR
1176	SCW HEAT REMOVED BY W ZONE (2)	KILO B.T.U. PER HOUR
1177	SCW HEAT REMOVED BY W ZONE (3)	KILO B.T.U. PER HOUR
1178	SCW HEAT REMOVED BY SITE E	KILO B.T.U. PER HOUR
1179	SCW HEAT REMOVED BY EAST ZONE	KILO B.T.U. PER HOUR
1180	HEAT REMOVED FROM SCW (1)	KILO B.T.U. PER HOUR
1181	HEAT REMOVED FROM SCW (2)	KILO B.T.U. PER HOUR
1182	HEAT REMOVED FROM SCW (3)	KILO B.T.U. PER HOUR
1183	SCW HEAT LOSSES (1)	KILO B.T.U. PER HOUR
1184	SCW HEAT LOSSES (2)	KILO B.T.U. PER HOUR
1185	SCW HEAT LOSSES (3)	KILO B.T.U. PER HOUR
1191	RAW H20 HEAT ADDED BY EG1 (1)	KILO B.T.U. PER HOUR
1192	RAW H20 HEAT ADDED BY EG1 (2)	KILO B.T.U. PER HOUR
1193	RAW H20 HEAT ADDED BY EG1 (3)	KILO B.T.U. PER HOUR
1194	HEAT ADDED BY EG2 TO RAW H20	KILO B.T.U. PER HOUR
1195	HEAT ADDED BY EG3-5 TO RAW H20	KILO B.T.U. PER HOUR
1196	HEAT ADDED BY ALL EG RAW (1)	KILO B.T.U. PER HOUR
1197	HEAT ADDED BY ALL EG RAW (2)	KILO B.T.U. PER HOUR
1198	HEAT ADDED BY ALL EG RAW (3)	KILO B.T.U. PER HOUR
1199	HEAT ADDED BY ALL EG RAW (4)	KILO B.T.U. PER HOUR
1200	HEAT ADDED BY HX 3 TO RAW H20	KILO B.T.U. PER HOUR
1201	HEAT ADDED BY HX 4 TO RAW H20	KILO B.T.U. PER HOUR

LOC	TITLE	UNITS
1202	HEAT ADDED BY HWP TO RAW H20	KILO B.T.U. PER HOUR
1203	HEAT ADDED BY COILS TO RAW H20	KILO B.T.U. PER HOUR
1204	HEAT ADDED BY DCRW TO RAW H20	KILO B.T.U. PER HOUR
1205	TOTAL HEAT ADDED TO RAW H20 (1)	KILO B.T.U. PER HOUR
1206	TOTAL HEAT ADDED TO RAW H20 (2)	KILO B.T.U. PER HOUR
1207	TOTAL HEAT ADDED TO RAW H20 (3)	KILO B.T.U. PER HOUR
1208	TOTAL HEAT ADDED TO RAW H20 (4)	KILO B.T.U. PER HOUR
1209	TOTAL HEAT ADDED TO RAW H20 (5)	KILO B.T.U. PER HOUR
1210	TOTAL HEAT ADDED TO RAW H20 (6)	KILO B.T.U. PER HOUR
1211	TOTAL HEAT ADDED TO RAW H20 (7,	KILO B.T.U. PER HOUR
1212	HEAT REMOVED FROM RAW H20	KILO B.T.U. PER HOUR
1213	HEAT LOSSES TO RAW H20 (1)	KILO B.T.U. PER HOUR
1214	HEAT LOSSES TO RAW H20 (2)	KILO B.T.U. PER HOUR
1215	HEAT LOSSES TO RAW H20 (3)	KILO B.T.U. PER HOUR
1216	HEAT LOSSES TO RAW H20 (4)	KILO B.T.U. PER HOUR
1217	HEAT LOSSES TO RAW H20 (5)	KILO B.T.U. PER HOUR
1218	HEAT LOSSES TO RAW H20 (6)	KILO B.T.U. PER HOUR
1219	HEAT LOSSES TO RAW H20 (7,	KILO B.T.U. PER HOUR
1225	HEAT ADDED BY BOILERS TO FUEL	KILO B.T.U. PER HOUR
1226	HEAT ADDED BY ALL EG TO FUEL	KILO B.T.U. PER HOUR
1227	TOTAL HEAT ADDED TO FUEL	KILO B.T.U. PER HOUR
1228	FUEL HEAT USED BY EG1	KILO B.T.U. PER HOUR
1229	FUEL HEAT USED BY EG2	KILO B.T.U. PER HOUR
1230	FUEL HEAT USED BY EG3	KILO B.T.U. PER HOUR
1231	FUEL HEAT USED BY EG4	KILO B.T.U. PER HOUR
1232	FUEL HEAT USED BY EG5	KILO B.T.U. PER HOUR
1233	SHELLEY A DOM H20 HEAT	KILO B.T.U. PER HOUR
1234	SHELLEY A SPACE HEAT	KILO B.T.U. PER HOUR
1235	HEAT USED BY SHELLEY A	KILO B.T.U. PER HOUR
1236	SHELLEY B DOM H20 HEAT	KILO B.T.U. PER HOUR
1237	SHELLEY B SPACE HEAT	KILO B.T.U. PER HOUR
1238	HEAT USED BY SHELLEY B	KILO B.T.U. PER HOUR
1241	HEAT USED BY POOL	KILO B.T.U. PER HOUR
1242	SCHOOL DOM H20 HEAT	KILO B.T.U. PER HOUR
1243	SCHOOL SPACE HEAT	KILO B.T.U. PER HOUR
1244	HEAT USED BY SCHOOL	KILO B.T.U. PER HOUR
1245	HEAT REMOVED BY SITE E	KILO B.T.U. PER HOUR
1246	HEAT REMOVED BY EAST ZONE	KILO B.T.U. PER HOUR
1247	EAST ZONE HEAT LOSSES	KILO B.T.U. PER HOUR
1248	DESCON DOM H20 HEAT	KILO B.T.U. PER HOUR
1249	DESCON SPACE HEAT	KILO B.T.U. PER HOUR
1250	HEAT USED BY DESCON	KILO B.T.U. PER HOUR
1251	CAMCI DOM H20 HEAT	KILO B.T.U. PER HOUR
1252	CAMCI SPACE HEAT	KILO B.T.U. PER HOUR
1253	HEAT USED BY CAMCI	KILO B.T.U. PER HOUR
1254	COM.BLDG DOM H20 HEAT	KILO B.T.U. PER HOUR
1255	COM.BLDG SPACE HEAT	KILO B.T.U. PER HOUR
1256	HEAT USED BY COM.BLDG	KILO B.T.U. PER HOUR
1257	HEAT USED BY WEST ZONE	KILO B.T.U. PER HOUR
1258	WEST ZONE HEAT LOSSES	KILO B.T.U. PER HOUR
1259	HEAT REMOVED BY SITE	KILO B.T.U. PER HOUR
1260	SITE HEAT LOSSES	KILO B.T.U. PER HOUR

LOC	TITLE	UNITS
1261	FUEL HEAT USED BY ALL EG	KILO B.T.U. PER HOUR
1262	FUEL HEAT USED BY B1	KILO B.T.U. PER HOUR
1263	FUEL HEAT USED BY B2	KILO B.T.U. PER HOUR
1264	FUEL HEAT USED BY BOILERS	KILO B.T.U. PER HOUR
1265	FUEL HEAT USED BY PLANT	KILO B.T.U. PER HOUR
1266	COOLING USED BY SHELLEY A	KILO B.T.U. PER HOUR
1267	COOLING USED BY SHELLEY B	KILO B.T.U. PER HOUR
1268	COOLING USED BY POOL	KILO B.T.U. PER HOUR
1269	COOLING USED BY SCHOOL	KILO B.T.U. PER HOUR
1270	COOLING USED BY SITE E	KILO B.T.U. PER HOUR
1271	COOLING USED BY EAST ZONE	KILO B.T.U. PER HOUR
1272	EAST ZONE COOLING HEAT LOSSES	KILO B.T.U. PER HOUR
1273	COOLING USED BY DESCON	KILO B.T.U. PER HOUR
1274	COOLING USED BY CAMCI	KILO B.T.U. PER HOUR
1275	COOLING USED BY COM.BLDG	KILO B.T.U. PER HOUR
1276	COOLING USED BY WEST ZONE	KILO B.T.U. PER HOUR
1277	WEST ZONE COOLING HEAT LOSSES	KILO B.T.U. PER HOUR
1278	COOLING USED BY SITE	KILO B.T.U. PER HOUR
1279	SITE COOLING HEAT LOSSES	KILO B.T.U. PER HOUR
1285	FUEL HEAT USED BY EG1 -TB	KILO B.T.U. PER HOUR
1286	FUEL HEAT USED BY EG2 -TB	KILO B.T.U. PER HOUR
1287	FUEL HEAT USED BY EG3-5 -TB	KILO B.T.U. PER HOUR
1288	FUEL HEAT USED BY ALL EG -TB	KILO B.T.U. PER HOUR
1289	FUEL HEAT USED BY B1 -TB	KILO B.T.U. PER HOUR
1290	FUEL HEAT USED BY B2 -TB	KILO B.T.U. PER HOUR
1291	FUEL HEAT USED BY BOILERS -TB	KILO B.T.U. PER HOUR
1292	FUEL HEAT USED BY PLANT -TB	KILO B.T.U. PER HOUR
1294	FUEL USED BY B1	GALLONS PER HOUR
1295	FUEL USED BY B2	GALLONS PER HOUR
1296	FUEL USED BY BOILERS	GALLONS PER HOUR
1298	FUEL USED BY EG1 -TB	GALLONS PER HOUR
1299	FUEL USED BY EG2 -TB	GALLONS PER HOUR
1300	FUEL USED BY EG3-5 -TB	GALLONS PER HOUR
1301	FUEL USED BY ALL EG -TB	GALLONS PER HOUR
1302	FUEL USED BY B1 -TB	GALLONS PER HOUR
1303	FUEL USED BY B2 -TB	GALLONS PER HOUR
1304	FUEL USED BY BOILERS -TB	GALLONS PER HOUR
1305	FUEL USED BY PLANT -TB	GALLONS PER HOUR
1307	FUEL USED BY EG1	GALLONS PER HOUR
1308	FUEL USED BY EG2	GALLONS PER HOUR
1309	FUEL USED BY EG3	GALLONS PER HOUR
1310	FUEL USED BY EG4	GALLONS PER HOUR
1311	FUEL USED BY EG5	GALLONS PER HOUR
1312	FUEL USED BY ALL EG	GALLONS PER HOUR
1313	FUEL USED BY PLANT	GALLONS PER HOUR
1315	TOTAL POWER USED BY SHWP	KILOWATTS
1316	CH ON=1; OFF=2	SEASON
1317	% LP1 TO ELECT	FRACTION
1318	EFF HX 4	FRACTION
1319	DEG API	DEGREES A.P.I.
1320	ANALYZED HEAT CONTENT OF FUEL	B.T.U. PER GALLON

IV. TYPICAL TEREVIEW OUTPUT OF A CONVERTED SCAN

NBS 0,	LOC 1:	3.000	NONE	3.000	M.V.	FLAG = 0
NBS 0,	LOC 2:	1.000	NONE	1.000	M.V.	FLAG = 1
NBS 0,	LOC 3:	5.000	NONE	5.000	M.V.	FLAG = 1
NBS 0,	LOC 4:	.000	NONE	.000	M.V.	FLAG = 1
NBS 0,	LOC 5:	40192.000	NONE	40192.000	M.V.	FLAG = 1
NBS 0,	LOC 6:	578000.000	NONE	578000.000	M.V.	FLAG = 1
NBS 0,	LOC 7:	47.000	NONE	47.000	M.V.	FLAG = 1
NBS 0,	LOC 8:	1.000	NONE	1.000	M.V.	FLAG = 1
NBS 0,	LOC 9:	15.000	NONE	15.000	M.V.	FLAG = 1
NBS 202,	LOC 10:	58.575	PSI	6686.000	M.V.	FLAG = 0
NBS 220,	LOC 11:	.887	PSI	2071.000	M.V.	FLAG = 0
NBS 221,	LOC 12:	57.787	PSI	6623.000	M.V.	FLAG = 0
NBS 230,	LOC 13:	-.018	PSI	1869.000	M.V.	FLAG = 0
NBS 231,	LOC 14:	.238	PSI	3758.000	M.V.	FLAG = 0
NBS 301,	LOC 15:	11323.916	LB/MIN	6041.000	M.V.	FLAG = 0
NBS 302,	LOC 16:	2440.695	LB/MIN	5592.000	M.V.	FLAG = 0
NBS 303,	LOC 17:	2310.435	LB/MIN	5212.000	M.V.	FLAG = 0
NBS 304,	LOC 18:	.000	LB/MIN	2030.000	M.V.	FLAG = 0
NBS 305,	LOC 19:	6299.441	LB/MIN	4132.000	M.V.	FLAG = 0
NBS 306,	LOC 20:	6448.356	LB/MIN	7148.000	M.V.	FLAG = 0
NBS 307,	LOC 21:	.000	LB/MIN	2046.000	M.V.	FLAG = 0
NBS 308,	LOC 22:	.000	LB/MIN	2048.000	M.V.	FLAG = 0
NBS 309,	LOC 23:	.000	LB/MIN	1971.000	M.V.	FLAG = 0
NBS 310,	LOC 24:	.000	LB/MIN	2041.000	M.V.	FLAG = 0
NBS 311,	LOC 25:	1285.854	LB/MIN	2070.000	M.V.	FLAG = 0
NBS 316,	LOC 26:	2836.554	LB/MIN	6420.000	M.V.	FLAG = 0
NBS 313,	LOC 27:	.000	LB/MIN	1978.000	M.V.	FLAG = 0
NBS 314,	LOC 28:	.000	LB/MIN	1984.000	M.V.	FLAG = 0
NBS 315,	LOC 29:	.000	LB/MIN	2036.000	M.V.	FLAG = 0
NBS 312,	LOC 30:	.000	GPM (AV)	5112.000	M.V.	FLAG = 0
NBS 317,	LOC 31:	.000	GPM (AV)	.000	M.V.	FLAG = 0
NBS 318,	LOC 32:	.000	GPM (AV)	3.000	M.V.	FLAG = 0
NBS 319,	LOC 33:	.000	GPM (AV)	2442.000	M.V.	FLAG = 0
NBS 320,	LOC 34:	.000	GPM (AV)	5045.000	M.V.	FLAG = 0
NBS 321,	LOC 35:	.000	GPM (AV)	29.000	M.V.	FLAG = 0
NBS 322,	LOC 36:	.000	GPM (AV)	5068.000	M.V.	FLAG = 0
NBS 323,	LOC 37:	.000	GPM (AV)	3206.000	M.V.	FLAG = 0
NBS 324,	LOC 38:	.000	GPM (AV)	1254.000	M.V.	FLAG = 0
NBS 325,	LOC 39:	.000	GPM (AV)	16.000	M.V.	FLAG = 0
NBS 326,	LOC 40:	.000	GPM (AV)	241.000	M.V.	FLAG = 0
NBS 550,	LOC 41:	748.800	KW (INS)	936.000	M.V.	FLAG = 0
NBS 551,	LOC 42:	.000	KW (INS)	-15.000	M.V.	FLAG = 0
NBS 552,	LOC 43:	262.200	KW (INS)	1748.000	M.V.	FLAG = 0
NBS 553,	LOC 44:	.111	KW (INS)	2.000	M.V.	FLAG = 0
NBS 554,	LOC 45:	13.767	KW (INS)	2484.000	M.V.	FLAG = 0
NBS 555,	LOC 46:	97.934	KW (INS)	1178.000	M.V.	FLAG = 0
NBS 556,	LOC 47:	31.813	KW (INS)	574.000	M.V.	FLAG = 0
NBS 557,	LOC 48:	.000	KW (INS)	-159.000	M.V.	FLAG = 0
NBS 558,	LOC 49:	.000	KW (INS)	-29.000	M.V.	FLAG = 0
NBS 600,	LOC 50:	181.184	DEG F	3.489	M.V.	FLAG = 0
NBS 603,	LOC 51:	182.296	DEG F	3.517	M.V.	FLAG = 0
NBS 604,	LOC 52:	187.408	DEG F	3.646	M.V.	FLAG = 0
NBS 616,	LOC 53:	181.859	DEG F	3.506	M.V.	FLAG = 0
NBS 617,	LOC 54:	190.486	DEG F	3.724	M.V.	FLAG = 0

NBS 627,	LOC 55:	193.478 DEG F	3.800 M.V.	FLAG = 0
NBS 629,	LOC 56:	195.127 DEG F	3.842 M.V.	FLAG = 0
NBS 630,	LOC 57:	183.090 DEG F	3.537 M.V.	FLAG = 0
NBS 633,	LOC 58:	187.289 DEG F	3.643 M.V.	FLAG = 0
NBS 636,	LOC 59:	181.899 DEG F	3.507 M.V.	FLAG = 0
NBS 640,	LOC 60:	180.627 DEG F	3.475 M.V.	FLAG = 0
NBS 661,	LOC 61:	81.512 DEG F	1.100 M.V.	FLAG = 0
NBS 662,	LOC 62:	81.205 DEG F	1.093 M.V.	FLAG = 0
NBS 663,	LOC 63:	117.737 DEG F	1.941 M.V.	FLAG = 0
NBS 665,	LOC 64:	84.141 DEG F	1.160 M.V.	FLAG = 0
NBS 671,	LOC 65:	67.903 DEG F	.792 M.V.	FLAG = 0
NBS 672,	LOC 66:	82.258 DEG F	1.117 M.V.	FLAG = 0
NBS 673,	LOC 67:	80.722 DEG F	1.082 M.V.	FLAG = 0
NBS 690,	LOC 68:	79.008 DEG F	1.043 M.V.	FLAG = 0
NBS 691,	LOC 69:	79.052 DEG F	1.044 M.V.	FLAG = 0
NBS 693,	LOC 70:	84.185 DEG F	1.161 M.V.	FLAG = 0
NBS 696,	LOC 71:	79.492 DEG F	1.054 M.V.	FLAG = 0
NBS 700,	LOC 72:	36.516 DEG F	.098 M.V.	FLAG = 0
NBS 701,	LOC 73:	183.249 DEG F	3.541 M.V.	FLAG = 0
NBS 711,	LOC 74:	80.766 DEG F	1.083 M.V.	FLAG = 0
NBS 713,	LOC 75:	79.887 DEG F	1.063 M.V.	FLAG = 0
NBS 730,	LOC 76:	83.835 DEG F	1.153 M.V.	FLAG = 0
NBS 731,	LOC 77:	86.021 DEG F	1.203 M.V.	FLAG = 0
NBS 732,	LOC 78:	75.615 DEG F	.966 M.V.	FLAG = 0
NBS 733,	LOC 79:	76.321 DEG F	.982 M.V.	FLAG = 0
NBS 612,	LOC 80:	303.351 DEG F	8.048 M.V.	FLAG = 0
NBS 613,	LOC 81:	170.239 DEG F	4.014 M.V.	FLAG = 0
NBS 750,	LOC 82:	112.830 DEG F	2.319 M.V.	FLAG = 0
NBS 751,	LOC 83:	559.041 DEG F	15.927 M.V.	FLAG = 0
NBS 752,	LOC 84:	130.060 DEG F	2.824 M.V.	FLAG = 0
NBS 753,	LOC 85:	412.905 DEG F	11.422 M.V.	FLAG = 0
NBS 601,	LOC 86:	.008 DL DEG F	.003 M.V.	FLAG = 0
NBS 602,	LOC 87:	5.385 DL DEG F	2.037 M.V.	FLAG = 0
NBS 694,	LOC 88:	3.548 DL DEG F	1.214 M.V.	FLAG = 0
NBS 605,	LOC 89:	5.116 DL DEG F	1.935 M.V.	FLAG = 0
NBS 614,	LOC 90:	-.143 DL DEG F	-.036 M.V.	FLAG = 0
NBS 615,	LOC 91:	7.267 DL DEG F	1.834 M.V.	FLAG = 0
NBS 628,	LOC 92:	.123 DL DEG F	.047 M.V.	FLAG = 0
NBS 631,	LOC 93:	.893 DL DEG F	.225 M.V.	FLAG = 0
NBS 632,	LOC 94:	11.880 DL DEG F	3.010 M.V.	FLAG = 0
NBS 634,	LOC 95:	53.751 DL DEG F	20.000 M.V.	FLAG = 0
NBS 635,	LOC 96:	-3.473 DL DEG F	-.872 M.V.	FLAG = 0
NBS 637,	LOC 97:	6.739 DL DEG F	2.565 M.V.	FLAG = 0
NBS 641,	LOC 98:	9.454 DL DEG F	2.366 M.V.	FLAG = 0
NBS 642,	LOC 99:	12.396 DL DEG F	3.098 M.V.	FLAG = 0
NBS 647,	LOC 100:	1.347 DL DEG F	.478 M.V.	FLAG = 0
NBS 659,	LOC 101:	4.863 DL DEG F	1.729 M.V.	FLAG = 0
NBS 660,	LOC 102:	-.931 DL DEG F	-.330 M.V.	FLAG = 0
NBS 664,	LOC 103:	-33.426 DL DEG F	-11.657 M.V.	FLAG = 0
NBS 674,	LOC 104:	-3.661 DL DEG F	-1.253 M.V.	FLAG = 0
NBS 675,	LOC 105:	-5.922 DL DEG F	-2.032 M.V.	FLAG = 0
NBS 692,	LOC 106:	-.079 DL DEG F	-.027 M.V.	FLAG = 0
NBS 695,	LOC 107:	5.500 DL DEG F	1.880 M.V.	FLAG = 0
NBS 702,	LOC 108:	.026 DL DEG F	.009 M.V.	FLAG = 0

