AN ABSTRACT FOR THE THESIS OF

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Title: Computer Simulation of Plywood Manufacturing Using the GASP IV Language

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Because of the increasing need for the plywood industry to improve the performance and adaptability of its production facilities to meet demand, the need for a process-related decision-aiding method has been growing.

The objective of this study was to develop a computer simulation for a plywood plant starting at the dryer and ending at the banding station using the GASP IV simulation language.

A simplified model of an existing facility was developed and the computer program was thoroughly documented. Two sample runs were made and discussed. They show how this method can be used as a decision-helping tool in the real-world industrial environment.

Because there is no application of simulation languages to the area of plywood manufacturing in the literature, future improvements of this simulation technique and its applications were discussed.

Computer Simulation of Plywood Manufacturing Using the GASP IV Language

by

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Computer Simulation of Plywood Manufacturing Using the GASP IV Language

I. INTRODUCTION

A. Present work and future outlook

The availability of a good tool for modeling plywood plants would be very helpful to the forest products industry which needs effective decision-helping methods, especially during the present period of economic hardship.

Industries have been using decision-helping methods for some time. Some companies would cease to operate without their assistance. Operations research is a recently developed "decision-helping" science. It has been booming since the development and miniaturization of digital computers. The methods it gave birth to are described in a large number of books and articles (12).

Applications of operations research are numerous in forestry-related activities. For example, Program Evaluation and Review Technique (PERT) has been used with success for investment set-up in a sawmill (22), dynamic programming helped optimize the tree bucking operation (23), and materials flows as well as lumber sorting policies have been investigated by using the queuing theory (6, 7).

Linear programming is, by far, the most widely used and known operations research technique. This method is well adapted to the plywood industry and enjoys an enormous success. Most applications started in the 1960's (16), and the need to use them is still so great that, while all large companies own and manage their own systems, successful specialized consultants market "turnkey software" to smaller ones.

Linear programming is mainly used for the product mix-cost analysis problem (2). It helps to optimize the profit that can be derived from given industrial installations and constraints through variable products assortment. It has also been applied to production planning and scheduling, and literature references on the subject are very numerous (4, 5, 21, 27, 32, 33).

The preliminary steps prior to applying these operations research methods consist of building a mathematical model from a set of equations or inequalities with major flows or phenomena quantified: From this a simulation model resulted (25). It yielded good predictions of the status of the studied system, the best of a studied set.

Even without applying one of the more refined methods named above, one can use the preliminary mathematical model for such predicting without actually running a manufacturing plant. Most of the time this is done on a computer by translating the mathematical model components into a high level language (Fortran, Pascal or Basic, for instance), and the numerous necessary iterations will be performed by the computer by running the program. This practice is extremely frequent. In the wood industry these models gave birth to many improvements, particularly in the wood recovery area. A good example is the work of D. Lewis and H. Hallock on the best opening face sawing program (20), which optimizes log sawing patterns by calculating all possible solutions at computer speed, comparing them, and selecting the best one.

Many simulation languages exist on the market. Their purpose is to provide a structure which makes the computer implementation of a model easier, especially when time is the independent variable. Their ability to handle time-related situations allows these languages to be particularly well adapted to industrial processes modeling. Though it is quite possible to implement time dependent models without using a simulation language on a computer, their built-in time advance system as well as many other features make them very attractive to the user.

All these languages offer their own advantages. Goulet, Iff and Sirois (11) compare several simulations of tree-to-mill forest harvesting which uses different languages and show the differences in the results when applied to the same problem.

GASP IV (GASP stands for General Activity Simulation Program) and GPSS (General Purpose Simulation System) are two of the most widely used discrete simulation languages. Both of them have been used in a wide range of applications. GPSS (8, 10) has been used in many fields such as production line simulations (19, 29), space shuttle scheduling, (26), space and scheduling policies in hospitals (17), and whole-tree chipping simulation (3). Examples of GASP IV uses are just as diversified: gasoline queuing simulation (14), job shop scheduling (7), steel ingot processing (30), chemical reactions modeling using its continuous capability (13), as well as timber harvesting (15, 31), and veneer drying (28).

Use of these two simulation languages started in the late 1960's. They are not as widely employed as other operations research methods because of their limitations and because they are difficult to modify. On the other hand these techniques appeared to be very adaptable for studying the discrete plywood manufacturing process.

A forest products firm which has its own linear programming system was interested to see how this method would perform when adapted to the modeling of one of its plywood operations. By doing this, comparisons could be made later between production data which would be obtained from both linear programming and simulation language tools.

B. Scope of the model

Eight panel constructions, from among many possible at the cooperating plant, were the simulated production goal. The plant shows a simple product flow and has no green end, i.e. lathe and chippers. Green veneers were purchased from other plants of the company or on the open market and dried on a roller drier. The rest of the needed veneers were purchased from the same sources as the green veneers. As the plant produced a high proportion of sanded or touch sanded panel grades, five Raimann pluggers upgraded a large amount of veneers from the low grade veneers which were purchased as green veneers. A recently acquired jointer enhanced this upgrading capability by allowing jointed half sheets to be plugged.

All plywood panels were assembled on one soft roll gluespreader, which sent its production to a prepress and then to 25-openings and/or a 10-openings hot press. The glued panels of lower grades were then sawn and banded. Higher grade plywood went through a synthetic patching line and a wide belt/speed sander system. When their production cycle was over, all panels were grouped into standard loads and banded prior to shipping. (Figure 1.1).

The simulation model started at the dryer outfeed and/or at the dry veneer inventory as input to the system and stopped when panels were regrouped into standard loads prior to banding. The plant layout is shown in Figure 1.2.