NBS 703,	LOC 109:	-.023 DL DEG F	-.008 M.V.	FLAG = 0
NBS 501,	LOC 110:	805.546 KW (AVG)	734.000 M.V.	FLAG = 0
NBS 502,	LOC 111:	.000 KW (AVG)	4677.000 M.V.	FLAG = 0
NBS 503,	LOC 112:	258.560 KW (AVG)	3406.000 M.V.	FLAG = 0
NBS 509,	LOC 113:	.000 KW (AVG)	2.000 M.V.	FLAG = 0
NBS 510,	LOC 114:	14.472 KW (AVG)	4943.000 M.V.	FLAG = 0
NBS 511,	LOC 115:	102.158 KW (AVG)	3198.000 M.V.	FLAG = 0
NBS 512,	LOC 116:	30.269 KW (AVG)	1755.000 M.V.	FLAG = 0
NBS 513,	LOC 117:	.000 KW (AVG)	8.000 M.V.	FLAG = 0
NBS 514,	LOC 118:	.000 KW (AVG)	1354.000 M.V.	FLAG = 0
NBS 0,	LOC 119:	1331.000 NONE	1331.000 M.V.	FLAG = 1
NBS 806,	LOC 120:	1332.000 ON/OFF	1332.000 M.V.	FLAG = 0
NBS 815,	LOC 121:	1331.000 ON/OFF	1331.000 M.V.	FLAG = 0
NBS 821,	LOC 122:	1331.000 ON/OFF	1331.000 M.V.	FLAG = 0
NBS 830,	LOC 123:	1331.000 ON/OFF	1331.000 M.V.	FLAG = 0
NBS 836,	LOC 124:	1330.000 ON/OFF	1330.000 M.V.	FLAG = 0
NBS 845,	LOC 125:	1330.000 ON/OFF	1330.000 M.V.	FLAG = 0
NBS 851,	LOC 126:	1330.000 ON/OFF	1330.000 M.V.	FLAG = 0
NBS 800,	LOC 127:	1329.000 ON/OFF	1329.000 M.V.	FLAG = 0
NBS 860,	LOC 128:	1329.000 ON/OFF	1329.000 M.V.	FLAG = 0
NBS 866,	LOC 129:	1328.000 ON/OFF	1328.000 M.V.	FLAG = 0
NBS 0,	LOC 130:	1328.000 NONE	1328.000 M.V.	FLAG = 1
NBS 0,	LOC 131:	1327.000 NONE	1327.000 M.V.	FLAG = 1
NBS 0,	LOC 132:	1327.000 NONE	1327.000 M.V.	FLAG = 1
NBS 0,	LOC 133:	1327.000 NONE	1327.000 M.V.	FLAG = 1
NBS 0,	LOC 134:	1326.000 NONE	1326.000 M.V.	FLAG = 1
NBS 0,	LOC 135:	1326.000 NONE	1326.000 M.V.	FLAG = 1
NBS 0,	LOC 136:	1326.000 NONE	1326.000 M.V.	FLAG = 1
NBS 0,	LOC 137:	1325.000 NONE	1325.000 M.V.	FLAG = 1
NBS 0,	LOC 138:	1325.000 NONE	1325.000 M.V.	FLAG = 1
NBS 0,	LOC 139:	1324.000 NONE	1324.000 M.V.	FLAG = 1
NBS 360,	LOC 140:	.002 GPM (AV)	8428.000 M.V.	FLAG = 0
NBS 361,	LOC 141:	.428 GPM (AV)	9754.000 M.V.	FLAG = 0
NBS 362,	LOC 142:	.356 GPM (AV)	5451.000 M.V.	FLAG = 0
NBS 363,	LOC 143:	.335 GPM (AV)	5899.000 M.V.	FLAG = 0
NBS 364,	LOC 144:	.000 GPM (AV)	1456.000 M.V.	FLAG = 0
NBS 365,	LOC 145:	.843 GPM (AV)	3207.000 M.V.	FLAG = 0
NBS 366,	LOC 146:	.000 GPM (AV)	6456.000 M.V.	FLAG = 0
NBS 0,	LOC 147:	6364.000 NONE	6364.000 M.V.	FLAG = 1
NBS 0,	LOC 148:	6356.000 NONE	6356.000 M.V.	FLAG = 1
NBS 0,	LOC 149:	6355.000 NONE	6355.000 M.V.	FLAG = 1
NBS 0,	LOC 150:	6355.000 NONE	6355.000 M.V.	FLAG = 1
NBS 0,	LOC 151:	6354.000 NONE	6354.000 M.V.	FLAG = 1
NBS 0,	LOC 152:	6353.000 NONE	6353.000 M.V.	FLAG = 1
NBS 0,	LOC 153:	6352.000 NONE	6352.000 M.V.	FLAG = 1
NBS 0,	LOC 154:	6351.000 NONE	6351.000 M.V.	FLAG = 1
NBS 0,	LOC 155:	6350.000 NONE	6350.000 M.V.	FLAG = 1
NBS 0,	LOC 156:	6350.000 NONE	6350.000 M.V.	FLAG = 1
NBS 0,	LOC 157:	6349.000 NONE	6349.000 M.V.	FLAG = 1
NBS 0,	LOC 158:	6348.000 NONE	6348.000 M.V.	FLAG = 1
NBS 0,	LOC 159:	6347.000 NONE	6347.000 M.V.	FLAG = 1
NBS 400,	LOC 160:	496.000 VOLTS	4960.000 M.V.	FLAG = 0
NBS 0,	LOC 161:	70.000 NONE	70.000 M.V.	FLAG = 1
NBS 0,	LOC 162:	30.000 NONE	30.000 M.V.	FLAG = 1

NBS 410,	LOC 163:	465.000	VOLTS	4650.000	M.V.	FLAG = 0
NBS 0,	LOC 164:	20.000	NONE	20.000	M.V.	FLAG = 1
NBS 0,	LOC 165:	10.000	NONE	10.000	M.V.	FLAG = 1
NBS 0,	LOC 166:	20.000	NONE	20.000	M.V.	FLAG = 1
NBS 0,	LOC 167:	20.000	NONE	20.000	M.V.	FLAG = 1
NBS 0,	LOC 168:	20.000	NONE	20.000	M.V.	FLAG = 1
NBS 0,	LOC 169:	20.000	NONE	20.000	M.V.	FLAG = 1
NBS 0,	LOC 170:	-.030	NONE	-.030	M.V.	FLAG = 1
NBS 0,	LOC 171:	-.030	NONE	-.030	M.V.	FLAG = 1
NBS 102,	LOC 172:	5.120	MINUTES	3669.000	M.V.	FLAG = 0
NBS 110,	LOC 173:	.000	MINUTES	4583.000	M.V.	FLAG = 0
NBS 111,	LOC 174:	.427	MINUTES	2085.000	M.V.	FLAG = 0
NBS 0,	LOC 175:	1834.000	NONE	1834.000	M.V.	FLAG = 1
NBS 0,	LOC 176:	1670.000	NONE	1670.000	M.V.	FLAG = 1
NBS 130,	LOC 177:	.695	PWR FACT	3054.000	M.V.	FLAG = 0
NBS 141,	LOC 178:	60.031	HERTZ	2578.000	M.V.	FLAG = 0
NBS 772,	LOC 179:	4.049	DL DEG F	1187.000	M.V.	FLAG = 0
NBS 332,	LOC 180:	708.432	LB/MIN	4396.000	M.V.	FLAG = 0
NBS 0,	LOC 181:	2531.000	NONE	2617.000	M.V.	FLAG = 1
NBS 0,	LOC 182:	2935.000	NONE	3021.000	M.V.	FLAG = 1
NBS 522,	LOC 183:	10.404	KW (AVG)	4185.000	M.V.	FLAG = 0
NBS 0,	LOC 184:	424.000	NONE	510.000	M.V.	FLAG = 1
NBS 0,	LOC 185:	4499.000	NONE	4585.000	M.V.	FLAG = 1
NBS 0,	LOC 186:	4372.000	NONE	4458.000	M.V.	FLAG = 1
NBS 760,	LOC 187:	271.661	DEG F	5946.000	M.V.	FLAG = 0
NBS 0,	LOC 188:	6487.000	NONE	6573.000	M.V.	FLAG = 1
NBS 0,	LOC 189:	1886.000	NONE	1972.000	M.V.	FLAG = 1
NBS 0,	LOC 190:	3176.000	NONE	3262.000	M.V.	FLAG = 1
NBS 0,	LOC 191:	296.000	NONE	382.000	M.V.	FLAG = 1
NBS 0,	LOC 192:	.000	NONE	86.000	M.V.	FLAG = 1
NBS 771,	LOC 193:	19.219	DL DEG F	4726.000	M.V.	FLAG = 0
NBS 330,	LOC 194:	.000	LB/MIN	-17.000	M.V.	FLAG = 0
NBS 651,	LOC 195:	4.730	DL DEG F	1144.000	M.V.	FLAG = 0
NBS 339,	LOC 196:	.000	LB/MIN	-15.000	M.V.	FLAG = 0
NBS 791,	LOC 197:	.526	DL DEG F	116.000	M.V.	FLAG = 0
NBS 348,	LOC 198:	.000	GPM (AV)	9244.000	M.V.	FLAG = 0
NBS 524,	LOC 199:	8.847	KW (AVG)	4175.000	M.V.	FLAG = 0
NBS 523,	LOC 200:	3.053	KW (AVG)	3477.000	M.V.	FLAG = 0
NBS 424,	LOC 201:	306.400	VOLTS	3049.000	M.V.	FLAG = 0
NBS 624,	LOC 202:	151.588	DEG F	2740.000	M.V.	FLAG = 0
NBS 761,	LOC 203:	170.394	DEG F	3204.000	M.V.	FLAG = 0
NBS 781,	LOC 204:	171.438	DEG F	3230.000	M.V.	FLAG = 0
NBS 0,	LOC 205:	.000	NONE	-15.000	M.V.	FLAG = 1
NBS 0,	LOC 206:	.000	NONE	-15.000	M.V.	FLAG = 1
NBS 775,	LOC 207:	.613	DL DEG F	2573.000	M.V.	FLAG = 0
NBS 331,	LOC 208:	.000	LB/MIN	2287.000	M.V.	FLAG = 0
NBS 655,	LOC 209:	-.620	DL DEG F	2161.000	M.V.	FLAG = 0
NBS 340,	LOC 210:	.000	LB/MIN	1924.000	M.V.	FLAG = 0
NBS 795,	LOC 211:	-1.941	DL DEG F	1728.000	M.V.	FLAG = 0
NBS 349,	LOC 212:	13.728	GPM (AV)	2763.000	M.V.	FLAG = 0
NBS 532,	LOC 213:	181.371	KW (AVG)	2918.000	M.V.	FLAG = 0
NBS 531,	LOC 214:	.173	KW (AVG)	2977.000	M.V.	FLAG = 0
NBS 432,	LOC 215:	28.367	VOLTS	2982.000	M.V.	FLAG = 0
NBS 0,	LOC 216:	586.000	NONE	2954.000	M.V.	FLAG = 1

NBS 625,	LOC 217:	59.680	DEG F	2976.000	M.V.	FLAG = 0
NBS 762,	LOC 218:	60.891	DEG F	3003.000	M.V.	FLAG = 0
NBS 782,	LOC 219:	45.576	DEG F	2664.000	M.V.	FLAG = 0
NBS 0,	LOC 220:	.000	NONE	2368.000	M.V.	FLAG = 1
NBS 148,	LOC 221:	.000	WEA.STA.	2588.000	M.V.	FLAG = 0
NBS 149,	LOC 222:	.000	WEA.STA.	2547.000	M.V.	FLAG = 0
NBS 0,	LOC 223:	-145.000	NONE	2494.000	M.V.	FLAG = 1
NBS 0,	LOC 224:	-220.000	NONE	2419.000	M.V.	FLAG = 1
NBS 200,	LOC 225:	27.000	WEA.STA.	2325.000	M.V.	FLAG = 0
NBS 710,	LOC 226:	-2.540	WEA.STA.	2385.000	M.V.	FLAG = 0
NBS 712,	LOC 227:	.000	WEA.STA.	2457.000	M.V.	FLAG = 0
NBS 714,	LOC 228:	-1.130	WEA.STA.	2526.000	M.V.	FLAG = 0
NBS 0,	LOC 229:	-50.000	NONE	2589.000	M.V.	FLAG = 1
NBS 0,	LOC 230:	.000	NONE	2639.000	M.V.	FLAG = 1
NBS 0,	LOC 231:	.000	NONE	2683.000	M.V.	FLAG = 1
NBS 0,	LOC 232:	.000	NONE	2726.000	M.V.	FLAG = 1
NBS 0,	LOC 233:	.000	NONE	2717.000	M.V.	FLAG = 1
NBS 0,	LOC 234:	.000	NONE	2668.000	M.V.	FLAG = 1
NBS 770,	LOC 235:	10.100	DL DEG F	3814.000	M.V.	FLAG = 0
NBS 328,	LOC 236:	966.035	LB/MIN	2705.000	M.V.	FLAG = 0
NBS 650,	LOC 237:	-3.573	DL DEG F	-1192.000	M.V.	FLAG = 0
NBS 337,	LOC 238:	.000	LB/MIN	2056.000	M.V.	FLAG = 0
NBS 790,	LOC 239:	5.916	DL DEG F	2253.000	M.V.	FLAG = 0
NBS 346,	LOC 240:	441.024	LB/MIN	5194.000	M.V.	FLAG = 0
NBS 520,	LOC 241:	70.451	KW (AVG)	3914.000	M.V.	FLAG = 0
NBS 519,	LOC 242:	8.602	KW (AVG)	3174.000	M.V.	FLAG = 0
NBS 420,	LOC 243:	117.920	VOLTS	5928.000	M.V.	FLAG = 0
NBS 643,	LOC 244:	85.278	DEG F	1218.000	M.V.	FLAG = 0
NBS 763,	LOC 245:	178.277	DEG F	3448.000	M.V.	FLAG = 0
NBS 783,	LOC 246:	178.835	DEG F	3462.000	M.V.	FLAG = 0
NBS 0,	LOC 247:	.000	NONE	32.000	M.V.	FLAG = 1
NBS 0,	LOC 248:	.000	NONE	32.000	M.V.	FLAG = 1
NBS 768,	LOC 249:	7.667	DL DEG F	2869.000	M.V.	FLAG = 0
NBS 327,	LOC 250:	4493.028	LB/MIN	3324.000	M.V.	FLAG = 0
NBS 648,	LOC 251:	-4.495	DL DEG F	-1578.000	M.V.	FLAG = 0
NBS 336,	LOC 252:	.000	LB/MIN	2048.000	M.V.	FLAG = 0
NBS 788,	LOC 253:	7.596	DL DEG F	2842.000	M.V.	FLAG = 0
NBS 345,	LOC 254:	851.297	LB/MIN	5839.000	M.V.	FLAG = 0
NBS 516,	LOC 255:	124.859	KW (AVG)	4285.000	M.V.	FLAG = 0
NBS 515,	LOC 256:	13.243	KW (AVG)	201.000	M.V.	FLAG = 0
NBS 416,	LOC 257:	533.040	VOLTS	6667.000	M.V.	FLAG = 0
NBS 0,	LOC 258:	1.000	NONE	5.000	M.V.	FLAG = 1
NBS 644,	LOC 259:	112.394	DEG F	1819.000	M.V.	FLAG = 0
NBS 764,	LOC 260:	174.883	DEG F	3335.000	M.V.	FLAG = 0
NBS 784,	LOC 261:	174.643	DEG F	3329.000	M.V.	FLAG = 0
NBS 0,	LOC 262:	.000	NONE	4.000	M.V.	FLAG = 1
NBS 774,	LOC 263:	22.819	DL DEG F	8495.000	M.V.	FLAG = 0
NBS 334,	LOC 264:	1210.428	LB/MIN	3078.000	M.V.	FLAG = 0
NBS 654,	LOC 265:	11.646	DL DEG F	4119.000	M.V.	FLAG = 0
NBS 343,	LOC 266:	1363.075	LB/MIN	2347.000	M.V.	FLAG = 0
NBS 794,	LOC 267:	10.893	DL DEG F	4090.000	M.V.	FLAG = 0
NBS 353,	LOC 268:	145.149	LB/MIN	2157.000	M.V.	FLAG = 0
NBS 530,	LOC 269:	79.456	KW (AVG)	3818.000	M.V.	FLAG = 0
NBS 529,	LOC 270:	30.742	KW (AVG)	3687.000	M.V.	FLAG = 0