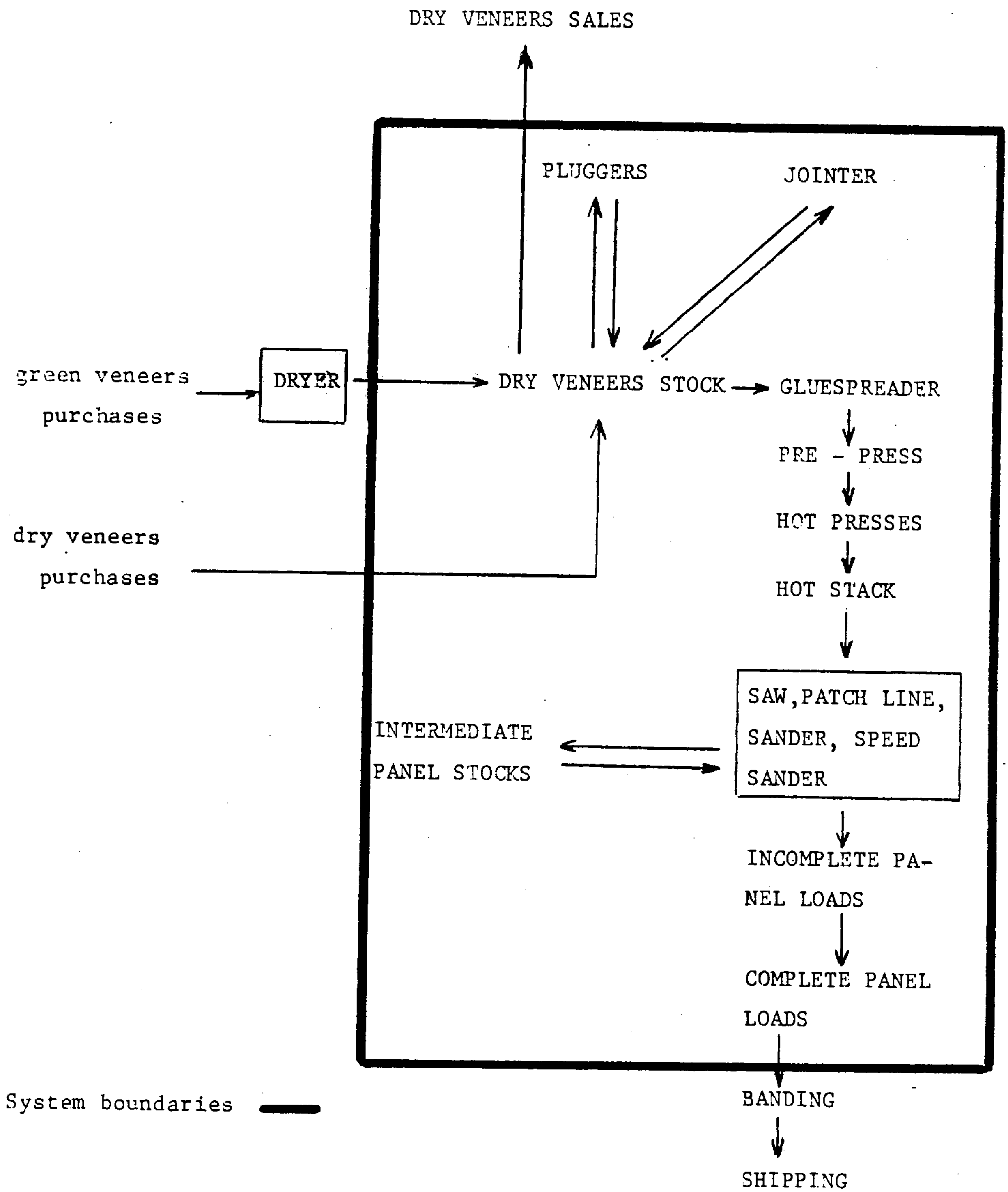


Figure 1.1. Diagram of the system

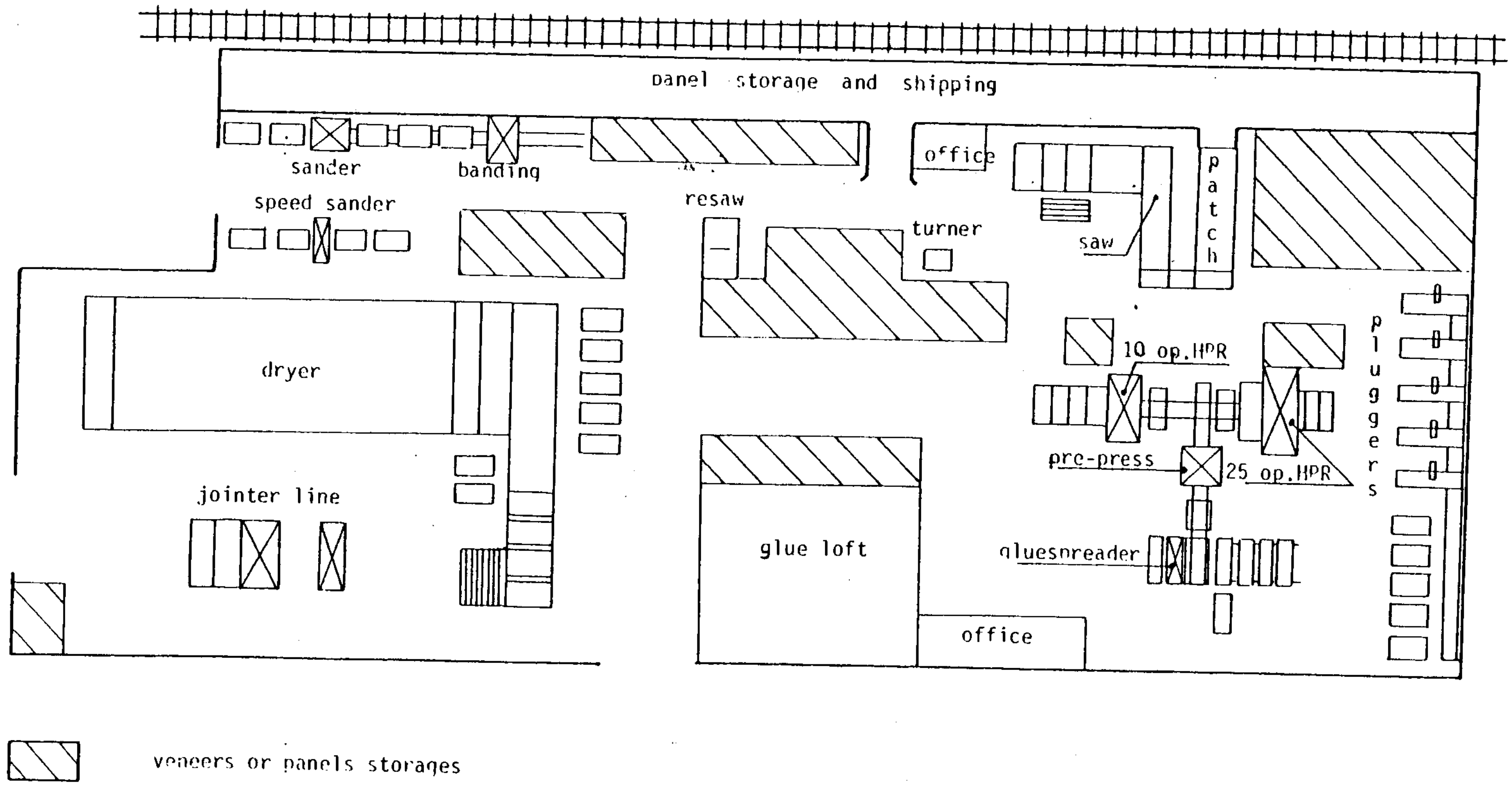


Figure 1.2. Sketch of the plant

II. OBJECTIVES

The purpose of this study was to build a model of a plywood plant by using the GASP IV simulation language. Because records of earlier research using this approach for this particular purpose cannot be found in the literature, an additional goal was to evaluate its adaptability to common problem-solving in plywood manufacturing processes.

Sample runs show an example of how the model can be used in the real world. In the first run, the plant was asked to produce a given product mix. The results provided the plant manager with decision-helping elements. The resulting policies were tried through a second run and improvements were evaluated. The method's success as a decision-helping tool was discussed, as well as what must be done in the future to perfect it.

III. METHOD OF ANALYSIS

A. The GASP IV language

GASP IV handles a system to be simulated with the event scheduling approach. The process is centered upon detailed descriptions of the steps that occur every time an event takes place. In contrast is the process-interaction approach used in GPSS (9) where the system considers all operations that will occur for each entity as it goes through the system.

The GASP IV package consists of a pre-written set of subroutines which monitor the simulation (24). The entities, or objects within the system, are grouped into files with their attributes or specific user-defined characteristics. They can be sent into or removed from files by the GASP IV system through the use of the appropriate calls to GASP IV subroutines. These file manipulations can be made according to various patterns of priority rules or other considerations. This feature allows an excellent handling of any queuing situation, which is very valuable when studying discontinuous manufacturing processes.

The GASP IV language can handle discrete, continuous or combined simuations. In this particular case we used only its discrete capability since the system variables only change at events which occur at specified points of time. Only a small part of the GASP IV package is used for discrete simulations.

The package includes statistical features: up to 6 pseudo-random numbers streams and built-in functions for generating deviates from most common distributions. System subroutines also compute statistics on time persistent variables and on variables based on observations. The system is also capable of plots and histograms through the use of specialized subroutines.

All system and user-written subroutines use the Fortran IV language. This allows the user to understand how the GASP IV subroutines work, and even to make small changes to the system. The user can also define the contents and format of the output to a very large extent, which is not always the case in other packages.

B. Justification

GASP IV was chosen for this study for several reasons. It uses Fortran and is easily understood and implemented on any mid-size computer with a Fortran IV compiler. It is also low in price compared to other languages. This might be an asset for corporations which would be interested in using this technique. Other relative advantages of GASP IV are discussed by Law and Kelton (18), Chapter 3.

IV. THE PLYWOOD PLANT TO BE MODELED

A. Production

The actual production of the plant averaged 6.9 MMSF 3/8" per month (where MMSF stands for million square feet). The most common thicknesses were:

Sanded grades: 5/16" AC/BC

9/16" AC/BC

Touch-sanded: 15/32" CCPTS

Sheathing: 1/2" CD, 3/4" CD, 5/8" CD, 3/8" CD, and 5/16" CD.

This was a typical mix for "ordinary" past periods. The difficult situation which the plywood industry faced at that time was quite different, as it had to adapt to demand and particularly to special orders. This simulation program and technique, however, is more adapted to a steady panel production situation than to the difficult economic situation that was taking place.

The shift organization for the main production centers is shown in Figure 4.1.