NBS 150, LOC 271:	346.000 WEA.STA.	3472.000 M.V.	FLAG = 0
NBS 151, LOC 272:	7.000 WEA.STA.	719.000 M.V.	FLAG = 0
NBS 645, LOC 273:	106.294 DEG F	1684.000 M.V.	FLAG = 0
NBS 765, LOC 274:	177.041 DEG F	3397.000 M.V.	FLAG = 0
NBS 785, LOC 275:	178.397 DEG F	3431.000 M.V.	FLAG = 0
NBS 0, LOC 276:	.000 NONE	12.000 M.V.	FLAG = 1
NBS 626, LOC 277:	14.032 DL DEG F	4842.000 M.V.	FLAG = 0
NBS 333, LOC 278:	1847.929 LB/MIN	2427.000 M.V.	FLAG = 0
NBS 793, LOC 279:	8.162 DL DEG F	3076.000 M.V.	FLAG = 0
NBS 351, LOC 280:	3238.291 LB/MIN	4341.000 M.V.	FLAG = 0
NBS 526, LOC 281:	47.295 KW (AVG)	51.000 M.V.	FLAG = 0
NBS 527, LOC 282:	26.485 KW (AVG)	5077.000 M.V.	FLAG = 0
NBS 528, LOC 283:	27.034 KW (AVG)	4464.000 M.V.	FLAG = 0
NBS 426, LOC 284:	489.520 VOLTS	6138.000 M.V.	FLAG = 0
NBS 428, LOC 285:	132.740 VOLTS	6656.000 M.V.	FLAG = 0
NBS 646, LOC 286:	93.851 DEG F	1402.000 M.V.	FLAG = 0
NBS 786, LOC 287:	177.560 DEG F	3417.000 M.V.	FLAG = 0
NBS 147, LOC 288:	.000 SUM/WINT	19.000 M.V.	FLAG = 0
NBS 147, LOC 289:	.000 SUM/WINT	19.000 M.V.	FLAG = 0
NBS 0, LOC 290:	.000 NONE	19.000 M.V.	FLAG = 1

V. TYPICAL NUMERICAL SUMMARY LISTING
1. HOURLY

HOURLY SUMMARY FOR SEPTEMBER 20, 1976; 1100-1200 PAGE 1
TOTAL DATA TIME: 60 MINUTES, ACTUAL TIME: 264 11: 0

NBS LOC	VALUE	UNITS	TIME	DER*	VALUE	UNITS	TIME
10	55.591	PSI	60	1010	-.014	MINUTES	60
11	56.675	PSI	60	1011	58.849	MINUTES	60
12	.000	PSI	60	1012	.000	MINUTES	60
13	.346	PSI	60	1013	1169.733	KWH(INS)	60
14	.001	PSI	60	1014	362.537	KWH(INS)	60
15	11410.902	LB/MIN	60	1015	.000	KWH(INS)	60
16	2416.938	LB/MIN	60	1016	807.195	KWH(INS)	60
17	2262.988	LB/MIN	60	1018	.000	KWH(INS)	60
18	6935.794	LB/MIN	60	1019	15.812	KWH(INS)	60
19	6546.213	LB/MIN	60	1020	109.670	KWH(INS)	60
20	5511.771	LB/MIN	60	1021	107.906	KWH(INS)	60
21	17064.230	LB/MIN	60	1022	153.561	KWH(INS)	60
22	18374.711	LB/MIN	60	1023	.000	KWH(INS)	60
23	782.666	LB/MIN	60	1025	1196.941	KWH(AVG)	60
24	17924.504	LB/MIN	60	1026	370.346	KWH(AVG)	60
25	10148.211	LB/MIN	60	1027	.000	KWH(AVG)	60
26	2856.137	LB/MIN	60	1028	826.595	KWH(AVG)	60
27	843.221	LB/MIN	60	1030	.000	KWH(AVG)	60
28	8441.324	LB/MIN	60	1031	16.120	KWH(AVG)	60
29	9974.648	LB/MIN	60	1032	116.464	KWH(AVG)	60
30	.000	GPM (AV)	60	1033	109.882	KWH(AVG)	60
31	5.414	GPM (AV)	60	1034	164.035	KWH(AVG)	60
32	5.334	GPM (AV)	60	1035	7.646	KWH(AVG)	60
33	5.067	GPM (AV)	60	1036	20.573	KWH(AVG)	60
34	3.975	GPM (AV)	60	1037	146.063	KWH(AVG)	60
35	24.201	GPM (AV)	60	1038	166.636	KWH(AVG)	60
36	22.442	GPM (AV)	60	1039	.000	KWH(AVG)	0
37	4.468	GPM (AV)	60	1040	.000	KWH(AVG)	0
38	5.480	GPM (AV)	60	1041	.000	KWH(AVG)	0
39	2.847	GPM (AV)	60	1042	.000	KWH(AVG)	60
40	2.892	GPM (AV)	60	1043	4.417	KWH(AVG)	60
41	1169.733	KW (INS)	60	1044	33.915	KWH(AVG)	55
42	362.537	KW (INS)	60	1045	38.331	KWH(AVG)	55
43	.000	KW (INS)	60	1046	55.966	KWH(AVG)	60
44	.000	KW (INS)	60	1047	33.580	KWH(AVG)	60
45	15.812	KW (INS)	60	1048	89.545	KWH(AVG)	60
46	109.670	KW (INS)	60	1049	26.880	KWH(AVG)	60
47	107.906	KW (INS)	60	1050	116.425	KWH(AVG)	60
48	153.561	KW (INS)	60	1051	34.289	KWH(AVG)	60
49	.000	KW (INS)	60	1052	87.732	KWH(AVG)	60
50	201.758	DEG. F.	60	1053	122.021	KWH(AVG)	60
51	207.875	DEG. F.	60	1054	2.940	KWH(AVG)	60
52	201.176	DEG. F.	60	1055	98.304	KWH(AVG)	60
53	215.121	DEG. F.	60	1056	101.244	KWH(AVG)	60
54	197.319	DEG. F.	60	1059	414.147	KWH(AVG)	60
55	218.524	DEG. F.	60	1060	46.000	KWH(AVG)	60
56	204.319	DEG. F.	60	1061	.000	KWH(AVG)	0
57	202.077	DEG. F.	60	1062	.000	KWH(AVG)	0
58	207.500	DEG. F.	60	1063	.000	KWH(AVG)	0

*DER DENOTES THE DERIVED VARIABLE CODE (SEE APPENDIX III).

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
59	201.697	DEG.F.	60	1064	.000	KWH(AVG)	0
60	201.970	DEG.F.	60	1065	7.646	KWH(AVG)	60
61	58.176	DEG.F.	60	1066	782.793	KWH(AVG)	60
62	61.966	DEG.F.	60	1067	.000	KWH(AVG)	0
63	59.688	DEG.F.	60	1073	70.808	KWH(AVG)	60
64	61.914	DEG.F.	60	1074	.000	KWH(AVG)	0
65	70.225	DEG.F.	60	1075	.000	KWH(AVG)	0
66	73.855	DEG.F.	60	1076	186.036	KWH(AVG)	60
67	73.939	DEG.F.	60	1077	82.846	KWH(AVG)	60
68	80.166	DEG.F.	60	1078	33.915	KWH(AVG)	55
69	82.619	DEG.F.	60	1079	.000	KWH(AVG)	0
70	87.567	DEG.F.	60	1080	146.063	KWH(AVG)	60
71	82.671	DEG.F.	60	1081	.000	KWH(AVG)	0
72	217.886	DEG.F.	5	1082	.000	KWH(AVG)	0
73	119.293	DEG.F.	60	1087	8698860.000	B.T.U.	60
74	90.542	DEG.F.	60	1088	4627887.000	B.T.U.	60
75	90.292	DEG.F.	60	1089	13326746.000	B.T.U.	60
76	98.146	DEG.F.	60	1090	12653688.000	B.T.U.	60
77	99.543	DEG.F.	60	1091	170443.375	B.T.U.	60
78	90.133	DEG.F.	60	1092	502614.000	B.T.U.	60
79	90.770	DEG.F.	60	1093	13999802.000	B.T.U.	60
80	306.095	DEG.F.	60	1100	.000	B.T.U.	0
81	95.595	DEG.F.	60	1101	284408.500	B.T.U.	60
82	665.878	DEG.F.	60	1102	284408.500	B.T.U.	60
83	141.056	DEG.F.	60	1103	.000	B.T.U.	0
84	483.674	DEG.F.	60	1104	-182693.375	B.T.U.	60
85	138.418	DEG.F.	60	1105	-182693.375	B.T.U.	60
86	6.078	DL DEG.F	60	1106	887020.875	B.T.U.	60
87	-.611	DL DEG.F	60	1107	881472.625	B.T.U.	60
88	-.230	DL DEG.F	60	1108	881472.625	B.T.U.	60
89	5.737	DL DEG.F	60	1109	-79002.922	B.T.U.	60
90	8.040	DL DEG.F	60	1110	-82934.203	B.T.U.	60
91	-1.956	DL DEG.F	60	1111	-82934.203	B.T.U.	60
92	.000	DL DEG.F	0	1112	.000	B.T.U.	0
93	.358	DL DEG.F	60	1113	1165881.000	B.T.U.	60
94	2.061	DL DEG.F	60	1114	1165881.000	B.T.U.	60
95	16.070	DL DEG.F	60	1115	.000	B.T.U.	0
96	-3.589	DL DEG.F	60	1116	-265627.562	B.T.U.	60
97	11.059	DL DEG.F	60	1117	-265627.562	B.T.U.	60
98	1.285	DL DEG.F	60	1118	.000	B.T.U.	0
99	3.081	DL DEG.F	60	1119	3027623.500	B.T.U.	60
100	3.988	DL DEG.F	60	1120	3027623.500	B.T.U.	60
101	1.006	DL DEG.F	60	1121	3927877.000	B.T.U.	60
102	2.103	DL DEG.F	60	1122	.000	B.T.U.	0
103	5.513	DL DEG.F	60	1123	.000	B.T.U.	0
104	8.496	DL DEG.F	60	1124	.000	B.T.U.	0
105	4.198	DL DEG.F	60	1125	.000	B.T.U.	0
106	-.214	DL DEG.F	60	1126	.000	B.T.U.	0
107	2.309	DL DEG.F	60	1127	7547513.000	B.T.U.	60
108	2.160	DL DEG.F	60	1128	7571375.000	B.T.U.	60

NBS LOC	VALUE	UNITS	TIME	DEH	VALUE	UNITS	TIME
109	2.466	DL DEG.F	60	1129	7571375.000	B.T.U.	60
110	1196.941	KW (AVG)	60	1130	6687524.000	B.T.U.	60
111	370.346	KW (AVG)	60	1131	3037476.000	B.T.U.	60
112	.000	KW (AVG)	60	1132	9725000.000	B.T.U.	60
113	.000	KW (AVG)	60	1133	1535373.500	B.T.U.	60
114	16.120	KW (AVG)	60	1134	1411287.500	B.T.U.	60
115	116.464	KW (AVG)	60	1135	1411287.500	B.T.U.	60
116	109.882	KW (AVG)	60	1136	260380.844	B.T.U.	60
117	164.035	KW (AVG)	60	1137	244813.062	B.T.U.	60
118	7.646	KW (AVG)	60	1138	244813.062	B.T.U.	60
120	.000	ON/OFF	0	1139	-42164.062	B.T.U.	60
121	.000	ON/OFF	0	1140	-3217.673	B.T.U.	60
122	.000	ON/OFF	0	1141	11472172.000	B.T.U.	60
123	.000	ON/OFF	0	1142	11496034.000	B.T.U.	60
124	.000	ON/OFF	0	1143	11496034.000	B.T.U.	60
125	.000	ON/OFF	0	1144	11478588.000	B.T.U.	60
126	.000	ON/OFF	0	1145	11338934.000	B.T.U.	60
127	.000	ON/OFF	0	1146	11338934.000	B.T.U.	60
128	.000	ON/OFF	0	1147	-6416.000	B.T.U.	60
129	.000	ON/OFF	0	1148	157100.000	B.T.U.	60
160	49.292	VOLTS	60	1149	157100.000	B.T.U.	60
163	46.825	VOLTS	60	1155	1523791.250	B.T.U.	60
172	4.987	MINUTES	60	1156	.000	B.T.U.	60
173	4.904	MINUTES	60	1157	.000	B.T.U.	60
174	.000	MINUTES	60	1158	1019067.875	B.T.U.	60
177	.693	PWR.FACT	60	1159	504723.375	B.T.U.	60
178	59.986	HERTZ	60	1160	504723.375	B.T.U.	60
179	.000	DL DEG.F	0	1161	11582.250	B.T.U.	60
180	.000	LB/MIN	0	1162	-112503.750	B.T.U.	60
183	.000	KW (AVG)	60	1163	-112503.750	B.T.U.	60
187	.000	DEG.F.	0	1170	2276295.000	B.T.U.	60
193	.000	DL DEG.F	60	1171	-24369.730	B.T.U.	60
194	.000	LB/MIN	60	1172	2251925.000	B.T.U.	60
195	.445	DL DEG.F	60	1173	278938.125	B.T.U.	60
196	1000.939	LB/MIN	60	1174	28710.973	B.T.U.	60
197	3.354	DL DEG.F	60	1175	.000	B.T.U.	0
198	.000	GPM (AV)	60	1176	1258578.500	B.T.U.	60
199	33.915	KW (AVG)	55	1177	1258578.500	B.T.U.	60
200	4.417	KW (AVG)	60	1178	172074.250	B.T.U.	60
201	56.068	VOLTS	60	1179	479723.375	B.T.U.	60
202	61.600	DEG.F.	60	1180	.000	B.T.U.	0
203	193.965	DEG.F.	60	1181	1738301.750	B.T.U.	60
204	199.328	DEG.F.	60	1182	1738301.750	B.T.U.	60
207	6.581	DL DEG.F	60	1183	.000	B.T.U.	0
208	733.844	LB/MIN	60	1184	513623.250	B.T.U.	60
209	2.355	DL DEG.F	60	1185	513623.250	B.T.U.	60
210	2909.195	LB/MIN	60	1191	420510.500	B.T.U.	60
211	6.599	DL DEG.F	60	1192	422554.062	B.T.U.	60
212	2.190	GPM (AV)	60	1193	422554.062	B.T.U.	60
213	98.304	KW (AVG)	60	1194	8759.818	B.T.U.	60

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
214	2.940	KW (AVG)	60	1195	839059.875	B.T.U.	60
215	81.187	VOLTS	60	1196	1268330.250	B.T.U.	60
217	65.846	DEG.F.	55	1197	1268330.000	B.T.U.	60
218	190.430	DEG.F.	60	1198	1270373.500	B.T.U.	60
219	182.915	DEG.F.	60	1199	1270373.500	B.T.U.	60
221	.884	C/CM2/MN	60	1200	370088.750	B.T.U.	60
222	.223	C/CM2/MN	60	1201	502614.000	B.T.U.	60
223	.000	DEGREES	60	1202	-36736.539	B.T.U.	60
224	102.917	MILES/HR	60	1203	-2739.078	B.T.U.	60
225	30.426	IN.HG.	60	1204	435101.437	B.T.U.	60
226	73.799	DEG.F.	60	1205	1231593.500	B.T.U.	60
227	43.500	PER-CENT	60	1206	1231593.250	B.T.U.	60
228	.000	DEG.F.	0	1207	1233636.750	B.T.U.	60
235	5.164	DL DEG.F	60	1208	1233636.750	B.T.U.	60
236	.000	LB/MIN	60	1209	1231593.500	B.T.U.	60
237	.841	DL DEG.F	60	1210	1233637.000	B.T.U.	60
238	1988.088	LB/MIN	60	1211	1233637.000	B.T.U.	60
239	5.448	DL DEG.F	60	1212	1305065.000	B.T.U.	60
240	275.341	LB/MIN	60	1213	-73471.500	B.T.U.	60
241	.000	KW (AVG)	0	1214	-73471.750	B.T.U.	60
242	.000	KW (AVG)	0	1215	-71428.250	B.T.U.	60
243	117.748	VOLTS	60	1216	-71428.250	B.T.U.	60
244	61.287	DEG.F.	60	1217	-73471.500	B.T.U.	60
245	196.643	DEG.F.	60	1218	-71428.000	B.T.U.	60
246	198.229	DEG.F.	60	1219	-71428.000	B.T.U.	60
249	5.871	DL DEG.F	60	1225	42604.570	B.T.U.	60
250	1149.771	LB/MIN	60	1226	60421.836	B.T.U.	60
251	1.604	DL DEG.F	60	1227	103026.406	B.T.U.	60
252	6950.810	LB/MIN	60	1233	356788.750	B.T.U.	60
253	6.333	DL DEG.F	60	1234	48240.187	B.T.U.	60
254	938.934	LB/MIN	60	1235	405028.937	B.T.U.	60
255	146.063	KW (AVG)	60	1236	90010.453	B.T.U.	60
256	20.573	KW (AVG)	60	1237	-4697.328	B.T.U.	60
257	119.087	VOLTS	60	1238	85313.125	B.T.U.	60
259	61.995	DEG.F.	55	1241	.000	B.T.U.	0
260	201.554	DEG.F.	60	1242	.000	B.T.U.	60
261	200.330	DEG.F.	60	1243	.000	B.T.U.	60
263	6.624	DL DEG.F	50	1244	.000	B.T.U.	60
264	438.645	LB/MIN	60	1245	490342.062	B.T.U.	60
265	1.161	DL DEG.F	60	1246	490342.062	B.T.U.	60
266	2573.372	LB/MIN	60	1247	14381.312	B.T.U.	60
267	8.591	DL DEG.F	60	1248	.000	B.T.U.	60
268	238.678	LB/MIN	60	1249	.000	B.T.U.	60
269	87.732	KW (AVG)	60	1250	.000	B.T.U.	60
270	34.289	KW (AVG)	60	1251	123027.062	B.T.U.	60
271	130.228	VOLTS	60	1252	51310.031	B.T.U.	50
273	61.152	DEG.F.	55	1253	174337.094	B.T.U.	50
274	198.956	DEG.F.	60	1254	866.949	B.T.U.	60
275	197.949	DEG.F.	60	1255	288882.250	B.T.U.	60
277	-.595	DL DEG.F	60	1256	289749.250	B.T.U.	60

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
278	4686.000	LB/MIN	60	1257	464086.312	B.T.U.	50
279	1.428	DL DEG.F	60	1258	554981.500	B.T.U.	50
280	.000	LB/MIN	60	1259	954428.375	B.T.U.	50
281	55.966	KW (AVG)	60	1260	569362.750	B.T.U.	50
282	33.580	KW (AVG)	60	1266	669002.000	B.T.U.	60
283	26.880	KW (AVG)	60	1267	100338.656	B.T.U.	60
284	118.143	VOLTS	60	1268	.000	B.T.U.	60
285	111.867	VOLTS	60	1269	26731.184	B.T.U.	60
286	61.705	DEG.F.	60	1270	796071.750	B.T.U.	60
287	201.254	DEG.F.	60	1271	1103720.500	B.T.U.	60
288	.000	SUM/WINT	0	1272	-623997.125	B.T.U.	60
289	.000	SUM/WINT	0	1273	167273.687	B.T.U.	60
315	46.000	KW (AVG)	60	1274	179297.812	B.T.U.	60
316	1.000	SUM/WINT	60	1275	411035.875	B.T.U.	60
317	.500	PER-CENT	60	1276	757607.375	B.T.U.	60
318	1.000	EFF.	60	1277	500971.125	B.T.U.	60
319	33.900	DEG.API	60	1278	1861327.750	B.T.U.	60
320	139200.000	BTU/GAL	60	1279	-123026.000	B.T.U.	60
				1285	.000	B.T.U.	0
				1286	.000	B.T.U.	0
				1287	.000	B.T.U.	0
				1288	14562678.000	B.T.U.	60
				1289	669730.000	B.T.U.	60
				1290	9005438.000	B.T.U.	60
				1291	9675168.000	B.T.U.	60
				1292	.000	B.T.U.	0
				1298	.000	GALLONS	0
				1299	.000	GALLONS	0
				1300	.000	GALLONS	0
				1301	104.617	GALLONS	60
				1302	4.811	GALLONS	60
				1303	64.694	GALLONS	60
				1304	69.506	GALLONS	60
				1305	.000	GALLONS	0
				1315	46.000	KW (AVG)	60
				1316	1.000	SUM/WINT	60
				1317	.500	PER-CENT	60
				1318	1.000	EFF.	60
				1319	33.900	DEG.API	60
				1320	139200.000	BTU,GAL	60