B. Veneer Supply

Green veneers were mostly (95%) purchased from other captive plants. The remaining 5%, as well as most dry veneers, were bought on the open market. The average supplies ranged between 4.0 and 4.6

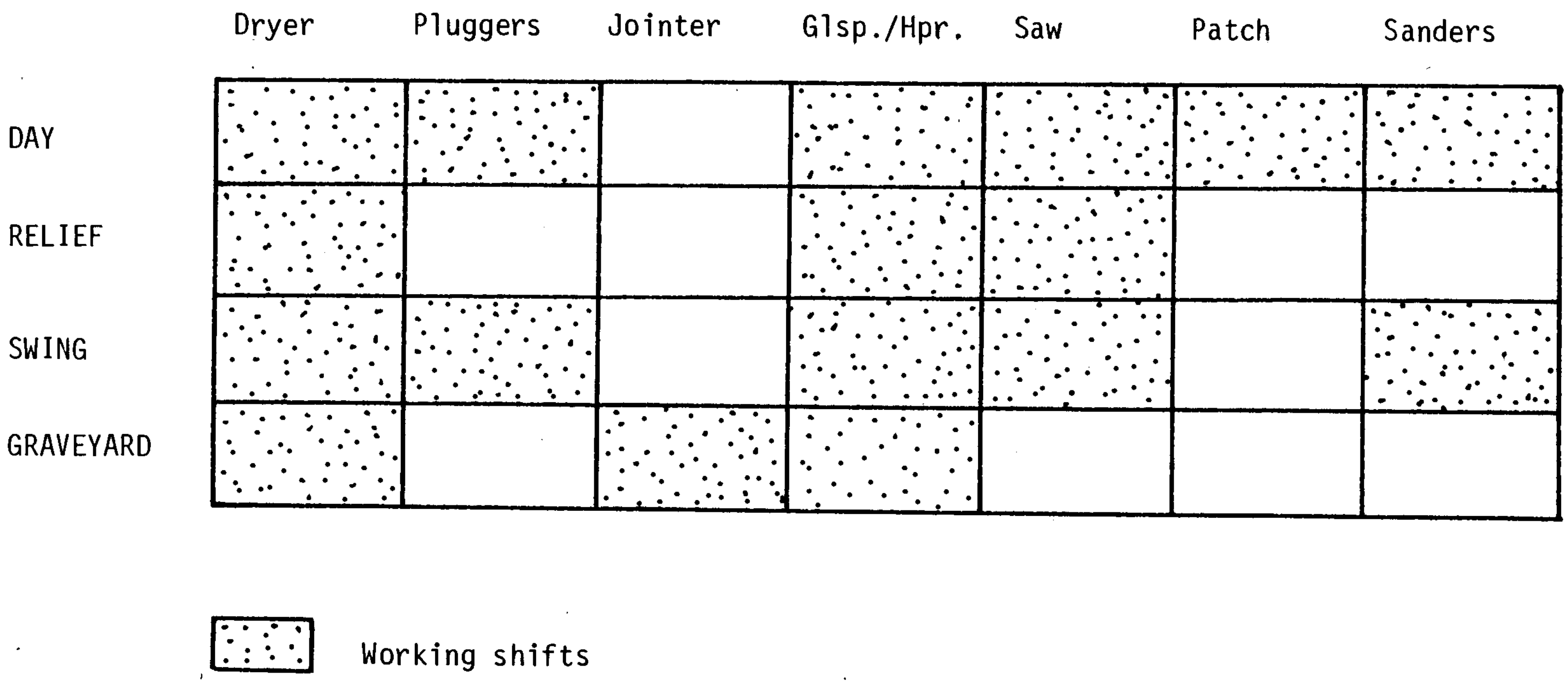


Figure 4.1. Schedule for production centers

MMSF per month for green veneers, and 2 and 2.5 MMSF per month for dry veneeers.

A typical pattern for dry veneer supply was:

- 80 MSF C/D Core strips 1/10" once a week (65%C grade and 35% D grade)
- 80 MSF C, D, or Centers in 1/10", 1/6", or 1/8" - 54" or 27", five days a week, according to the needs, and including 50% C grade, 35% D grade, and 15% Centers.

The green veneer supply was matched with the dryer input. The dryer crew varied with the products being dried. Thus the organization of the drying step was adjusted to the product mix but remained fairly constant:

- Day and Relief shifts: Drying 27" and strips
- Swing and Graveyard shifts: Full size 54" wide veneers. The production standards for the dryer are shown in Appendix A.

Within this rule, the veneer mix was matched to the needs of the production. The products were graded at the outfeed. The average percentages are shown in Table 4.1.

The typical veneer inventories ranged between .6 and 1.2 MMSF for green veneers, and between .4 and 2.5 MMSF for dry veneers. The dry veneer stock was usually composed of about 80% 1/10" veneers and 20% 1/6" veneers, among which one could find 40% 54" faces and backs, 40% core strip materials, and 20% centers, mostly 27". The approximate species distribution is shown in Table 4.2.

Table 4.1. Grade distribution at the dryer outfeed in percent for each shift.

	Full size 54"	Halves 27"
Bpatch (to be patched)	15%	15%
C grade	60	50
D grade	15	15
Centers	-	10
Cores D	-	2
Redry	10	8

Table 4.2. Approximate Species Distribution

Species	Percent
Douglas fir	85
White fir	5
Spruce	5
Alder	2
Hemlock	2

Commonly used veneer thicknesses were 1/10" and 1/6". Less common panel sorts or constructions required 1/8", and, to some extent, 3/16" (.200") and 7/32" (.228") thick veneers.

The average veneer waste factor was 6.7% for 1/6" and 1/8", and 6% for 1/10" thick veneer. This loss occurred throughout the plant, but mainly at the gluespreader.

C. Veneer Upgrading Operations

The 1/10" face veneers which were dried at the mill yielded around 15% Bpatch grade veneers. They were plugged on five Raimann pluggers which worked on Day and Swing shifts. Average output grade mix at the pluggers was:

A	B	C	D	Utility (Centers)
25%	45%	25%	3%	2%

In addition, 27" veneers could be jointed in pairs into 54" veneers on an edge-gluing/jointing line. Bpatch veneers were jointed prior to being plugged in order to prevent patches from falling from upgraded veneers. All 27" grades were jointed according to need.

D. Gluing and Pressing

The soft roll gluespreader was operated by bushelers on a four continuous-shift basis. Most usual panel constructions are shown later in Table 6.2. Panels were composed into standard stacks. Standard stack assembly times are shown in Appendix A. Numbers of panels per stack were multiples of the number of openings of the press that they were scheduled for. The press was chosen according to the following policy: A stack is scheduled for the more productive 25-openings press as long as there are currently no more than 4 stacks waiting. Otherwise, a stack is scheduled for the 10-openings press.

The following priorities were followed for the layup:

1. The orders of the week must be filled. This is one of the foreman's direct responsibilities.

2. Manufacture of the sanded orders starts on Sunday Graveyard shift after the presses have been cleaned up during maintenance. Unsanded panels are glued when all sanded orders have been filled, or when the initial sanded panels session stops because necessary veneers are no longer available.

3. In order to divide the workload as equitably as possible, work must be organized in such a way that all four busheler teams should lay-up the same number of heavy cores (1/6" and 1/8" thick veneers).

After the panels were assembled the stacks were pre-pressed for a constant time in a cold press and then after a waiting period were hot-pressed as previously outlined. Within these limits, the presses operated on a first in, first out basis (FIFO).

Press times were determined by panel thickness and press temperture (see Appendix A). At the outfeed of the presses panels were grouped into multiple loads and moved into the hot stack. This is where the glue bonds became fully cured before further handling of panels. The policy was to have the panels remain for a minimum of two hours in a hot stack, except in case of emergency demand.

E. Finishing Operations

Finishing operations included the following steps:

1. Sawing: Panels were sawn to standard dimensions.
2. Patching: Defects on the surface of sanded and touch-sanded grade panels were filled with a fast curing polyester putty.
3. Sanding: Panel surfaces were improved and patch repairs leveled.
4. Banding: Panels were strapped into standard loads.

The path routes followed by the different sorts of panels are shown in Figure 6.10.

The saw operated in three shifts. The main problem was the regularity with which panel stacks were fed into the saw by the forklifts. Because the forklift operators assigned to the saw had a number of tasks, the saw remained idle quite often, and the average production was far lower than the machine capability. The saw crews also performed other tasks, such as relief at the dryer crews for 20 minutes per shift and handling the trimmings eventually used for fuel.

Panels were sorted at the outfeed of the saw and automatically stacked accordingly into bins. The average grades distribution for sheathing panels was, 93% good, mill certified, 3%; shop, 3%, delaminated panels, 1%. For all sanded grades, the grades distribution was: acceptable for the next steps, 99%; delaminated, 1%.

Mill certified grade applied to panels which had unallowable appearance defects. What was certified by the mill was the bond quality. Shop panels showed unallowable defects and were sawn later into smaller "good" panels. Delaminated panels were unacceptable for any of the preceeding definitions. Panels which needed further processing after the saw were sent into intermediate stocks before the next step.

The patch line was operated by three men. Sanded grade panels from the hotstack were repaired before sawing or re-patched when rejected from the sander. Sawn PTS panels (touch sanded grades) were also repaired here.

The two machines worked alternately since they were operated by only one man at a time. A wide belt sander handled the basic sanded production and a speed sander was used to sand the panels locally. The speed sander was well adapted to touch-sanded grades as well as leveling out local patch repairs which had been made on re-patched sanded grade panels.

Sanded and touch-sanded panels which left the system at this point were graded into three levels: good, shop, and downgrade. Downgraded sanded panels were considered as "good" sheathing panels of corresponding thickness.

A new automatic banding line handled the panels and bundled them into standard loads when their manufacturing process had ended. The station was operated by the forklift drivers. When strapped, the loads were stored and were ready for shipment by rail or by road.

Average actual machine production standards are given in Table 4.3.

Table 4.3. Production standards of main machines

Production Center	Variable names and values*	Units
Dryer	DRNITE = 880.6 DRDAY (1) = 727.3, DRDAY (2) = 779.5, DRDAY (3) = 753.4, DRDAY (4) = 369.7	good veneers/hr
Pluggers	PLUGG = 306	good veneers/hr all 5 machines
Jointer	AJOINT = 300	good veneers/hr
Gluespread Hot press	See Appendix A	
Saw	SAWSPD = 360	panels/hour
Patch	PATCH = 188	panels/hour
Sander	SAND = 313	panels/hour
Touchsander	SAND = 313	panels/hour

*All numerical values appear on each run printout under the heading "constants for the simulation."

V. MODEL STRUCTURES

A. Entities

The permanent entities in the system were the machines. Only the temporary entities, the veneers and panels, were considered during the simulation. The purpose of the simulation was to monitor their flow versus time.

Temporary entities were of three kinds:

. Dry veneers: Dry veneers which entered the system at the outfeed of the dryer or when purchased veneers were delivered to the plant.

. Panel stacks: At this level, the panels were assembled, pre-pressed or hot-pressed. They were created at the gluespreader and "traveled" through the system until they were introduced into the hot stack stock.

. Individual panels: Handled or stored in all finishing operations downstream from the hot stack stock.

Dry veneers and panels within the finishing area were thus handled in the same manner and stored into arrays instead of being stored into GASP IV files. At this level, GASP IV was only used for its event-scheduling capability. This allowed a considerable simplification of the simulation without any loss of accuracy. This could be done because queuing or time delay problems were not important for dry veneers or panels being finished. For instance, veneers were used in this particular plant without delay between dryer outfeed and gluespreader since the management considered the dryer cooling section efficient. The same was true for panels between the saw and the sander, or between the patch area and the saw, even if it is preferable to process patched panels quickly.