2. DAILY

DAILY SUMMARY FOR SEPTEMBER 20, 1976 PAGE 1

TOTAL DATA TIME: 1440 MINUTES, ACTUAL TIME: 264 0: 0

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
10	55.638	PSI	1440	1010	-.192	MINUTES	1440
11	56.931	PSI	1440	1011	1414.947	MINUTES	1435
12	1.207	PSI	1440	1012	116.431	MINUTES	1435
13	.335	PSI	1440	1013	27803.605	KWH(INS)	1440
14	.005	PSI	1440	1014	8560.643	KWH(INS)	1440
15	11773.168	LB/MIN	1440	1015	111.950	KWH(INS)	1440
16	2485.011	LB/MIN	1440	1016	19131.012	KWH(INS)	1440
17	2336.201	LB/MIN	1440	1018	.000	KWH(INS)	1440
18	6887.752	LB/MIN	1440	1019	367.203	KWH(INS)	1440
19	6543.331	LB/MIN	1440	1020	2642.867	KWH(IKS)	1440
20	5512.026	LB/MIN	1440	1021	2388.825	KWH(INS)	1440
21	16965.340	LB/MIN	1440	1022	3680.268	KWH(INS)	1440
22	18247.160	LB/MIN	1440	1023	.000	KWH(INS)	1440
23	786.361	LB/MIN	1440	1025	28223.805	KWH(AVG)	1435
24	17826.770	LB/MIN	1440	1026	8653.604	KWH(AVG)	1435
25	10268.971	LB/MIN	1440	1027	137.223	KWH(AVG)	1435
26	2858.187	LB/MIN	1440	1028	19432.973	KWH(AVG)	1435
27	846.587	LB/MIN	1440	1030	.000	KWH(AVG)	1435
28	8417.047	LB/MIN	1440	1031	375.123	KWH(AVG)	1435
29	9862.311	LB/MIN	1440	1032	2800.131	KWH(AVG)	1435
30	.000	GPM (AV)	1435	1033	2428.678	KWH(AVG)	1435
31	5.410	GPM (AV)	1435	1034	3932.602	KWH(AVG)	1435
32	5.332	GPM (AV)	1435	1035	118.808	KWH(AVG)	1435
33	5.059	GPM (AV)	1435	1036	476.110	KWH(AVG)	1410
34	3.968	GPM (AV)	1435	1037	3664.533	KWH(AVG)	1435
35	24.151	GPM (AV)	1435	1038	4150.239	KWH(AVG)	1410
36	22.440	GPM (AV)	1435	1039	.000	KWH(AVG)	0
37	4.476	GPM (AV)	1435	1040	.000	KWH(AVG)	0
38	5.501	GPM (AV)	1435	1041	.000	KWH(AVG)	0
39	3.021	GPM (AV)	1435	1042	.000	KWH(AVG)	1435
40	3.060	GPM (AV)	1435	1043	60.185	KWH(AVG)	1435
41	1158.484	KW (INS)	1440	1044	405.278	KWH(AVG)	1405
42	356.693	KW (INS)	1440	1045	465.611	KWH(AVG)	1405
43	4.665	KW (INS)	1440	1046	1470.938	KWH(AVG)	1435
44	.000	KW (INS)	1440	1047	796.771	KWH(AVG)	1435
45	15.300	KW (INS)	1440	1048	2267.710	KWH(AVG)	1435
46	110.119	KW (INS)	1440	1049	796.878	KWH(AVG)	1435
47	99.534	KW (INS)	1440	1050	3064.588	KWH(AVG)	1435
48	153.344	KW (INS)	1440	1051	822.934	KWH(AVG)	1370
49	.000	KW (INS)	1440	1052	2128.970	KWH(AVG)	1435
50	202.162	DEG.F.	1440	1053	2970.111	KWH(AVG)	1370
51	207.881	DEG.F.	1440	1054	72.374	KWH(AVG)	1435
52	201.665	DEG.F.	1440	1055	1818.965	KWH(AVG)	1430
53	214.434	DEG.F.	1440	1056	1891.345	KWH(AVG)	1430
54	197.881	DEG.F.	1440	1059	9655.338	KWH(AVG)	1435
55	218.502	DEG.F.	1440	1060	1104.000	KWH(AVG)	1440
56	204.669	DEG.F.	1440	1061	979.056	KWH(AVG)	180
57	202.523	DEG.F.	1440	1062	6426.405	KWH(AVG)	180
58	207.596	DEG.F.	1440	1063	2854.110	KWH(AVG)	180

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
59	202.079	DEG.F.	1440	1064	7405.459	KWH(AVG)	180
60	202.434	DEG.F.	1440	1065	118.808	KWH(AVG)	1435
61	57.686	DEG.F.	1440	1066	18568.465	KWH(AVG)	1435
62	60.601	DEG.F.	1440	1067	30398.887	KWH(AVG)	180
63	58.847	DEG.F.	1440	1073	1692.068	KWH(AVG)	1370
64	61.079	DEG.F.	1440	1074	.000	KWH(AVG)	0
65	70.156	DEG.F.	1440	1075	.000	KWH(AVG)	0
66	74.779	DEG.F.	1440	1076	3948.286	KWH(AVG)	1430
67	74.875	DEG.F.	1440	1077	2267.816	KWH(AVG)	1435
68	78.941	DEG.F.	1440	1078	405.278	KWH(AVG)	1405
69	81.360	DEG.F.	1440	1079	.000	KWH(AVG)	0
70	86.354	DEG.F.	1440	1080	3664.533	KWH(AVG)	1435
71	81.413	DEG.F.	1440	1081	.000	KWH(AVG)	0
72	217.886	DEG.F.	5	1082	.000	KWH(AVG)	0
73	126.553	DEG.F.	1440	1087	202281824.000	B.T.U.	1440
74	90.821	DEG.F.	1440	1088	116057664.000	B.T.U.	1440
75	90.751	DEG.F.	1440	1089	318339456.000	B.T.U.	1440
76	99.009	DEG.F.	1440	1090	304828608.000	B.T.U.	1440
77	100.328	DEG.F.	1440	1091	5181246.000	B.T.U.	1440
78	90.981	DEG.F.	1440	1092	8329605.000	B.T.U.	1440
79	91.583	DEG.F.	1440	1093	331850240.000	B.T.U.	1440
80	307.627	DEG.F.	1440	1100	.000	B.T.U.	0
81	95.641	DEG.F.	1440	1101	6401640.000	B.T.U.	1440
82	654.854	DEG.F.	1440	1102	6401640.000	B.T.U.	1440
83	161.072	DEG.F.	1440	1103	.000	B.T.U.	0
84	476.668	DEG.F.	1440	1104	-4441271.000	B.T.U.	1440
85	157.515	DEG.F.	1440	1105	-4441271.000	B.T.U.	1440
86	5.715	DL DEG.F	1440	1106	20493504.000	B.T.U.	1440
87	-.492	DL DEG.F	1440	1107	20480412.000	B.T.U.	1440
88	-.205	DL DEG.F	1440	1108	20480412.000	B.T.U.	1440
89	5.450	DL DEG.F	1440	1109	-1656385.500	B.T.U.	1440
90	7.495	DL DEG.F	1440	1110	-1640116.750	B.T.U.	1440
91	-1.815	DL DEG.F	1440	1111	-1640116.750	B.T.U.	1440
92	.000	DL DEG.F	50	1112	.000	B.T.U.	0
93	.436	DL DEG.F	1440	1113	26882044.000	B.T.U.	1440
94	1.953	DL DEG.F	1440	1114	26882044.000	B.T.U.	1440
95	15.626	DL DEG.F	1440	1115	.000	B.T.U.	0
96	-4.035	DL DEG.F	1440	1116	-6081389.000	B.T.U.	1440
97	10.897	DL DEG.F	1440	1117	-6081389.000	B.T.U.	1440
98	1.370	DL DEG.F	1440	1118	.000	B.T.U.	0
99	2.920	DL DEG.F	1440	1119	71747504.000	B.T.U.	1440
100	4.386	DL DEG.F	1440	1120	71747504.000	B.T.U.	1440
101	1.026	DL DEG.F	1440	1121	92548160.000	B.T.U.	1440
102	2.215	DL DEG.F	1440	1122	189214048.000	B.T.U.	50
103	4.469	DL DEG.F	1440	1123	189983232.000	B.T.U.	50
104	8.276	DL DEG.F	1440	1124	189214048.000	B.T.U.	50
105	4.427	DL DEG.F	1440	1125	189214048.000	B.T.U.	50
106	-.198	DL DEG.F	1440	1126	.000	B.T.U.	50
107	3.443	DL DEG.F	1440	1127	184665792.000	B.T.U.	1440
108	1.946	DL DEG.F	1440	1128	184521888.000	B.T.U.	1440

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
109	2.452	DL DEG.F	1440	1129	184521888.000	B.T.U.	1440
110	1175.992	KW (AVG)	1435	1130	155057760.000	B.T.U.	1440
111	360.567	KW (AVG)	1435	1131	79307520.000	B.T.U.	1440
112	5.718	KW (AVG)	1435	1132	234365312.000	B.T.U.	1440
113	.000	KW (AVG)	1435	1133	36403128.000	B.T.U.	1440
114	15.630	KW (AVG)	1435	1134	33142132.000	B.T.U.	1440
115	116.672	KW (AVG)	1435	1135	33142132.000	B.T.U.	1440
116	101.195	KW (AVG)	1435	1136	7568791.000	B.T.U.	1440
117	163.858	KW (AVG)	1435	1137	7436494.000	B.T.U.	1440
118	4.950	KW (AVG)	1435	1138	7436494.000	B.T.U.	1440
120	.000	ON/OFF	0	1139	-1390951.000	B.T.U.	1440
121	.000	ON/OFF	0	1140	267393.187	B.T.U.	1440
122	.000	ON/OFF	0	1141	277481216.000	B.T.U.	1440
123	.000	ON/OFF	0	1142	277337408.000	B.T.U.	1440
124	.000	ON/OFF	0	1143	277337408.000	B.T.U.	1440
125	.000	ON/OFF	0	1144	276946240.000	B.T.U.	1440
126	.000	ON/OFF	0	1145	273552960.000	B.T.U.	1440
127	.000	ON/OFF	0	1146	273552960.000	B.T.U.	1440
128	.000	ON/OFF	0	1147	535044.000	B.T.U.	1440
129	.000	ON/OFF	0	1148	3784467.000	B.T.U.	1440
160	49.289	VOLTS	1440	1149	3784467.000	B.T.U.	1440
163	46.705	VOLTS	1440	1155	36083904.000	B.T.U.	1440
172	4.998	MINUTES	1435	1156	.000	B.T.U.	1440
173	4.913	MINUTES	1435	1157	.000	B.T.U.	1440
174	.404	MINUTES	1435	1158	23176068.000	B.T.U.	1440
177	.696	PWR.FACT	1440	1159	12907832.000	B.T.U.	1440
178	59.992	HERTZ	1440	1160	12907832.000	B.T.U.	1440
179	.000	DL DEG.F	0	1161	319230.875	B.T.U.	1440
180	.000	LB/MIN	0	1162	-2941773.500	B.T.U.	1440
183	.000	KW (AVG)	1435	1163	-2941773.500	B.T.U.	1440
187	.000	DEG.F.	0	1170	50169384.000	B.T.U.	1440
193	.000	DL DEG.F	1440	1171	5150729.000	B.T.U.	1440
194	.000	LB/MIN	1440	1172	55320096.000	B.T.U.	1440
195	1.393	DL DEG.F	1440	1173	5443969.000	B.T.U.	1440
196	769.723	LB/MIN	1440	1174	757840.250	B.T.U.	1440
197	2.476	DL DEG.F	1440	1175	.000	B.T.U.	0
198	.584	GPM (AV)	1435	1176	31446700.000	B.T.U.	1440
199	16.887	KW (AVG)	1405	1177	31446700.000	B.T.U.	1440
200	2.508	KW (AVG)	1435	1178	5555217.000	B.T.U.	1440
201	56.002	VOLTS	1440	1179	11757030.000	B.T.U.	1440
202	62.639	DEG.F.	1440	1180	.000	B.T.U.	0
203	194.832	DEG.F.	1440	1181	43203720.000	B.T.U.	1440
204	199.450	DEG.F.	1440	1182	43203720.000	B.T.U.	1440
207	6.638	DL DEG.F	1440	1183	.000	B.T.U.	0
208	739.900	LB/MIN	1440	1184	12116384.000	B.T.U.	1440
209	2.414	DL DEG.F	1440	1185	12116384.000	B.T.U.	1440
210	2822.189	LB/MIN	1440	1191	9954438.000	B.T.U.	1440
211	6.607	DL DEG.F	1440	1192	10089188.000	B.T.U.	1440
212	2.338	GPM (AV)	1435	1193	10089188.000	B.T.U.	1440
213	75.790	KW (AVG)	1430	1194	217613.187	B.T.U.	1440

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
214	3.016	KW (AVG)	1435	1195	20335988.000	B.T.U.	1440
215	81.194	VOLTS	1440	1196	30508036.000	B.T.U.	1440
217	65.449	DEG.F.	1330	1197	30508036.000	B.T.U.	1440
218	190.461	DEG.F.	1440	1198	30642784.000	B.T.U.	1440
219	183.213	DEG.F.	1440	1199	30642784.000	B.T.U.	1440
221	.245	C/CM2/MN	1440	1200	8003005.000	B.T.U.	1440
222	.093	C/CM2/MN	1440	1201	8329605.000	B.T.U.	1440
223	8.740	DEGREES	1440	1202	-813024.000	B.T.U.	1440
224	103.028	MILES/HR	1440	1203	-30048.586	B.T.U.	1440
225	30.343	IN.HG.	1440	1204	15018464.000	B.T.U.	1440
226	72.940	DEG.F.	1440	1205	29695008.000	B.T.U.	1440
227	45.896	PER-CENT	1440	1206	29695000.000	B.T.U.	1440
228	.000	DEG.F.	0	1207	29829768.000	B.T.U.	1440
235	6.142	DL DEG.F	1440	1208	29829768.000	B.T.U.	1440
236	.000	LB/MIN	1440	1209	29695000.000	B.T.U.	1440
237	1.077	DL DEG.F	1440	1210	29829768.000	B.T.U.	1440
238	1990.060	LB/MIN	1440	1211	29829768.000	B.T.U.	1440
239	6.396	DL DEG.F	1440	1212	31321024.000	B.T.U.	1440
240	278.025	LB/MIN	1440	1213	-1626012.000	B.T.U.	1440
241	.000	KW (AVG)	0	1214	-1626014.500	B.T.U.	1440
242	.000	KW (AVG)	0	1215	-1491261.750	B.T.U.	1440
243	118.030	VOLTS	1440	1216	-1491261.750	B.T.U.	1440
244	60.607	DEG.F.	1440	1217	-1626013.500	B.T.U.	1440
245	197.139	DEG.F.	1440	1218	-1491260.250	B.T.U.	1440
246	198.634	DEG.F.	1440	1219	-1491260.250	B.T.U.	1440
249	5.959	DL DEG.F	1440	1225	1033525.625	B.T.U.	1435
250	1076.856	LB/MIN	1440	1226	1435525.000	B.T.U.	1435
251	1.416	DL DEG.F	1440	1227	2469050.500	B.T.U.	1435
252	6964.394	LB/MIN	1440	1233	8581212.000	B.T.U.	1440
253	6.339	DL DEG.F	1440	1234	722917.250	B.T.U.	1440
254	940.105	LB/MIN	1440	1235	9304128.000	B.T.U.	1440
255	152.689	KW (AVG)	1435	1236	2559199.000	B.T.U.	1440
256	19.838	KW (AVG)	1410	1237	-101735.016	B.T.U.	1440
257	119.172	VOLTS	1440	1238	2457463.500	B.T.U.	1440
259	61.031	DEG.F.	1335	1241	.000	B.T.U.	0
260	201.786	DEG.F.	1440	1242	2462.760	B.T.U.	1435
261	200.720	DEG.F.	1440	1243	.000	B.T.U.	1440
263	6.322	DL DEG.F	1115	1244	2462.760	B.T.U.	1435
264	500.308	LB/MIN	1440	1245	11766738.000	B.T.U.	1435
265	1.216	DL DEG.F	1440	1246	11766738.000	B.T.U.	1435
266	2619.511	LB/MIN	1440	1247	1134996.000	B.T.U.	1435
267	11.366	DL DEG.F	1435	1248	.000	B.T.U.	1440
268	219.169	LB/MIN	1440	1249	.000	B.T.U.	1440
269	88.707	KW (AVG)	1435	1250	.000	B.T.U.	1440
270	34.289	KW (AVG)	1370	1251	4052565.500	B.T.U.	1435
271	130.453	VOLTS	1440	1252	-307916.250	B.T.U.	1115
273	60.819	DEG.F.	1350	1253	4606460.000	B.T.U.	1115
274	198.806	DEG.F.	1440	1254	22257.375	B.T.U.	1435
275	198.312	DEG.F.	1440	1255	7050363.000	B.T.U.	1435
277	-.625	DL DEG.F	1410	1256	7072822.000	B.T.U.	1440

DAILY SUMMARY FOR SEPTEMBER 20, 1976

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
278	4686.000	LB/MIN	1440	1257	11657700.000	B.T.U.	1115
279	1.245	DL DEG.F	1440	1258	12734876.000	B.T.U.	1115
280	.000	LB/MIN	1440	1259	24029080.000	B.T.U.	1115
281	61.289	KW (AVG)	1435	1260	13457276.000	B.T.U.	1115
282	33.199	KW (AVG)	1435	1266	14200098.000	B.T.U.	1440
283	33.203	KW (AVG)	1435	1267	3084700.500	B.T.U.	1440
284	118.869	VOLTS	1440	1268	.000	B.T.U.	1440
285	110.876	VOLTS	1440	1269	1536270.500	B.T.U.	1440
286	60.793	DEG.F.	1440	1270	18821072.000	B.T.U.	1440
287	201.606	DEG.F.	1440	1271	25022868.000	B.T.U.	1440
288	.000	SUM/WINT	0	1272	-13265850.000	B.T.U.	1440
289	.000	SUM/WINT	0	1273	4215489.000	B.T.U.	1410
315	46.000	KW (AVG)	1440	1274	4593305.000	B.T.U.	1440
316	1.000	SUM/WINT	1440	1275	9809110.000	B.T.U.	1440
317	.500	PER-CENT	1440	1276	18612800.000	B.T.U.	1410
318	1.000	EFF.	1440	1277	12850484.000	B.T.U.	1410
319	33.900	DEG.API	1440	1278	43703352.000	B.T.U.	1410
320	139200.000	BTU/GAL	1440	1279	-442126.312	B.T.U.	1410
				1285	.000	B.T.U.	0
				1286	2181524.000	B.T.U.	180
				1287	.000	B.T.U.	0
				1288	339729984.000	B.T.U.	1435
				1289	15707948.000	B.T.U.	1435
				1290	215837312.000	B.T.U.	1435
				1291	231545376.000	B.T.U.	1435
				1292	.000	B.T.U.	0
				1298	.000	GALLONS	0
				1299	15.672	GALLONS	180
				1300	.000	GALLONS	0
				1301	2440.588	GALLONS	1435
				1302	112.845	GALLONS	1435
				1303	1550.555	GALLONS	1435
				1304	1663.401	GALLONS	1435
				1305	.000	GALLONS	0
				1315	1104.000	KW (AVG)	1440
				1316	1.000	SUM/WINT	1440
				1317	.500	PER-CENT	1440
				1318	1.000	EFF.	1440
				1319	33.900	DEG.API	1440
				1320	139200.000	BTU/GAL	1440

3. MONTHLY

MONTHLY SUMMARY FOR SEPTEMBER 1976 PAGE 1

TOTAL DATA TIME: 41020 MINUTES, ACTUAL TIME: 245 0: 0

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
10	51.398	PSI	41000	1010	-2.104	MINUTES	41020
11	48.177	PSI	41020	1011	35681.656	MINUTES	40135
12	8.929	PSI	41020	1012	9408.479	MINUTES	40135
13	.275	PSI	41020	1013	799000.625	KWH(ILS)	41020
14	.045	PSI	41020	1014	209559.219	KWH(INS)	41020
15	11579.326	LB/MIN	41015	1015	38338.719	KWH(INS)	41020
16	2398.346	LB/MIN	41010	1016	551102.750	KWH(INS)	41020
17	2293.812	LB/MIN	40225	1018	.000	KWH(INS)	41020
18	7041.582	LB/MIN	41010	1019	9602.703	KWH(INS)	41020
19	6586.456	LB/MIN	41005	1020	79032.328	KWH(INS)	41020
20	5561.771	LB/MIN	41020	1021	65791.687	KWH(ILS)	41015
21	16582.301	LB/MIN	41020	1022	98060.562	KWH(INS)	41020
22	13672.738	LB/MIN	41000	1023	.000	KWH(INS)	41020
23	790.819	LB/MIN	41020	1025	809468.750	KWH(AVG)	40135
24	16966.988	LB/MIN	27105	1026	211870.625	KWH(AVG)	40125
25	9838.746	LB/MIN	39430	1027	38513.672	KWH(AVG)	40025
26	2859.493	LB/MIN	41020	1028	559083.375	KWH(AVG)	40015
27	832.853	LB/MIN	30895	1030	.000	KWH(AVG)	40135
28	8153.119	LB/MIN	27715	1031	9782.033	KWH(AVG)	40135
29	7831.028	LB/MIN	40990	1032	83309.922	KWH(AVG)	40130
30	.000	GPM (AV)	40135	1033	66207.031	KWH(AVG)	40130
31	5.515	GPM (AV)	40075	1034	102638.156	KWH(AVG)	40135
32	5.435	GPM (AV)	40135	1035	3110.234	KWH(AVG)	40100
33	4.939	GPM (AV)	40135	1036	14217.898	KWH(AVG)	40040
34	4.228	GPM (AV)	40135	1037	105028.016	KWH(AVG)	40135
35	24.105	GPM (AV)	40125	1038	119256.047	KWH(AVG)	40040
36	22.469	GPM (AV)	40135	1039	.000	KWH(AVG)	0
37	4.091	GPM (AV)	40125	1040	.000	KWH(AVG)	0
38	5.077	GPM (AV)	40130	1041	.000	KWH(AVG)	0
39	3.477	GPM (AV)	33230	1042	1.766	KWH(AVG)	40135
40	3.459	GPM (AV)	33250	1043	1313.621	KWH(AVG)	40135
41	1107.273	KW (INS)	41020	1044	9951.068	KWH(AVG)	40065
42	287.995	KW (INS)	41020	1045	11264.805	KWH(AVG)	40065
43	52.490	KW (INS)	41020	1046	43444.977	KWH(AVG)	40135
44	.000	KW (INS)	41020	1047	21762.734	KWH(AVG)	40090
45	13.302	KW (INS)	41020	1048	65212.289	KWH(AVG)	40090
46	109.861	KW (INS)	41020	1049	23785.141	KWH(AVG)	40135
47	90.828	KW (INS)	41015	1050	89000.125	KWH(AVG)	40090
48	135.482	KW (INS)	41020	1051	25471.598	KWH(AVG)	39990
49	.000	KW (INS)	41020	1052	66487.500	KWH(AVG)	40130
50	199.157	DEG.F.	41020	1053	91981.531	KWH(AVG)	39985
51	203.514	DEG.F.	40520	1054	2207.447	KWH(AVG)	40135
52	199.450	DEG.F.	41020	1055	51131.383	KWH(AVG)	40130
53	208.169	DEG.F.	41020	1056	53338.844	KWH(AVG)	40130
54	196.221	DEG.F.	41020	1059	265096.125	KWH(AVG)	40090
55	211.618	DEG.F.	41020	1060	33120.000	KWH(AVG)	43200
56	202.052	DEG.F.	41020	1061	30607.930	KWH(AVG)	6190
57	199.604	DEG.F.	41020	1062	196093.594	KWH(AVG)	6190
58	204.427	DEG.F.	41020	1063	83761.828	KWH(AVG)	6190

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
58	204.427	DEG.F.	41020	1063	83761.828	KWH(AVG)	6190
59	199.060	DEG.F.	41020	1064	226701.500	KWH(AVG)	6190
60	199.482	DEG.F.	41020	1065	3110.234	KWH(AVG)	40100
61	48.542	DEG.F.	41020	1066	544359.000	KWH(AVG)	40090
62	49.675	DEG.F.	41020	1067	826882.500	KWH(AVG)	6170
63	48.504	DEG.F.	41020	1073	49443.312	KWH(AVG)	39970
64	50.923	DEG.F.	41020	1074	.000	KWH(AVG)	0
65	69.732	DEG.F.	41020	1075	.000	KWH(AVG)	0
66	75.362	DEG.F.	41020	1076	117619.234	KWH(AVG)	40125
67	73.780	DEG.F.	41020	1077	67230.109	KWH(AVG)	40135
68	77.995	DEG.F.	41020	1078	9952.836	KWH(AVG)	40065
69	79.906	DEG.F.	41020	1079	.000	KWH(AVG)	0
70	84.931	DEG.F.	41020	1080	105028.016	KWH(AVG)	40135
71	79.994	DEG.F.	41020	1081	.000	KWH(AVG)	0
72	176.803	DEG.F.	7410	1082	.000	KWH(AVG)	0
73	130.545	DEG.F.	41020	1087	4540280832.000	B.T.U.	40615
74	84.866	DEG.F.	41020	1088	2659220480.000	B.T.U.	32810
75	84.702	DEG.F.	41020	1089	7262274560.000	B.T.U.	32405
76	94.746	DEG.F.	41020	1090	7107586048.000	B.T.U.	26400
77	95.974	DEG.F.	41020	1091	124074000.000	B.T.U.	41020
78	87.721	DEG.F.	41020	1092	229037920.000	B.T.U.	34845
79	88.213	DEG.F.	41020	1093	7906913280.000	B.T.U.	26400
80	268.856	DEG.F.	41020	1100	.000	B.T.U.	0
81	90.903	DEG.F.	41020	1101	111341488.000	B.T.U.	40235
82	558.469	DEG.F.	40385	1102	111341488.000	B.T.U.	40235
83	212.213	DEG.F.	41020	1103	.000	B.T.U.	0
84	413.362	DEG.F.	41020	1104	-93311600.000	B.T.U.	40215
85	190.627	DEG.F.	41020	1105	-93311600.000	B.T.U.	40215
86	4.738	DL DEG.F	40240	1106	486566272.000	B.T.U.	40510
87	.295	DL DEG.F	41020	1107	486308736.000	B.T.U.	40235
88	-.234	DL DEG.F	41020	1108	487077568.000	B.T.U.	40510
89	5.233	DL DEG.F	41000	1109	34343544.000	B.T.U.	40225
90	5.751	DL DEG.F	41020	1110	34451864.000	B.T.U.	40225
91	-.670	DL DEG.F	41010	1111	34451864.000	B.T.U.	40225
92	1.930	DL DEG.F	3910	1112	.000	B.T.U.	0
93	.519	DL DEG.F	40990	1113	602923520.000	B.T.U.	41010
94	2.265	DL DEG.F	40855	1114	602923520.000	B.T.U.	41010
95	11.892	DL DEG.F	40955	1115	.000	B.T.U.	0
96	-4.470	DL DEG.F	40825	1116	-58839560.000	B.T.U.	40215
97	7.190	DL DEG.F	41020	1117	-58839560.000	B.T.U.	40215
98	1.528	DL DEG.F	40695	1118	.000	B.T.U.	0
99	3.282	DL DEG.F	40940	1119	2063543296.000	B.T.U.	40200
100	5.776	DL DEG.F	41020	1120	2063543296.000	B.T.U.	40200
101	.847	DL DEG.F	40670	1121	2613410816.000	B.T.U.	41000
102	2.514	DL DEG.F	41015	1122	3160504832.000	B.T.U.	3910
103	7.243	DL DEG.F	41020	1123	3160312320.000	B.T.U.	3910
104	6.133	DL DEG.F	40615	1124	3160505344.000	B.T.U.	3910
105	3.930	DL DEG.F	32810	1125	3160505344.000	B.T.U.	3910
106	-.229	DL DEG.F	41020	1126	693677440.000	B.T.U.	3910
107	4.229	DL DEG.F	40955	1127	3575449088.000	B.T.U.	41015

NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
107	4.229	DL DEG.F	40955	1127	3575449088.000	B.T.U.	41015
108	1.048	DL DEG.F	34910	1128	3575043072.000	B.T.U.	41015
109	1.930	DL DEG.F	41020	1129	3575043072.000	B.T.U.	41015
110	1120.576	KW (AVG)	40135	1130	3620448768.000	B.T.U.	40945
111	289.888	KW (AVG)	40125	1131	1142693632.000	B.T.U.	40945
112	52.694	KW (AVG)	40025	1132	4762614784.000	B.T.U.	41015
113	.000	KW (AVG)	40135	1133	1222118656.000	B.T.U.	41015
114	13.544	KW (AVG)	40135	1134	1130434560.000	B.T.U.	40850
115	115.926	KW (AVG)	40130	1135	1124976896.000	B.T.U.	41015
116	91.201	KW (AVG)	40130	1136	271216576.000	B.T.U.	41015
117	141.672	KW (AVG)	40135	1137	258856672.000	B.T.U.	40985
118	4.310	KW (AVG)	40100	1138	261953312.000	B.T.U.	41015
120	.000	ON/OFF	0	1139	-48675744.000	B.T.U.	41015
121	.000	ON/OFF	0	1140	-17916852.000	B.T.U.	41000
122	.000	ON/OFF	0	1141	6171609088.000	B.T.U.	41000
123	.000	ON/OFF	0	1142	6171157504.000	B.T.U.	41000
124	.000	ON/OFF	0	1143	6171157504.000	B.T.U.	41000
125	.000	ON/OFF	0	1144	6207275008.000	B.T.U.	41015
126	.000	ON/OFF	0	1145	6102960128.000	B.T.U.	40840
127	.000	ON/OFF	0	1146	6100869120.000	B.T.U.	41015
128	.000	ON/OFF	0	1147	-35826744.000	B.T.U.	41000
129	.000	ON/OFF	0	1148	69533152.000	B.T.U.	40840
160	49.358	VOLTS	41020	1149	70165008.000	B.T.U.	41000
163	46.573	VOLTS	41020	1155	1217056512.000	B.T.U.	40690
172	5.000	MINUTES	40135	1156	.000	B.T.U.	43200
173	4.073	MINUTES	40135	1157	.000	B.T.U.	43200
174	1.068	MINUTES	40135	1158	783505024.000	B.T.U.	40940
177	.700	PWR.FACT	41020	1159	432854912.000	B.T.U.	40690
178	59.999	HERTZ	41020	1160	432854912.000	B.T.U.	40690
179	.000	DL DEG.F	0	1161	9423112.000	B.T.U.	40685
180	344.030	LB/MIN	20	1162	-85451936.000	B.T.U.	40680
183	.003	KW (AVG)	40135	1163	-88236528.000	B.T.U.	40685
187	.000	DEG.F.	0	1170	1085969920.000	B.T.U.	39430
193	.000	DL DEG.F	41020	1171	589488640.000	B.T.U.	26855
194	.000	LB/MIN	41020	1172	1606886400.000	B.T.U.	26855
195	2.315	DL DEG.F	40985	1173	224175296.000	B.T.U.	30895
196	559.649	LB/MIN	41020	1174	29978172.000	B.T.U.	41020
197	2.385	DL DEG.F	34115	1175	.000	B.T.U.	0
198	.064	GPM (AV)	40135	1176	838152576.000	B.T.U.	40990
199	14.050	KW (AVG)	40065	1177	838152576.000	B.T.U.	40990
200	1.847	KW (AVG)	40135	1178	28105752.000	B.T.U.	27095
201	55.338	VOLTS	41020	1179	303152640.000	B.T.U.	27095
202	52.699	DEG.F.	41020	1180	.000	B.T.U.	0
203	192.340	DEG.F.	41020	1181	1175510016.000	B.T.U.	27095
204	195.064	DEG.F.	40615	1182	1175510016.000	B.T.U.	27095
207	8.456	DL DEG.F	41005	1183	.000	B.T.U.	0
208	770.135	LB/MIN	41020	1184	436560256.000	B.T.U.	26845
209	3.110	DL DEG.F	41015	1185	436560256.000	B.T.U.	26845
210	2540.772	LB/MIN	41020	1191	238367936.000	B.T.U.	41020
211	6.590	DL DEG.F	41015	1192	240827328.000	B.T.U.	41020

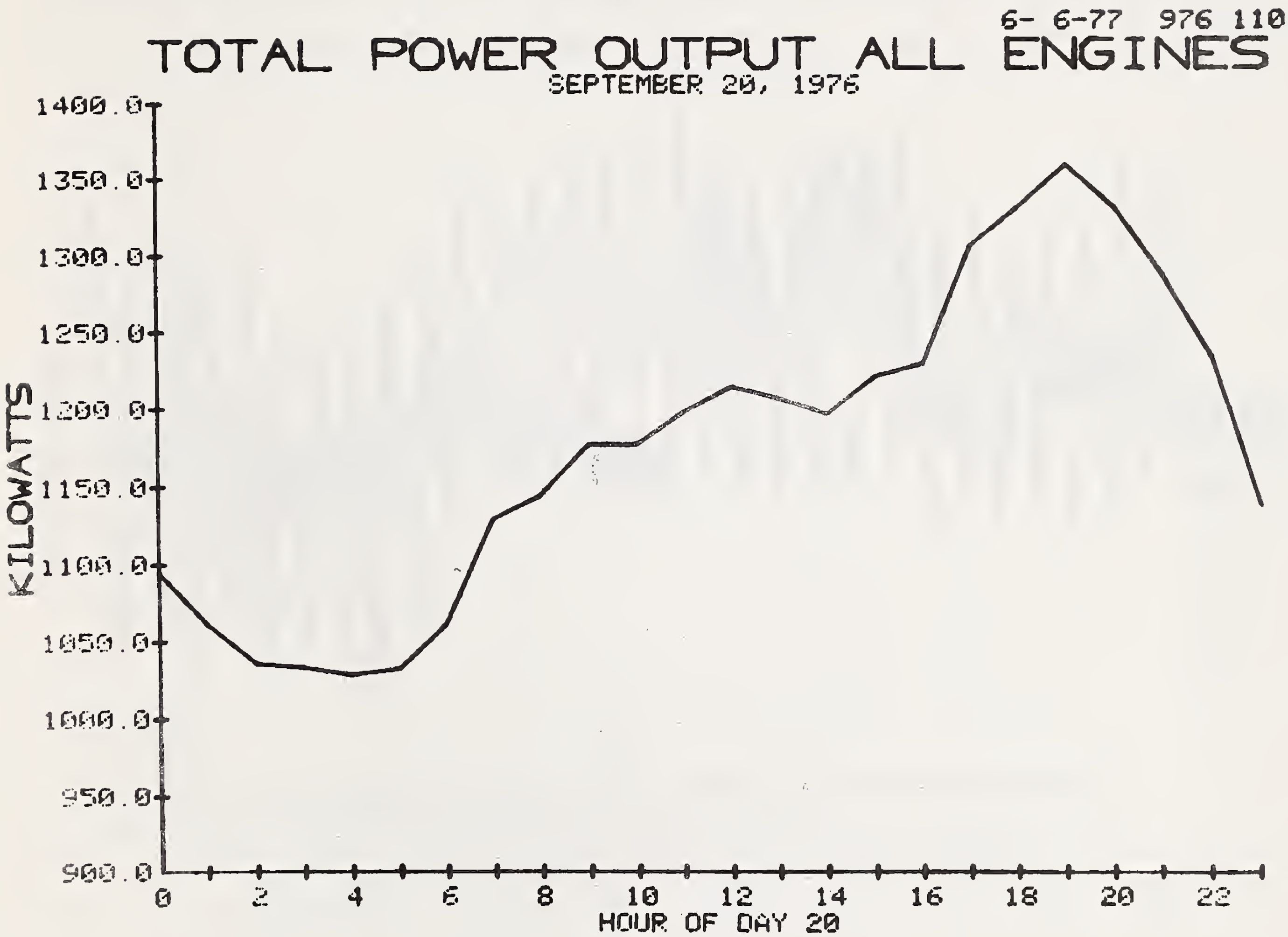
NBS LOC	VALUE	UNITS	TIME	DER	VALUE	UNITS	TIME
211	6.590	DL DEG.F	41015	1192	240827328.000	B.T.U.	41020
212	2.143	GPM (AV)	40135	1193	240827328.000	B.T.U.	41020
213	70.829	KW (AVG)	40130	1194	10999480.000	B.T.U.	41020
214	3.071	KW (AVG)	40135	1195	608739840.000	B.T.U.	41020
215	83.577	VOLTS	41020	1196	858106880.000	B.T.U.	41020
217	58.444	DEG.F.	40800	1197	858106880.000	B.T.U.	41020
218	184.827	DEG.F.	41020	1198	860566528.000	B.T.U.	41020
219	177.040	DEG.F.	40855	1199	860566528.000	B.T.U.	41020
221	.226	C/CM2/MN	41020	1200	123135472.000	B.T.U.	34910
222	.079	C/CM2/MN	41020	1201	229037920.000	B.T.U.	34845
223	1.008	DEGREES	41020	1202	-28229428.000	B.T.U.	41020
224	103.062	MILES/HR	41020	1203	-613580.875	B.T.U.	41020
225	30.591	IN.HG.	41020	1204	546454784.000	B.T.U.	40955
226	67.405	DEG.F.	41020	1205	829877760.000	B.T.U.	41020
227	52.387	PER-CENT	41020	1206	829877376.000	B.T.U.	41020
228	.000	DEG.F.	0	1207	832337024.000	B.T.U.	41020
235	5.942	DL DEG.F	40965	1208	832337024.000	B.T.U.	41020
236	.000	LB/MIN	41020	1209	830086528.000	B.T.U.	39755
237	.735	DL DEG.F	40685	1210	832537600.000	B.T.U.	39755
238	1994.234	LB/MIN	41020	1211	832537600.000	B.T.U.	39755
239	6.808	DL DEG.F	41015	1212	893619200.000	B.T.U.	33470
240	277.066	LB/MIN	41020	1213	-56805024.000	B.T.U.	33470
241	.000	KW (AVG)	0	1214	-56805104.000	B.T.U.	33470
242	.000	KW (AVG)	0	1215	-54317208.000	B.T.U.	33470
243	118.182	VOLTS	41020	1216	-54317208.000	B.T.U.	33470
244	50.633	DEG.F.	40965	1217	-56805072.000	B.T.U.	33470
245	193.876	DEG.F.	40750	1218	-54317168.000	B.T.U.	33470
246	195.678	DEG.F.	40730	1219	-54317168.000	B.T.U.	33470
249	6.038	DL DEG.F	40805	1225	20216884.000	B.T.U.	40075
250	1032.203	LB/MIN	41020	1226	39415632.000	B.T.U.	40125
251	1.110	DL DEG.F	40915	1227	59633608.000	B.T.U.	40065
252	7053.854	LB/MIN	41020	1233	256957056.000	B.T.U.	40795
253	6.379	DL DEG.F	40795	1234	14057096.000	B.T.U.	40795
254	930.040	LB/MIN	41020	1235	270956544.000	B.T.U.	40805
255	145.142	KW (AVG)	40135	1236	80467776.000	B.T.U.	41015
256	19.740	KW (AVG)	40040	1237	-10687476.000	B.T.U.	40960
257	118.929	VOLTS	41020	1238	69844960.000	B.T.U.	40965
259	51.319	DEG.F.	40800	1241	.000	B.T.U.	0
260	198.804	DEG.F.	40940	1242	7310.021	B.T.U.	33310
261	197.760	DEG.F.	41020	1243	.000	B.T.U.	41020
263	6.610	DL DEG.F	32730	1244	7310.021	B.T.U.	33310
264	481.293	LB/MIN	41020	1245	345187200.000	B.T.U.	32595
265	1.053	DL DEG.F	40960	1246	345187200.000	B.T.U.	32595
266	2469.101	LB/MIN	41020	1247	92331840.000	B.T.U.	32490
267	11.200	DL DEG.F	40695	1248	.000	B.T.U.	37385
268	258.411	LB/MIN	41020	1249	.000	B.T.U.	43200
269	92.464	KW (AVG)	40130	1250	.000	B.T.U.	37385
270	35.394	KW (AVG)	39990	1251	138922496.000	B.T.U.	40695
271	130.893	VOLTS	41020	1252	-30569224.000	B.T.U.	32725
273	50.084	DEG.F.	40890	1253	136463296.000	B.T.U.	32730