On the other hand, notions of time and delays were rather important in the gluing/pressing area. Time elapsed between gluing and pre-pressing (open assembly time), time between gluing and hot press (total assembly time), and time spent during the post-curing process that takes place after hot pressing are important variables. This is the reason why, in this area, the panel stacks were handled by GASP IV by means of files where entities were manipulated as required by the process, and from which records and statistics were easily collected.

The three basic sorts of entities were differentiated into numerous categories. The ones which were stored into arrays could be recognized through their subscript values. Those which were handled by GASP IV within files were recognized through their attribute values.

1. Veneers. In the basic model, two veneer thicknesses were considered with three veneer dimensions and eight grade possibilities. They did not "travel" through the system the way it actually happened in the plant, but were added or removed from the dry veneer stock array at each event time. For instance, they were added to the stock at the moment when dry veneers were delivered to the plant or were removed from the stock when needed at the gluespreader as well as at the jointer or the pluggers. Veneers could also change subscripts;

they may be removed from the stock as half sheets and sent back when upgraded into full sheets. All these manipulations were made in such a way that the number of elements was accurately monitored. For this purpose, only equivalent full size veneers were considered throughout the model. An equivalent full size veneer refers to the veneer components which build up one 4' x 8' panel component when assembled into a panel. For instance, one equivalent veneer equals two 27" veneers or the necessary amount of strips which compose one full size core. These individual equivalent veneers were considered as integers, and the dry veneer stock an integer array.

2. Panel stacks. Specific characteristics of panels stacks were stored within their attribute vector. The panel code number corresponding to the considered thickness was stored as ATRIB(3), and the hot press code for which it was scheduled or from which it came was stored in ATRIB(4). The time when the first panel of a stack was assembled was stored in ATRIB(5). As the stack "traveled" through the system from time event to time event (through a succession of queues, or files), these three attributes were needed to direct their movement and gather necessary data.

A stack of panels was taken into consideration by the system at the moment it left the gluespreader. The veneers which had been removed from the veneer stock array when the first panel of the stack was assembled were converted into a panel stack. Between the two events, the veneers had simply "vanished" while the stack was yet to be created. This was possible since the necessary data was stored within the ATRIB(•) vector until the next "LEAGLS" event. At each event a stack was sent to the next machine, which means that the moment it entered or left it was scheduled and stored with the other attributes. If the next machine was already busy, the stack was sent into a queue (file) where it was stored with its attributes. It left the queue at the same time the next machine became idle and when the priority rules were fulfilled.

After pre-pressing, stacks engaged the press that they were scheduled for or joined a queue before one of the hot presses. When a hot press became available, the "oldest" stack was removed from the file and engaged the press. The same process was used for the hot stack stock, except that there was another constraint: a minimum of two hours (120 minutes) must have elapsed before a stack could leave it.

3. Panels after leaving the hot stack stock. At the moment panels left the hot stack stock, they resumed their individuality and were stored into arrays. These kept track of the number of panels of a given code present within intermediate stocks. Of course these panels were batch-processed, but they were no longer stored within files between operations. When two dependent events followed one another, like ENTSAW and LEASAW (entering and leaving saw), the attributes of the batch load (panel code and number of panels) were stored in the Atrib array. As soon as they left the saw, panels recovered their individuality and were stored within the next array.

B. Events

The event determination was extremely important as the GASP IV system is event-oriented. There were fifteen events and each was modeled within a user-written subroutine. Table 5.1 gives a summary of these events with their names and codes.

In this model, several operations had been considered as "black boxes" for simplicity. The main one was the dryer. It was assumed that the availability of green veneer was not limited and that the production schedule was mainly dependent upon the organization of the shift. Under these conditions the black box outputs (every thirty minutes) its veneer production into the dry veneer stock. Because of this, only average figures were used. It would take a full-scale study to model the real dryer operation, including drying and labor availability, cooling times between thicknesses and overlaps of shifts.

By using an event-oriented approach, one knows what happens at event times, but largely ignores what takes place between them. In this simulation, the event times were mostly batch loading and unloading times of most machines. Only inputs and outputs to these machines were described since they were considered black boxes.

When the entities were individualized or considered as single elements, the events took place on a regular schedule. They occurred every thirty minutes, and the necessary amount of veneers or panels was input to or output from the black boxes (dryer, jointer, pluggers).

When entities were grouped within a file they were input to the blackboxes. An interval between two events depended upon the time needed to process one batch. This happens at the gluespreader, pre-

Table 5.1. Description of events

	Name	Code
Drying for 30 minutes just ended	DRYER	1
Beginning of Day shift: Dry veneers are delivered to the plant	INVNT	2
Plugging for 30 minutes just ended	PLUG	3
Enough veneers for 30 minutes of jointing enter the jointer	ENTJNT	4
30 minutes of jointing just ended	LEAJNT	5
Composition of a panel stack starts at the gluespreader	ENTGLS	6
A stack leaves the gluespreader	LEAGLS	7
A stack leaves the pre-press	LEAPPR	8
A pressing cycle just ended on one of the two hot presses	LEAHPR	9
A batch of panels enters the patch line	ENTPAT	10
The last panel of the last batch has just been patched	LEAPAT	11
A batch of panels enters the sawq	ENTSAW	12
The last panel of the last batch has just been sawn	LEASAW	13
A batch of panels enters one of the sanders	ENTSND	14
The last panel of the last batch has just been sanded on one of the sanders	LEASND	15

press, and hot presses. The two systems could also coexist; panels which were fed into the saw were removed from a file (panel stacks from the hot stack), or from a numerical array (panels from the intermediate stock between patch and saw). In this case, the black box worked both ways.

C. Subroutines

The simplified flowchart of the operating system (Figure 5.1) shows the basic components of the model and the relationships between them. Main program PLYSIM defined the dimensions. The I/O units read numerical data from the datafile and called the system main subroutine GASP. The executive routine took care of event scheduling, simulation progress, and file maintenance.

Before the simulation started, subroutine GASP called subroutine DATIN so that the basic GASP IV input could be read from the user-defined datafile. Then subroutine INTLC was called, the initial conditions of the system were defined, and the first events were scheduled. Numerical data that changed between runs were also read from the datafile. The simulation was now ready to start.

According to its basic function, subroutine GASP made appropriate calls to subroutine EVNTS, which in turn called the proper user-defined event subroutine. As the system was self-propagating, the event subroutines calculated the time when a call to the next subroutine had to be performed. The information was sent to the GASP system event file where it was stored. Subroutine EVNTS

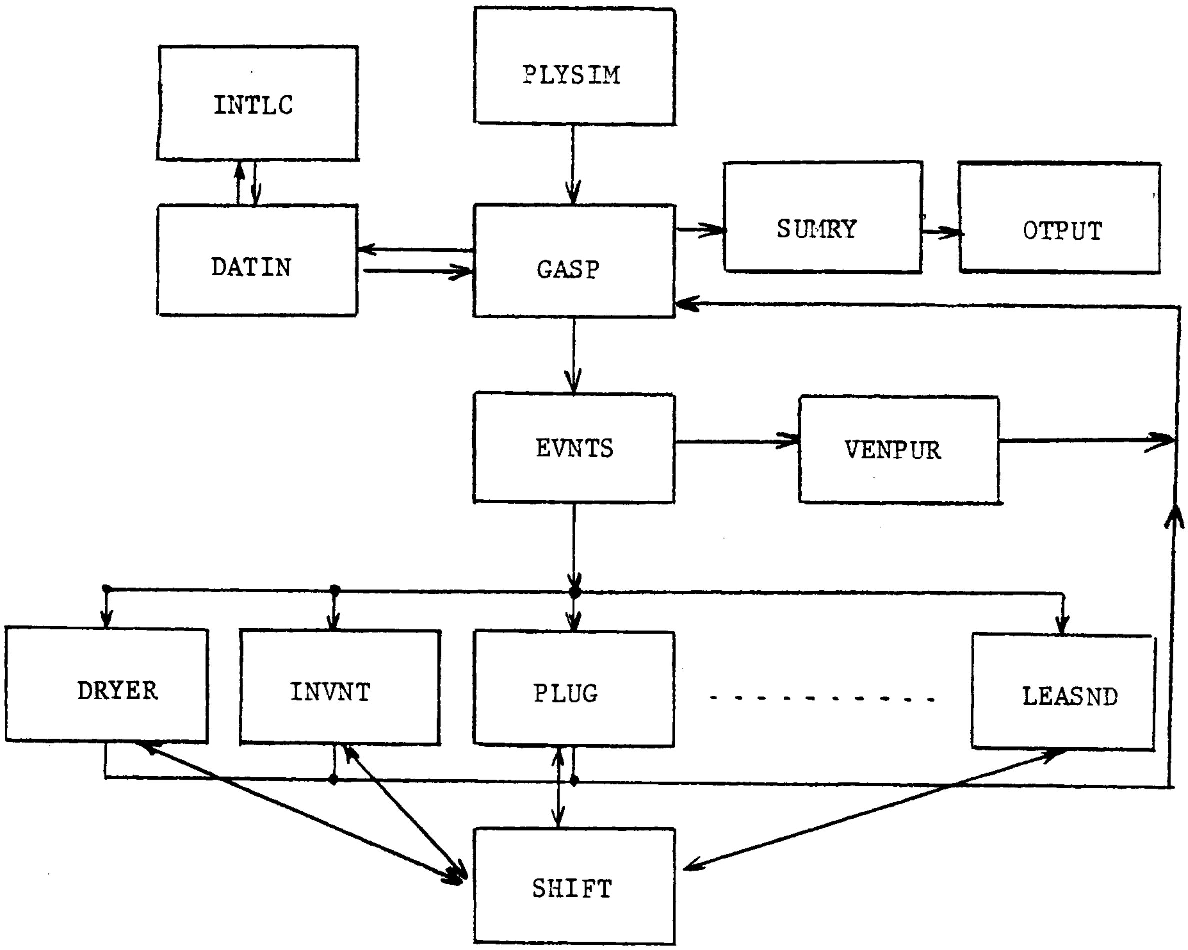


Figure 5.1. Flowchart of the operating system

also called user defined subroutine VENPUR in order to monitor the veneer stock very closely.

Of course, the GASP system allows the user to include any user-defined subroutines. For instance, the user-defined event subroutines made direct calls when needed to user-defined subroutine SHIFT without intervention of GASP. When the simulation had reached the time limit, GASP called the user-defined subroutine OTPUT which allowed the desired results to be printed according to the user's wishes, and system subroutine SUMRY, which printed the standard GASP output and information on files as needed.

D. User Defined Variables and Arrays

These were grouped within three common blocks UCOMx, which allowed easy accessibility to these variables from any subroutine. In UCOM1, general purpose variables or variables which could be needed in any subroutines were stored. In UCOM2, variables which related to what takes place along the production flow upstream from the hot stack stock are located. The variables dealing with the finishing section were stored in UCOM3.

There were two sorts of user-defined variables. Some of them were constants during the simulation, such as grade percentages or production standards. Others were real variables and helped to monitor stock arrays, activity indicators or flags. Variables and arrays are listed in Table 5.2.