NBS LOC	VALUE	UNITS	TIME
273	50.084	DEG.F.	40890
274	196.057	DEG.F.	41020
275	195.509	DEG.F.	41020
277	-1.568	DL DEG.F	38670
278	3845.256	LB/MIN	43140
279	1.342	DL DEG.F	37385
280	.000	LB/MIN	41020
281	60.230	KW (AVG)	40135
282	30.063	KW (AVG)	40090
283	32.950	KW (AVG)	40135
284	119.139	VOLTS	41020
285	118.851	VOLTS	41015
286	57.693	DEG.F.	36095
287	192.973	DEG.F.	39920
288	.000	SUM/WINT	0
289	.000	SUM/WINT	0
315	46.000	KW (AVG)	43200
316	1.000	SUM/WINT	43200
317	.500	PER-CENT	43200
318	1.000	EFF.	43200
319	33.900	DEG.API	43200
320	138966.656	BTU/GAL	43200

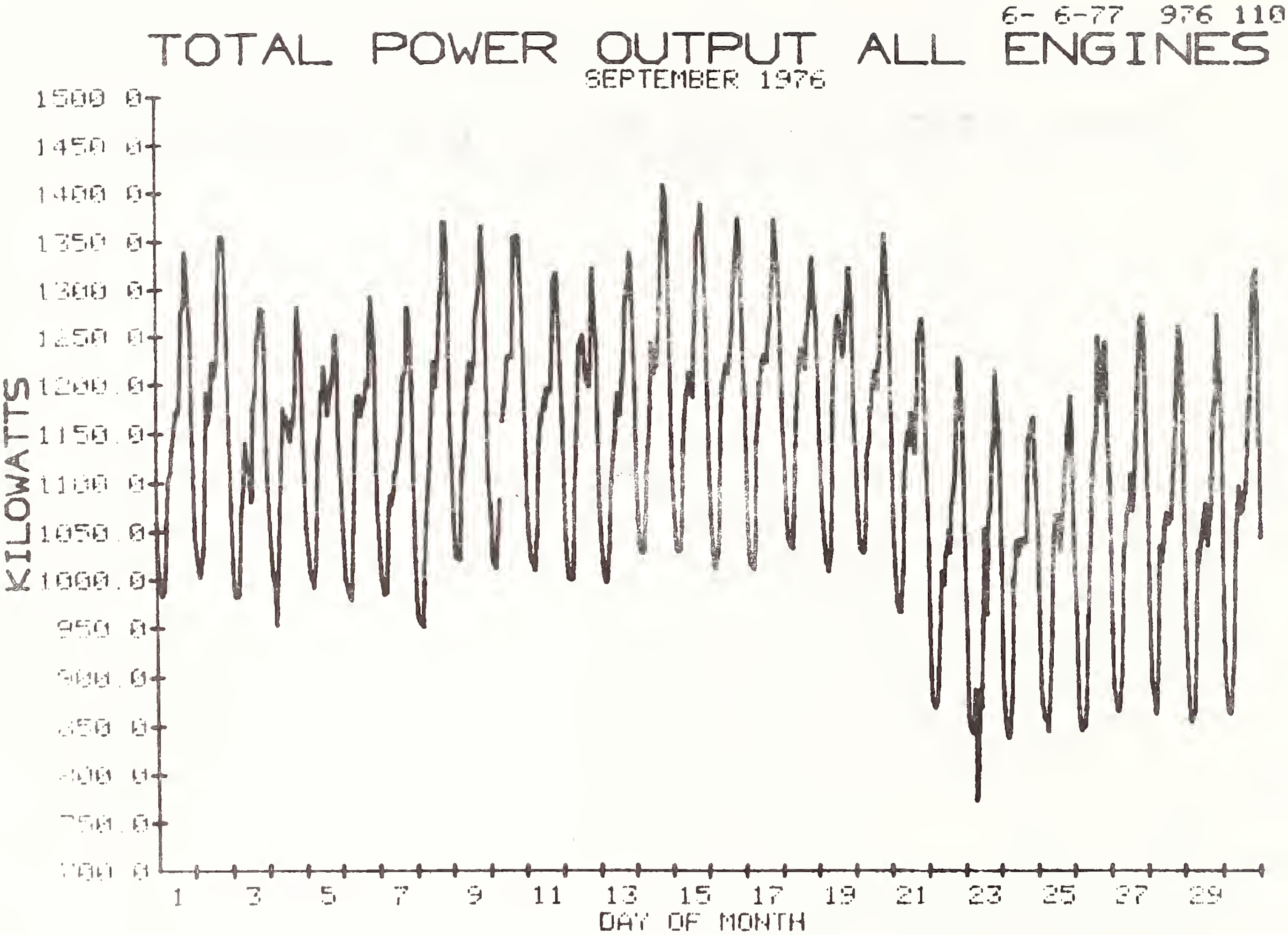
DER	VALUE	UNITS	TIME
1253	136463296.000	B.T.U.	32730
1254	609192.250	B.T.U.	40135
1255	282970752.000	B.T.U.	40120
1256	283464128.000	B.T.U.	41005
1257	420417088.000	B.T.U.	29950
1258	414484480.000	B.T.U.	29895
1259	772402816.000	B.T.U.	25125
1260	512038528.000	B.T.U.	25065
1266	341837888.000	B.T.U.	40915
1267	64780856.000	B.T.U.	40685
1268	.000	B.T.U.	43200
1269	50358672.000	B.T.U.	40985
1270	454385280.000	B.T.U.	39180
1271	735054976.000	B.T.U.	29425
1272	-487735744.000	B.T.U.	25870
1273	129484336.000	B.T.U.	38670
1274	115748016.000	B.T.U.	40960
1275	339673536.000	B.T.U.	41015
1276	584567040.000	B.T.U.	38645
1277	266362496.000	B.T.U.	38645
1278	1322289664.000	B.T.U.	27730
1279	-191434464.000	B.T.U.	24445
1285	.000	B.T.U.	0
1286	1225264128.000	B.T.U.	6940
1287	.000	B.T.U.	0
1288	9768740864.000	B.T.U.	40125
1289	479334400.000	B.T.U.	40075
1290	4258932224.000	B.T.U.	40135
1291	4738601984.000	B.T.U.	40075
1292	.000	B.T.U.	0
1298	.000	GALLONS	0
1299	8823.734	GALLONS	6940
1300	.000	GALLONS	0
1301	70288.500	GALLONS	40125
1302	3449.461	GALLONS	40075
1303	30623.777	GALLONS	40135
1304	34075.641	GALLONS	40075
1305	.000	GALLONS	0
1315	33120.000	KW (AVG)	43200
1316	1.000	SUM/WINT	43200
1317	.500	PER-CENT	43200
1318	1.000	EFF.	43200
1319	33.900	DEG.API	43200
1320	138966.656	BTU/GAL	43200

VI. TYPICAL GRAPHICAL DISPLAYS

1. DAILY

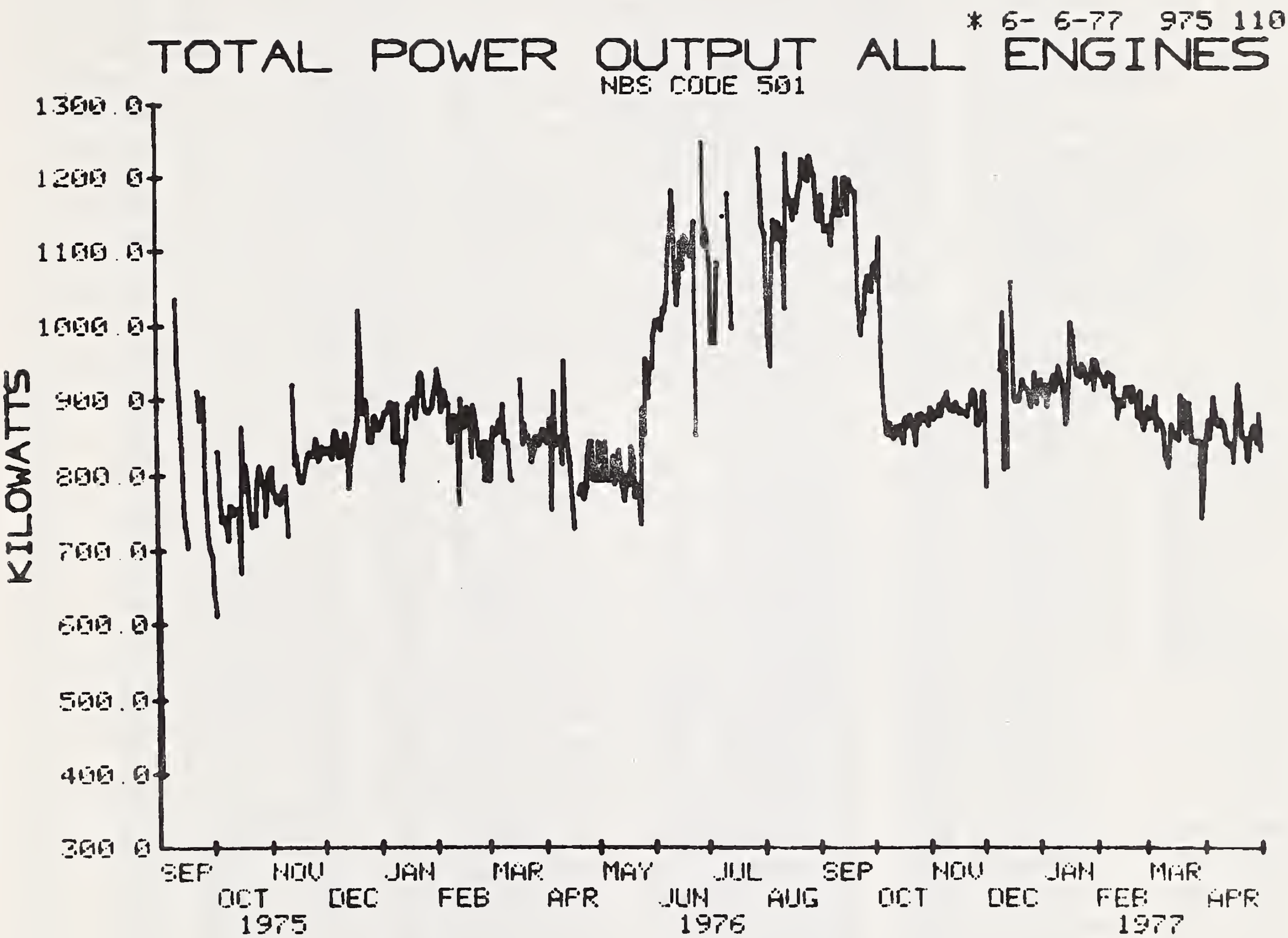


2. MONTHLY



6- 6-77 976 110
TOTAL POWER OUTPUT ALL ENGINES
SEPTEMBER 1976
KILOWATTS
1500.0
1450.0
1400.0
1350.0
1300.0
1250.0
1200.0
1150.0
1100.0
1050.0
1000.0
950.0
900.0
850.0
800.0
750.0
700.0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29
DAY OF MONTH

3. YEARLY



* 6- 6-77 975 110
TOTAL POWER OUTPUT ALL ENGINES
NBS CODE 501
KILOWATTS
1300.0
1200.0
1100.0
1000.0
900.0
800.0
700.0
600.0
500.0
400.0
300.0
SEP NOV JAN MAR MAY JUL SEP NOV JAN MAR
OCT DEC FEB APR JUN AUG OCT DEC FEB APR
1975
1976
1977

VII. TYPICAL MODEM SCAN OUTPUT

1. CHARACTERS RECEIVED

```
1 541415019771581032 00200V-120835 00300V+156295 00400V+023395 00500V+0
7 6475 00600V+017475 00700V+040085 00800V+046935 00900V-001205 00201V-0
1 4715 00301V+021385 00401V+035035 00501V+043825 00601V+021425 00701V+0
2 4625 00801V+020245 00901V+084535 00202V+072645 00302V+001085 00402V+0
0 9385 00502V-000025 00602V+010345 00702V-005895 00802V+001745 00902V+0
1 2435 00203V+018755 00303V+035585 00403V+049505 00503V-000015 00603V+0
2 1375 00703V+020385 00803V+034425 00903V+022815 00204V+022285 00304V+0
2 5125 00404V+012735 00504V+030145 00604V+019095 00704V+039765 00804V+0
5 9745 00904V+039045 00205V+037285 00305V+008075 00405V+041105 00505V+1
0 7035 00605V+081045 00705V+053295 00805V+029615 00905V+021285 00206V+0
2 2905 00306V+001535 00406V+049335 00506V+064715 00606V+051965 00706V+0
3 9845 00806V+046195 00906V+001175 00207V+003765 00307V+044585 00407V+0
4 7725 00507V+000005 00607V+049245 00707V+025725 00807V+047645 00907V+0
6 1745 00208V+055205 00308V+027445 00408V+041125 00508V+000005 00608V+0
5 9615 00708V+061335 00808V+058765 00908V+077705 00209V+074985 00309V-0
0 4915 00409V+015975 00509V+000005 00609V+009765 00709V-000045 00809V-0
0 0145 00909V+004405 00210V+012165 00310V+028015 00410V+005135 00510V-1
5 0085 00610V+038825 00710V+012925 00810V+003495 00910V+040195 00211V+0
3 7295 00311V+028295 00411V+037625 00511V-150055 00611V+039175 00711V+0
3 9825 00811V+039065 00911V+000345 00212V+004415 00312V-000155 00412V+0
3 6095 00512V-150035 00612V-000035 00712V+039665 00812V+038805 00912V+0
0 0345 00213V+001035 00313V-000155 00413V+000085 00513V-150025 00613V-0
0 0035 00713V-000045 00813V-000255 00913V+000335 010   V+072785 011   V+0
2 0635 012   V+021175 013   V+019515 014   V+019005 015   V+064155 016   V+0
5 8615 017   V+054025 018   V+033265 019   V+047885 020   V+069655 021   V+0
1 9935 022   V+067685 023   V+026145 024   V+029565 025   V+020765 026   V+0
6 5585 027   V+024635 028   V+029655 029   V+023075 030   V+035415 031   V+0
4 5255 032   V+021255 033   V+010185 034   V+005525 035   V+031295 036   V+0
4 5515 037   V+028745 038   V+030265 039   V+011555 040   V+029525 041   V+0
1 1915 042   V-000175 043   V-000235 044   V-000365 045   V+027505 046   V+0
1 2115 047   V+008665 048   V+004215 049   V-000295 050   M+039702 051   M+0
3 9692 052   M+039672 053   M+039272 054   M+039112 055   M+041342 056   M+0
4 0472 057   M+039882 058   M+040912 059   M+039742 060   M+039852 061   M+0
0 3782 062   M+003022 063   M+003102 064   M+003632 065   M+006952 066   M+0
1 2042 067   M+012542 068   M+010892 069   M+010892 070   M+012392 071   M+0
1 0902 072   M+004652 073   M+021922 074   M+011702 075   M+011602 076   M+0
1 3442 077   M+013872 078   M+012352 079   M+012452 080   M+029372 081   M+0
6 5902 082   M+029092 083   M+029362 084   M+029882 085   M+030252 086   M+0
0 1552 087   M-001562 088   M+002622 089   M+016692 090   M-002812 091   M-0
0 1492 092   M+143532 093   M+001352 094   M+005312 095   M+000212 096   M-0
0 6732 097   M+007172 098   M+003652 099   M+006462 100   M-022012 101   M-0
0 1502 102   M+012382 103   M+029692 104   M+004812 105   M+013252 106   M-0
0 0912 107   M+023512 108   M+000072 109   M+000062 110   V+042595 111   V+0
0 0515 112   V+018835 113   V+000005 114   V+044545 115   V+033015 116   V+0
4 9195 117   V+006525 118   V+026145 119   V+023045 120   V+023025 121   V+0
2 3015 122   V+022995 123   V+022985 124   V+022965 125   V+022955 126   V+0
2 2945 127   V+022935 128   V+022925 129   V+022915 130   V+022895 131   V+0
2 2885 132   V+022885 133   V+022865 134   V+022865 135   V+022845 136   V+0
2 2845 137   V+022835 138   V+022825 139   V+022815 140   V+035555 141   V+0
7 5095 142   V+098475 143   V+052395 144   V+092785 145   V+051125 146   V+0
1 8245 147   V+016445 148   V+016805 149   V+017425 150   V+017445 151   V+0
1 7465 152   V+017475 153   V+017495 154   V+017505 155   V+017515 156   V+0
1 7515 157   V+017525 158   V+017535 159   V+017535 160   V+004956 161   V+0
0 0026 162   V-000016 163   V+004726 164   V+000006 165   V-000016 166   V-0
0 0006 167   V-000006 168   V-000006 169   V-000006 170   V-000043 171   V-0
0 0043 172   V+021285 173   V+022965 174   V+016645 175   V+015815 176   V+0
1 5135 177   V+029565 17800V+025185 1541415019771581034 00200V+022195
```

2. CONVERTED OUTPUT

LABEL: 154141501977, TIME: 159 8:37

LOC	NBS	VOLTAGE		VALUE		FLAG		
10	202	7268.000	M.V.	65.850	PSI	0		
11	220	2071.000	M.V.	.887	PSI	0	L -USE:	.000
12	221	6742.000	M.V.	59.275	PSI	0		
13	230	1984.000	M.V.	-.002	PSI	0	L -USE:	.000
14	231	3686.000	M.V.	.228	PSI	0		
15	301	6472.000	M.V.	11756.033	LB/MIN	0		
16	302	5908.000	M.V.	2521.244	LB/MIN	0		
17	303	5563.000	M.V.	2407.683	LB/MIN	0		
18	304	3330.000	M.V.	4840.798	LB/MIN	0	H2-NO CALC	
19	305	4830.000	M.V.	7077.924	LB/MIN	0		
20	306	5549.000	M.V.	5257.695	LB/MIN	0		
21	307	2002.000	M.V.	.000	LB/MIN	0	L1-USE:	.000
22	308	6732.000	M.V.	19685.254	LB/MIN	0		
23	309	2624.000	M.V.	528.742	LB/MIN	0		
24	310	2982.000	M.V.	8820.963	LB/MIN	0	H2-NO CALC	
25	311	2064.000	M.V.	.000	LB/MIN	0	L1-USE:	.000
26	316	6575.000	M.V.	2890.877	LB/MIN	0		
27	313	2440.000	M.V.	472.625	LB/MIN	0	H2-NO CALC	
28	314	2952.000	M.V.	4189.204	LB/MIN	0	H2-NO CALC	
29	315	2288.000	M.V.	4536.300	LB/MIN	0		
30	312	3539.000	M.V.	.000	GPM (AV)	0		
31	317	3298.000	M.V.	4.853	GPM (AV)	0		
32	318	1823.000	M.V.	4.853	GPM (AV)	0		
33	319	1017.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
34	320	551.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
35	321	3127.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
36	322	4547.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
37	323	2872.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
38	324	3024.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
39	325	1154.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
40	326	2950.000	M.V.	.000	GPM (AV)	0	L -NO CALC	
41	550	1197.000	M.V.	957.600	KW (INS)	0		
42	551	-17.000	M.V.	.000	KW (INS)	0		
43	552	2128.000	M.V.	319.200	KW (INS)	0		
44	553	-35.000	M.V.	.000	KW (INS)	0		
45	554	2666.000	M.V.	14.776	KW (INS)	0		
46	555	1305.000	M.V.	108.492	KW (INS)	0		
47	556	870.000	M.V.	48.219	KW (INS)	0		
48	557	430.000	M.V.	23.832	KW (INS)	0		
49	558	-30.000	M.V.	.000	KW (INS)	0		
50	600	3.966	M.V.	199.982	DEG F	0		
51	603	3.967	M.V.	200.022	DEG F	0		
52	604	4.121	M.V.	206.021	DEG F	0		
53	616	3.933	M.V.	198.692	DEG F	0		
54	617	4.215	M.V.	209.668	DEG F	0		
55	627	4.127	M.V.	206.255	DEG F	0		
56	629	4.051	M.V.	203.298	DEG F	0		
57	630	3.986	M.V.	200.764	DEG F	0		
58	633	4.092	M.V.	204.894	DEG F	0		
59	636	3.971	M.V.	200.178	DEG F	0		
60	640	3.980	M.V.	200.529	DEG F	0		
61	661	.356	M.V.	48.304	DEG F	0		
62	662	.288	M.V.	45.211	DEG F	0		
63	663	.295	M.V.	45.530	DEG F	0		
64	665	.343	M.V.	47.714	DEG F	0		
65	671	.688	M.V.	63.264	DEG F	0		
66	672	1.097	M.V.	81.381	DEG F	0		

LOC	NBS	VOLTAGE	VALUE	FLAG
67	673	1.245 M.V.	87.854 DEG F	0
68	690	.973 M.V.	75.924 DEG F	0
69	691	.973 M.V.	75.924 DEG F	0
70	693	1.124 M.V.	82.565 DEG F	0
71	696	.980 M.V.	76.232 DEG F	0
72	700	-.630 M.V.	32.000 DEG F	0 L -NO CALC
73	701	3.565 M.V.	184.201 DEG F	0
74	711	1.137 M.V.	83.134 DEG F	0
75	713	1.130 M.V.	82.828 DEG F	0
76	730	1.342 M.V.	92.073 DEG F	0
77	731	1.388 M.V.	94.068 DEG F	0
78	732	1.233 M.V.	87.331 DEG F	0
79	733	1.243 M.V.	87.767 DEG F	0
80	612	2.834 M.V.	130.400 DEG F	0
81	613	5.804 M.V.	229.772 DEG F	0
82	750	2.910 M.V.	132.983 DEG F	0
83	751	16.737 M.V.	585.396 DEG F	0
84	752	3.039 M.V.	137.361 DEG F	0
85	753	10.594 M.V.	386.074 DEG F	0
86	601	-.139 M.V.	-.362 DL DEG F	0
87	602	2.194 M.V.	5.700 DL DEG F	0
88	694	.262 M.V.	.766 DL DEG F	0
89	605	1.735 M.V.	4.510 DL DEG F	0
90	614	-.255 M.V.	-.997 DL DEG F	0
91	615	1.956 M.V.	7.615 DL DEG F	0
92	628	14.438 M.V.	38.053 DL DEG F	0 H -NO CALC
93	631	.127 M.V.	.496 DL DEG F	0
94	632	.596 M.V.	2.324 DL DEG F	0
95	634	.021 M.V.	.054 DL DEG F	0
96	635	-.628 M.V.	-2.456 DL DEG F	0
97	637	.578 M.V.	1.498 DL DEG F	0
98	641	.278 M.V.	1.086 DL DEG F	0
99	642	.897 M.V.	3.508 DL DEG F	0
100	647	-2.233 M.V.	-6.804 DL DEG F	0
101	659	-.133 M.V.	-.404 DL DEG F	0 L -NO CALC
102	660	1.099 M.V.	3.331 DL DEG F	0
103	664	2.329 M.V.	7.045 DL DEG F	0
104	674	-.991 M.V.	-2.876 DL DEG F	0 L -NO CALC
105	675	1.196 M.V.	3.505 DL DEG F	0
106	692	-.090 M.V.	-.263 DL DEG F	0
107	695	2.443 M.V.	7.165 DL DEG F	0
108	702	.000 M.V.	.000 DL DEG F	0
109	703	.013 M.V.	.038 DL DEG F	0
110	501	374.000 M.V.	996.693 KW (AVG)	0
111	502	51.000 M.V.	.000 KW (AVG)	0
112	503	1622.000 M.V.	330.240 KW (AVG)	0
113	509	.000 M.V.	.000 KW (AVG)	0
114	510	1736.000 M.V.	15.040 KW (AVG)	0
115	511	2512.000 M.V.	110.671 KW (AVG)	0
116	512	2637.000 M.V.	48.241 KW (AVG)	0
117	513	651.000 M.V.	.000 KW (AVG)	0
118	514	4468.000 M.V.	.000 KW (AVG)	0
120	806	3913.000 M.V.	3913.000 ON/OFF	0
121	815	3909.000 M.V.	3909.000 ON/OFF	0
122	821	3905.000 M.V.	3905.000 ON/OFF	0
123	830	3902.000 M.V.	3902.000 ON/OFF	0
124	836	3899.000 M.V.	3899.000 ON/OFF	0

LOC	NBS	VOLTAGE		VALUE		FLAG		
125	845	3897.000	M.V.	3897.000	ON/OFF	0		
126	851	3895.000	M.V.	3895.000	ON/OFF	0		
127	800	3893.000	M.V.	3893.000	ON/OFF	0		
128	860	3891.000	M.V.	3891.000	ON/OFF	0		
129	866	3888.000	M.V.	3888.000	ON/OFF	0		
140	360	8116.000	M.V.	.018	GPM (AV)	0	L1-USE:	.000
141	361	40.000	M.V.	.489	GPM (AV)	0		
142	362	4288.000	M.V.	.000	GPM (AV)	0	L1-USE:	.000
143	363	3961.000	M.V.	.433	GPM (AV)	0		
144	364	5307.000	M.V.	.493	GPM (AV)	0		
145	365	59.000	M.V.	.045	GPM (AV)	0	L1-USE:	.000
146	366	3435.000	M.V.	.031	GPM (AV)	0	L1-USE:	.000
160	400	4950.000	M.V.	495.000	VOLTS	0		
163	410	4680.000	M.V.	468.000	VOLTS	0		
172	102	1927.300	M.V.	4.907	MINUTES	0		
173	110	2295.000	M.V.	.000	MINUTES	0		
174	111	1524.000	M.V.	.498	MINUTES	0		
177	130	2942.000	M.V.	.706	PWR FACT	0		
178	141	2986.000	M.V.	60.194	HERTZ	0		
200	772	-12074.000	M.V.	-43.976	DL DEG F	0	L -NO CALC	
201	332	-1441.000	M.V.	.000	LB/MIN	0		
204	522	2320.000	M.V.	10.404	KW (AVG)	0		
208	760	5894.000	M.V.	269.566	DEG F	0	H -NO CALC	
213	0	91.000	M.V.	.000	M.V.	1		
300	771	15620.000	M.V.	65.616	DL DEG F	0	OK-USE:	.000
301	330	2156.000	M.V.	38.160	LB/MIN	0	OK-USE:	.000
302	651	85.000	M.V.	.466	DL DEG F	0		
303	339	3611.000	M.V.	355.212	LB/MIN	0		
304	791	4927.000	M.V.	20.247	DL DEG F	0		
305	348	1537.000	M.V.	1.002	GPM (AV)	0		
306	524	4597.000	M.V.	31.703	KW (AVG)	0		
307	523	4796.000	M.V.	3.088	KW (AVG)	0		
308	424	2760.000	M.V.	277.400	VOLTS	0		
309	624	-410.000	M.V.	32.000	DEG F	0	L -NO CALC	
310	761	2903.000	M.V.	158.193	DEG F	0		
311	781	2942.000	M.V.	159.777	DEG F	0		
313	0	-14.000	M.V.	.000	M.V.	1		
400	775	1932.000	M.V.	5.055	DL DEG F	0		
401	331	3615.000	M.V.	923.758	LB/MIN	0		
402	655	811.000	M.V.	2.413	DL DEG F	0		
403	340	4823.000	M.V.	2061.633	LB/MIN	0		
404	795	1408.000	M.V.	3.693	DL DEG F	0		
405	349	4119.000	M.V.	.056	GPM (AV)	0		
406	532	2889.000	M.V.	83.313	KW (AVG)	0		
407	531	4955.000	M.V.	3.091	KW (AVG)	0		
408	432	4126.000	M.V.	190.205	VOLTS	0		
410	625	474.000	M.V.	53.241	DEG F	0		
411	762	3784.000	M.V.	192.494	DEG F	0		
412	782	3656.000	M.V.	187.447	DEG F	0		
413	0	9.000	M.V.	.000	M.V.	1		
500	148	4605.000	M.V.	2.605	C/CM2/MN	0	H -NO CALC	
501	149	3779.000	M.V.	2.345	C/CM2/MN	0	H -NO CALC	
502	150	-3.000	M.V.	.000	DIR.DEGS	0		
503	151	-2.000	M.V.	150.000	MILES/HR	0	H -NO CALC	
504	200	3016.000	M.V.	31.000	INCH HG.	0		
505	710	10214.000	M.V.	199.990	DEG.F.	0	H -NO CALC	
506	712	4521.000	M.V.	100.000	DEG.F.	0		

LOC	NBS	VOLTAGE	VALUE	FLAG		
507	714	-1.000 M.V.	149.830 DEG.F.	0	H -NO CALC	
513	0	-14984.000 M.V.	.000 M.V.	1		
600	770	1709.000 M.V.	4.478 DL DEG F	0		
601	328	2137.000 M.V.	440.670 LB/MIN	0	OK-USE:	.000
602	650	-866.000 M.V.	-2.540 DL DEG F	0	L -NO CALC	
603	337	2146.000 M.V.	406.702 LB/MIN	0		
604	790	1887.000 M.V.	4.940 DL DEG F	0		
605	346	8126.000 M.V.	631.225 LB/MIN	0		
606	520	4457.000 M.V.	53.248 KW (AVG)	0		
607	519	2341.000 M.V.	9.830 KW (AVG)	0		
608	420	5965.000 M.V.	119.340 VOLTS	0		
609	643	1021.000 M.V.	78.128 DEG F	0		
610	763	3885.000 M.V.	196.892 DEG F	0		
611	783	3914.000 M.V.	198.027 DEG F	0		
613	0	-2.000 M.V.	.000 M.V.	1		
700	768	3714.000 M.V.	9.721 DL DEG F	0		
701	327	1793.000 M.V.	.000 LB/MIN	0		
702	648	-704.000 M.V.	-2.035 DL DEG F	0	L -NO CALC	
703	336	2007.000 M.V.	.000 LB/MIN	0		
704	788	3696.000 M.V.	9.679 DL DEG F	0		
705	345	5378.000 M.V.	574.788 LB/MIN	0		
706	516	1194.000 M.V.	59.592 KW (AVG)	0		
707	515	4108.000 M.V.	18.445 KW (AVG)	0		
708	416	6142.000 M.V.	491.680 VOLTS	0		
710	644	1256.000 M.V.	88.508 DEG F	0		
711	764	3980.000 M.V.	200.685 DEG F	0		
712	784	3965.000 M.V.	200.100 DEG F	0		
713	0	-4.000 M.V.	.000 M.V.	1		
800	774	7909.000 M.V.	20.881 DL DEG F	0		
801	334	2035.000 M.V.	.000 LB/MIN	0		
802	654	115.000 M.V.	.430 DL DEG F	0		
803	343	3407.000 M.V.	2774.391 LB/MIN	0		
804	794	8086.000 M.V.	21.373 DL DEG F	0		
805	353	3249.000 M.V.	451.934 LB/MIN	0		
806	530	3246.000 M.V.	96.482 KW (AVG)	0		
807	529	51.000 M.V.	33.580 KW (AVG)	0		
808	430	5881.000 M.V.	472.640 VOLTS	0		
810	645	329.000 M.V.	48.304 DEG F	0		
811	765	3926.000 M.V.	199.474 DEG F	0		
812	785	3898.000 M.V.	198.379 DEG F	0		
813	0	-27.000 M.V.	.000 M.V.	1		
900	626	-79.000 M.V.	-.342 DL DEG F	0		
901	333	8492.000 M.V.	4448.622 LB/MIN	0		
902	793	2084.000 M.V.	5.349 DL DEG F	0		
903	351	2286.000 M.V.	598.682 LB/MIN	0		
904	526	3399.000 M.V.	55.808 KW (AVG)	0		
905	527	1247.000 M.V.	34.998 KW (AVG)	0		
906	528	3920.000 M.V.	24.576 KW (AVG)	0		
907	426	6200.000 M.V.	493.280 VOLTS	0		
908	428	7473.000 M.V.	148.780 VOLTS	0	H -NO CALC	
909	646	422.000 M.V.	49.756 DEG F	0		
910	786	4020.000 M.V.	200.764 DEG F	0		
911	147	34.000 M.V.	.000 SUM/WINT	0	OK-USE:	.000
912	147	34.000 M.V.	.000 SUM/WINT	0	OK-USE:	.000
913	0	34.000 M.V.	.000 M.V.	1		

35 ERRORS

VIII. RAW DATA FORMAT

1. Character Location Description

The first 9 characters of a scan consist of digits (0 through 9) which have been manually set (on thumbwheel switches) on the DAS as part of the label information. These 9 characters are used in the definition of the time and date when the current magnetic tape was placed on-line.

Characters 10, 11, and 12 contain the letters "NBS" and are used as a trigger point for the rest of the scan.

Characters 13 through 19 are generated by the DAS clock and represent the day of the year (13, 14, 15), hour of day (16, 17), and minute of hour (18, 19).

Characters 20 through 1475 and characters 1476 through 3672 consist of 112 groups of 13 characters representing data from remote locations and 169 groups of 13 characters representing data from CEB locations, respectively. Each group of 13 characters is further subdivided as follows.

Characters 1, 2, & 3	contain either the remote location number or the CEB channel number.
Characters 4 & 5	contain either the remote channel number (if a remote channel), two zeros or two blanks (spaces) if a CEB channel is being recorded on magentic tape, or two blanks if a CEB channel is being transmitted over the modem link.
Character 6	is either an M (millivolt) or a V (volts) and represent the programmed function (or sensitivity) of the Digital Voltmeter (DVM).
Character 7	is either a + or - and represents the polarity of the analog signal level and also is the most significant digit of the analog input voltage for the channel.
Charaters 9 thru 12	represent the second most significant digit through the least significant digit of the signal level.
Character 13	represents the range of the DVM and contains a digit indicating how far to the right (from just after character 7) to place the decimal point in order to obtain a reading in millivolts.

The following figures schematically describe the layout of a typical signal scan and depict the breakdown of the individual character groupings making up a scan. An alphanumeric printout of a complete typical scan is contained in Appendix I.

3672 CHARACTERS COMPLETE SCAN						
9 Characters	3 Characters	3 Characters	2 Characters	2 Characters	1456 Characters	2197 Characters
Manually Programmable Digits	NBS	Day of Year	Hour of Day	Minute of Hour	112 Groups of 13 (Remotes)	169 Groups of 13 (CEB)
		TIME				
LABEL					281 DATA SIGNAL GROUPS	

Overall data scan

Character	1	2	3	4	5	6	7	8	9	10	11	12	13
If a CEB Channel	Channel Number			Spaces or Zeros		M or V (See text)	+ or − (Polarity)	Significant Data Digits If character 8 is ϕ or 1 otherwise data is over range and not usable					Data Range Pointer
If a Remote Channel	Remote Location Number			Remote sub-Channel Number									

Individual data signal groups

2. Magnetic Tape Bit Configuration

Character	BITS	
0	11110000	
1	11110001	
2	11110010	
3	11110011	
4	11110100	
5	11110101	
6	11110110	- EBCDIC
7	11110111	
8	11110000	
9	11111001	
+	01001110	
-	01100000	
B	11000010	
M	11010100	
N	11010101	
S	11100010	
V	11100101	
BLANK	01000000	

3. MODEM BIT Configuration

Character	BITS	
0	00110000	
1	10110001	
2	10110010	
3	00110011	
4	10110100	
5	00110101	
6	00110110	- ASCII with an additional parity bit added.
7	10110111	
8	10111000	
9	00111001	
+	00101101	
B	01000010	
M	01001101	
N	01001110	
S	01010011	
V	01010110	
BLANK	10100000	

IX. LISTING OF SUBROUTINES

1. Input and Output

DATTAP - used to set up and write a single record on the output magnetic tape.

DSKRTS - used to read, write, update, and perform all necessary checks on a single disk file (scan) location.

ERRPRT - used to sort and display all errors which require operator assistance and a few that do not.

FRENPT - reads an input string of ASCII characters and returns a variable number of real numbers.

GETCOM - gets, converts, and checks a single input command along with its associated arguments.

HEXDMP - displays an entire buffer to the operator in a hexadecimal format.

PINPUT - displays the input buffer (to the operator) in several display modes as requested.

RDITMT - reads a single record from the output magnetic tape.

RDTAPE - causes a single data scan of data to be read from the raw data input magnetic tape, checks the format, and corrects it if logically correctable and necessary. A single data scan of data could consist of one or more magnetic tape records.

WRITEF - writes three ends-of-file on a requested tape drive.

2. Bookkeeping

DEHASH - deletes an alphanumerically defined variable from a reference table such that it can no longer be referenced. This routine will also delete a command such that it can no longer be used.

GETNBS - sets up all cross references between NBS data codes, DAS channel and subchannel, data location reference index number, measurement type, and measurement reference within a type.

INHASH - defines an integer number to be used in place of an alphanumerically defined variable. This subroutine is also used to define the parameters associated with a command.

UTABLE - sets up and continuously updates a reference table which defines the file location for the data scans located on the scratch disk. This subroutine also returns the contents of the reference table as requested.

3. Conversion

COMINT - converts a variable number of specially coded characters into a binary (integer) number.

CONATE - converts a complete buffer from ASCII format to EBCDIC format.

CONETA - converts a complete buffer from EBCDIC format to ASCII format.
CONGRP - converts a 13-character EBCDIC grouping of a single channel measurement into five integer code numbers.
DEGDLF - converts millivolt data to delta degrees Fahrenheit.
DEGRSF - converts millivolt data to degrees Fahrenheit.
DENSTY - calculates the density of water in pounds per cubic foot as a function of temperature.
EVENTS - converts millivolt data to a single number which represents the on or off status of six signals.
INTEGR - converts millivolt data to
(a) gallons per minute (turbines)
(b) kilowatts, or (c) minutes.
PRESS1 - converts millivolt data to pressure in pounds per square inch.
PWRFCT - converts millivolt data to total energy plant power factor.
SPECL1 - converts millivolt data to instantaneous kilowatts.
TIMER1 - calculates the time difference between two successive scans.
VENTRI - converts millivolt data to flow rate in pounds per minute.
VISCOS - calculates the viscosity of water in centipoises as a function of temperature.
VOLTS1 - converts millivolt data to total energy plant voltages.
WEASTA - converts all weather station millivolt data to the engineering units it represents.

4. Control

CKDISK - checks and controls the writing of data on the scratch disk. This subroutine will inhibit any write operation on a particular disk which has not been specifically assigned to TEREVIEW.
CONALL - controls the sequence of all character and engineering unit conversion operations.
DRIVER - controls the sequence of all operations required in order to create an output magnetic tape.
INIT - controls all initialization sequencing.
TEREVIEW - the main program which controls the overall sequencing of all initialization and command operations.
TRNRAW - controls the automatic sequencing for the transfer of raw input data through its various conversions prior to and including the writing on the scratch disk.
WIPOUT - controls the sequence of operations necessary in order to wipe out a scratch data disk and set it up such that it is ready to begin a new disk scan file.

5. Support

ADRESS - returns the memory address of a reference variable.
BACKSP - backspaces a requested magnetic tape a requested number of records.

CC1TEBCD - converts an ASCII character to EBCDIC format.
CHDECD - returns a reference index location number as a function of DAS channel and subchannel.
CLASS - defines and references the character strings in an operator input command containing arguments.
CODIT - converts an operator input string of alphanumeric into a specially coded numerical string.
DECDIT - converts a specially coded numerical string into a string of ASCII characters.
DECTOBIN - converts six ASCII characters into a single binary integer.
EBCDTCC1 - converts one EBCDIC format character to an ASCII format.
FCS - a set of subroutines which support all disk data file operations.
HASH - the subroutine that does the actual command decoding and makes integer assignments to variables.
HEXTCC - takes one binary word and converts it to four ASCII characters representing the hexadecimal equivalent for the word.
INDAN1 - contains the location reference required for differential temperature calculations. Also contains the ASCII representation of all units codes. This is basically a block data program.
LAND - returns the logical AND of two integers as an integer.
LEOR - returns the logical exclusive OR of two integers as an integer.
LOCTED - returns a data index location number as a function of NBS data code.
LOR - returns the logical OR of two integers as an integer.
LSHIFT - shifts a variable number of characters in a string to the left.
NBSLOC - returns the NBS data code as a function of the data index location number.
OUTHEX - outputs as hexadecimal text the contents of specified memory locations.
OUTINT - outputs as decimal text contents of specified memory locations.
OUTTXT - outputs a specified number of ASCII characters as text.
READIN - reads up to 72 ASCII characters into memory.
READMT - reads a single record of the raw data input tape.
RSHIFT - shifts a variable number of characters in a string to the right.
RWNDIT - rewinds a specified magnetic tape unit.
SEEKEF - seeks a specified number of ends-of-file on a requested magnetic tape unit.
SKBYTM - returns a relative scan number (contained on the scratch data disk) as a function of the time for which the scan occurred.
SKIP - skips a specified number of records on a requested magnetic tape unit.

SPLITA - splits one integer word logically into two words representing the left and right half of the original word.

TEDITX - serves as a support routine to TEREVIEW in the decoding and initialization of several special functions.

UNSPLT - combines two integer words logically into the left and right half of one integer word.

WRITMT - writes one magnetic tape record on the output tape drive.

X. TEREVIEW COMMAND LISTING

1. Definitions and Abbreviations

ABBREVIATION	DEFINITIONS
AN	Variable name (1 alpha and optional 1 number)
DD	Delta day
DH	Delta hour
DM	Delta minute
FC	First character
FD	First day
FL	First location number
FN	First NBS number
FS	First scan number
FT	First time (hour and minute of 1st day)
ICODE	Integer code for initialization
IDAY	Day of the year (1 through 366)
IHR	Hour of the day
IMIN	Minute of the hour
INT	An integer number
LC	Last character
LD	Last day
LL	Last location
LN	Last NBS number
LOC	Location number
LS	Last scan number
LT	Last time (hour and minute of last day)
LUN	Logical unit number
NBS	NBS number
NP	Number of position
NR	Number of remotes
NV	Number of variables
NUM	Number of records

2. Commands and Functions

BK, NUM, LUN

Backspace NUM records on magnetic tape drive LUN

CA

Convert the contents of the input buffer from EBCDIC to millivolts and then to engineering units. Place the millivolt values and engineering units into the millivolt and the engineering units output buffers respectively. Convert all labels and flags and place the results in the appropriate output buffer locations. This is a one step conversion which combines the CI and CE instructions explained below.

CE

Convert the contents of the millivolt buffer from millivolts to engineering units and place them into the appropriate output buffer. Flag values are also calculated.

CI

Convert the contents of the input buffer from EBCDIC to millivolt values and place them into the millivolt buffer. Label information is also included.

CO, FS, LS (or CO, FD, FT, LD, LT)

Create an output magnetic tape from the scratch data disk beginning at FS and ending with LS (or FD, FT through LD, LT). If only the beginning scan (or day and time) is given, i.e., CO, FS (or CO, FD, FT, 0), this command will create the output tape from FS (or FD, FT) through the end of the data that are currently on the scratch disk. If no arguments are given (CO), this command will create an output magnetic tape consisting of all data currently on the scratch disk.

DS

Produce a scratch disk summary consisting of the day and time of the first scan on the disk, the day and time of the last scan on the disk, and the total number of scans contained on the disk.

DV, AN

Delete variable AN from the variable name parameter table. This assumes that AN has been previously set by the SV instruction.

EU, FL, LL, 0 (or EU, FN, LN,)

Display the engineering units of the output buffer beginning at FL and ending with LL (or FN through LN). If only one argument is given, that argument is interpreted as an NBS code number and only the one output will be printed.

EX

Exit from the program after setting up the scratch disk with the necessary parameters for reentry and continuation.

GS, INT (or GS, IDAY, IHR, IMIN)

Place scan number INT (or the scan for IDAY, IHR, IMIN) which is currently on the scratch disk into the output buffer. Note that the arguments (IHR, IMIN) can also be written as one number [(IHR x 100)+IMIN].

HD, FC, LC

Display the input buffer in hexadecimal from FC through LC.

IN, ICODE

Initialize the disk according to ICODE as follows.
ICODE = 0, no operation if set by operator.
1, start processing where last stopped. This assumes that EX (exit) was previously called and that the scratch disk has not been disturbed.
2, initialize the scratch disk to contain no data.
3, start over with scan 1 on the scratch disk. This allows for program continuation, without exit, after the creation of an output magnetic tape (using the CO instruction).
4, Equivalent to the EX (exit) instruction.

LO, FL, LL, 0 (or LO, FN, LN)

Locate the corresponding NBS codes starting with FL and ending with LL (or the corresponding location starting with FN and ending with LN). One argument is interpreted as an NBS code and the appropriate location number will be returned.

LS, FC, LC, NP

Shift the input buffer characters beginning with FC and ending with LC to the left NP character positions.

NR, INT

Set the number of remotes to INT. This command was used during the early phases of the program when not all of the remote buildings were yet on line. This command is currently used only for very special reasons.

NV, INT

Set the number of variables to INT. This command was used during the early phases of the program when not all of the planned measurements were on line. This command is currently used only for very special reasons.

PF, FL, LL, 0 (or PF, FN, LN)

Print the value of the data flag beginning with location FL and ending with LL (or NBS code FN through LN). If only one argument is input, it will be interpreted as an NBS code and the one corresponding flag value will be displayed.

PI (or PI, FC, LC or PI, FC)

Print the characters currently contained in the raw data input buffer as follows:

PI - print the first 19 (label) characters only.

PI, FC - print all characters contained in the raw data input buffer beginning with character number FC.

PI, FC, LC - print the characters contained in the raw data input buffer beginning with character number FC and ending with LC.

PL

Display the label and time of the scan contained in the millivolt buffer.

PM, FL, LL, 0 (or PM, FN, LN)

Display the millivolt values contained in the millivolt buffer beginning with FL and ending with LL (or FN through LN). One argument is interpreted as an NBS code and only the one corresponding millivolt value will be displayed.

PT, FL, LL, 0 (or PT, FN, LN)

Display the thumbwheel constants (see section 6.5.4) currently assigned to locations FL through LL (or assigned to NBS codes FN through LN). One argument is interpreted to mean only one thumbwheel constant corresponding to the NBS number is desired.

RO

Read one record from the output magnetic tape and place it into the output buffer. If a particular record is required, the command RO, IDAY, IHR, IMIN will cause a search of the output tape for that record. Note that IHR and IMIN can be combined (as in the GS command) if desired.

RS, FC, LC, NP

Shift the input buffer characters beginning with FC and ending with LC to the right NP character positions.

RT

Read one record from the input raw data tape and place it into the input buffer. If a particular record is required, the command RT, IDAY, IHR, IMIN will cause a search similar to the RO command.

RW, LUN

Rewind the LUN magnetic tape.

SD, LOC, 0 (or SD, NBS)

Set the engineering units for a particular LOC (or NBS) channel to a new value. After the command is entered, there will be a slight delay followed by the request to enter the value. This command will also cause the appropriate flag value to be set to indicate that the operator has modified the data.

SE, INT, LUN

Seek INT number of ends-of-file on magnetic tape LUN.

SF, LOC, INT, 0 (or NBS, INT)

Set the flag value for LOC (or NBS) to the value INT.

SI, NP

Set the input character contained in the input character buffer position NP to a new EBCDIC value. A slight delay will occur followed by the request to enter the character (in ASCII).

SK, NUM, LUN

Skip NUM records on magnetic tape LUN.

SM, LOC, 0 (or SM, NBS)

Set the millivolt value contained in the millivolt array location LOC to a new value. This command is similar to the SD command.

SR, FC, LC, NP

A special read command to read the next record on the input raw data tape beginning with character FC (must be odd) and ending with character number LC (must be even). The data will be placed in the input buffer beginning with character position NP (must be odd).

SS

Change the delta time to the current time and set the delta time flag to reflect a normal status. This command allows for continued processing after an error in scan time has been detected.

ST, LOC, INT (or ST, NBS)

Set the thumbwheel calculation constant (see section 6.5.4) for location LOC (or NBS) to the value INT.

SV, AN, INT

Assign the two letter code AN to the value INT.

TM, DD, DH, DM

Modify all following label times up or down by a delta time factor corresponding to DD, DH, DM, with up being (+) and down being (-). This command is used to bring the raw data tape time to the actual data time when for any reason, the DAS clock was not in synchronization with the actual time.

TR, NUM, INT

Transfer NUM records from the raw data input tape to the scratch disk after converting the EBCDIC characters to millivolts and then to engineering units and calculating all label, flag, and data values. This command will cause NUM sequential executions of the RT, CA, and WS commands. The label information contained in the current scan will be displayed every INT records.

WE, LUN

Write three ends-of-file on magnetic tape number LUN.

WS

Write a scan from the output buffer to the next available scratch disk file location.

XI. TEREVIEW ERROR MESSAGES

The following error messages are listed in order of Type ().

NAME	TYPE	A B C D E	MEANING
MAIN	1	0 0 0 0 0	Undefined operator input detected in main program.
INIT	1	I J 0 0 0	Disk initialization error.
	2	I J 0 0 0	Disk exit error. I = 0, not occurring with disk read; 1, occurring with disk read. J = 1, disk assigned to data ; 2, disk assigned to TEREVIEW; 3, disk unassigned; and X, disk assignment unknown.
GETCOM	3	I 0 0 0 0	Illegal command or argument. I = number of arguments converted before error detection.
	4	0 0 0 0 0	Illegal argument type.
HASH	5	I 0 0 0 0	Incorrect command key value.
	6	I 0 0 0 0	Request for variable which is undefined. I = the command or a variable random access key value, and has little meaning except for software debugging.
INHASH	7	1 J K L M	Requested variable not equal to decoded variable.
	7	2 J K L M	Requested variable is already defined. J = requested variable key, K = requested variable value, L = decoded variable key, and M = decoded variable value.
DEHASH	8	I J K L 0	Requested command or variable is improper. I = 0, command or variable is in table; 1, command or variable not in table. J = requested key. K = decoded key. L = decoded value.
RDTAPE	9	I J K 0 0	Raw input tape read error or unexpected condition.

			I = 0, end-of-file detected; X, number of characters read (if negative, all characters were not read) in last record. J = -32767, record was unreadable; = -1, longitudinal parity or rate error; = 0, no mechanical magnetic tape errors; and = X, number of lateral parity errors detected. K = number of characters placed in input buffer before error detection.
CONALL	10	I 0 0 0 0	Illegal EBCDIC character detected in first 19 label characters. I = the number of illegal characters detected.
	11	I 1 K 0 M	Conversion error characters 1-4.
	11	I 2 K 0 M	Conversion error characters 5-8.
	11	I 3 K 0 M	Conversion error characters 9-12. I = 99, converted number too large; = X, number of the offending character K = number of 1st character in conversion group of 13. M = converted value.
	11	I 4 0 0 M	Day of year conversion error (characters 13, 14 and 15).
	11	I 5 1 0 M	Hour of day conversion error (characters 16 and 17).
	11	I 5 2 0 M	Minute of hour conversion error (characters 18 and 19). I = 99, converted number too large; = X, number of offending character. M = converted value.
	12	I J K L M	Data group conversion error. I = 1, minor error not affecting data value; 2, major error which affects data value. J = character number of 1st character in 13-character group. K = converted channel number. L = converted sub-channel number. M = the offending characters within the 13-character group as indicated by the bit positions which are set to a logical 1.
DRIVER	13	I 1 0 0 0	Disk scan request error. I = 1, first scan in table; 2, requested scan not in table.

	14	I J K L M	Disk scan or operation error. I = 1, first scan in table; 2, requested scan not in table. J = 1, disk busy; 2, disk location error. K = scan number requested. L = converted scan number. M = scan number passed to the file control system.
	(NOTE: see additional information on type 14 errors below.)		
DSKRTS	14	I J K O O	Disk file control. I = file control system error number (see documentation on Raytheon file control system error codes - Reference 6). J = 1, read mode; 2, write mode; 3, update mode. K = scan number requested.
	(NOTE: See additional information on type 14 errors below.)		
UTABLE	15	I J K L O	The time between successive scans has changed. I = old delta-time. J = new delta-time. K = J-I L = -1, next time table update will be based on next delta time, 0, next time table update will occur only if delta time does not change; 1, next time table update will occur even if delta time changes.
	16	I J K L M	Time table request error. I = last day of current block of data. J = last time in current block of data. K = requested day. L = requested time. M = delta time between each scan in current block.
	17	I J K L O	Time table is full. I = old delta time. J = new delta time. K = number of entries requested L = size of time table.
DATTAP	18	I J K L O	Error on creation of output data tape. I = 0, not a magnetic tape error; = minus, magnetic tape error. J = scan number. K = day of year (data). L = time of day (data).

Type 14 errors:

These errors will generally be preceded by "FCXX", where XX will correspond to the error code as listed in the Raytheon File Control System manual [5]. Additionally, since type-14 errors are considered to be major in nature (with no operator fix allowed), the entire File Control table (33 information control words) will be output following the normal error message.

Other Error Messages:

Additional error messages may be output from time to time; however, these messages are always textual in nature and are self-explanatory. Messages of a textual type are normally concerned with operator requests which are outside of the TEREVIEW capabilities or which could not possibly be correct. An example would be for the operator to define the number of remote locations to be 9 or more when the physical system only has 8 or less.

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L. Galowin, Section Chief, Building Services Section
J. Snell, Manager, Energy Conservation Programs
C.W. Phillips, Manager, Total Energy Program

For Initial Software Planning and Philosophy of Operation:

Dr. J. Snell
J.B. Coble
R.H.F. Jackson
R. Kirsch
D. J. Orser
Dr. R. Grot
Dr. L. Galowin

For Development of Engineering Units Conversion Techniques:

J.B. Coble
Dr. R. Grot

For Instrumentation Characterization:

C. Bulik
M. Kuklewicz
L.D. Ballard
J.B. Coble

For Output Display Philosophy:

J.B. Coble
C.W. Hurley

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D. E. Rorrer, W. G. Rippey and Y. L. Chang

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☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

The major processes used in the reduction of the data obtained from the Jersey City, New Jersey, Total Energy Site are discussed. These discussions begin with the acquisition of the raw engineering data and carry through to the final data presentation in a form from which the summary performance reports of the Total Energy Site are produced.

The major functions of the Jersey City toal energy data editing and conversion software program developed by the National Bureau of Standards are described in some detail. Included are descriptions of the command structure, overall data flow, data editing, data conversions, error processing, and the creation of data output tapes for use in further analysis. The more important subroutines which are used to handle the individual operations are also discussed. The equations used in the calculation of engineering units are described, along with their derivations where appropriate.

The report assumes that the reader has a basic familiarity with computer and engineering terminology.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)* Computerized processing; data editing; data flow; data processing; data reductions; raw data conversion to engineering units; total energy; total energy data flow.

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