Table 5.2. User defined variables and arrays

1. Dryer

Constants:

BFULA CFULA DFULA	Average percentages of BPATCH,C,D grade 1/10" thick-54" wide veneers after drying
BPHLFA CHLFA DHLFA CNHLFA COHLFA	Average percentages of Bpatch,C,D, Centers, Cores in 1/10" - 27" veneers after drying
CHLFB DHLFB CNHLFB COHLFB	Average percentages of C,D, Centers, Cores in 1/6" - 27" veneers after drying
COREC CORED	Average percentages of C and D grades within Core strips
ISTOCO ISTOJN	Minimum fixed stock of 1/10" strips and 27" for dryer schedule fixing
DRNITE DRDAY (4)	Average dryer production (average number of equivalent veneers dried per hour according to various configurations)

Variables:

IDRY (I)	Cumulative number of veneers code I output by the dryer

2. Dry veneer stock

Constants:

ISTOKI(I)	Array of the initial veneer stock for veneer code I read from the datafile by INTLC

Variables:

ISTOCK(I)	Position of the veneer stock at time t. Updated by simulation

Table 5.2 (continued)

3. Dry veneer purchases

Constants (read by PLYSIM from datafile):

DRYCOR	Number of Cores bought once a week from other company.
DRYC DRYD DRYCN	Percentages of C,D, Centers in daily dry veneer purchases
DRY(I)	Total number of veneers bought per week. I=1,6 corresponding to the six basic veneer sizes (see veneer codes, table 6.1)
PCTGR6	Percentage of the 1/6" veneer needs that are bought green
IREORD	Reorder point for emergency deliveries
ISCL6, ISCLIO	Stock control levels for 1/6" and 1/10" emergency purchases

Variables:

IPURCH(I)	Total number of veneers code I purchased dry

4. Pluggers

Constants (read by PLYSIM from the datafile):

PLUGG PLUGA PLUGB PLUGC PLUGD PLUGU	Average number of equivalent veneers plugged per hour

5. Jointer

Constants (read by PLYSIM from the datafile):

AJOINT	Average number of equivalent veneers jointed per hour
IBPATC	Maximum stock of 54" Bpatch veneers allowed for the jointer operation

Table 5.2 (continued)

6. Production data

Constants:

IVENR(I,J,K)	Number of veneers code J needed to compose one panel code I with the construction option code K (read from datafile by INTLC)
NPROD	Number of different products considered in the simulation (read in by PLYSIM)
IPROD(I)	Number of panels of code I to be manufactured during the simulation time (read by PLYSIM)
ICOR6 ICENT6 IFACE6	Number of 1/6" Cores, Centers and Faces needed to manufacture the required production

7. Gluespreader and presses

Constants:

GLSPT(I,J)	Average number of minutes needed to compose one stack of panels code I to be pressed on hot press code J (read by PLYSIM)
PPTIM	Pre-pressing time handling at the pre-press (min.) (read by PLYSIM)
PRESS(I,J)	Hot press time for one press load of panels thickness I on press J (read by PLYSIM)
IPANEL(I,J)	Number of panels of code I per stack scheduled to be pressed using press code J

Variables:

NNPLY	Cumulative number of 1/6" Cores glued in current shift
NNCOR6	Number of 1/6" Cores to be glued per shift after the sanding session
IGLUED(I)	Cumulative number of panels of code I already glued
IFLAG	Sanded grades gluing session indicator IFLAG = 1: sanded grades IFLAG = 0: initial session is over

Table 5.2 (continued)

IPR(I)	Cumulative number of panels of Code I already pressed

8. Hot stack and finishing line

Constants:

HOTCUR	Minimum time during which a stack of panels must remain in the hot stack
PATCH	Average number of panels patched per hour
SAWSPD	Average number of panels sawn per hour
SAND	Average number of panels sanded per hour
LOAD(I)	Standard number of panels of Code I per banded load
GOOD CERT SHOP	Average percentages of Good, Mill Certified, and Shop panels after the saw
SREPA SOKP SRSND SDOWN SSHOP	Average grade percentages and categories after wide-belt sanding: repatch,good,resand,downgrade, shop
TSGOOD TSSHOP	Average grade percentages after touch sander: Good,shop
INHSTK(I)	Initial number of stacks(press #1,panel I) in hot stack
ISTSAW(I) ISTOPA(I) ISTORP(I) ISTOPP(I) ISTOTS(I)	Initial intermediate stocks: Before saw, before patch, to repatched, to be sanded, to be touch-sanded. Hot stack panels not included

Variables:

ANSAW(I) ANPAT(I) ANREPA(I) ANSAND(I) ATSAND(I)	Current real number of panels of Code I in intermediate stocks before saw, patch, to be repatched, to be sanded, to be touch-sanded. Hot stack not included.

Table 5.2 (continued)

AGOOD(I) ACERT(I) ASHOP(I) ADELAM(I)	Current incomplete stacks of panels of Code I of Good, Mill Certified, Shop, and Delaminated grades
IGOODL(I) IMCL(I) ISHOPL(I) IDELL(I)	Cumulative number of standard loads of panels of Code I that left system with grades: Good, Mill Certified, Shop, Delaminated

9. General purpose variables

IBUS(I) BUSPLG BUSJNT BUSPPR BUSPR(2) BUSPAT BUSSAW BUSSND(2)	Status indicators for plugger, jointer, pre-press, two hot presses, patchline, saw, two sanders More details are given in Table 5.3.
TIME ISHIFT AMODUL IDAY	Output of SHIFT subroutine: Shift code, time modulus, day number computed from the input TIME
OPAT TOAT HOTST	Open assembly time, total assembly time, time in hotstack (used for collection of statistics)

E. Statistics to be Collected

The statistics which were collected within the GASP IV simulation were grouped into two distinct categories:

1. Statistics based on observations dealt with temporary entities (panel stacks for example) and were computed from sample points taken for each stack at given points of time. They were recorded through calls to COLCT GASP system subroutine.

2. Time-persistent statistics "continuously" monitored variables along the simulation and integrated the resultant function in order to find its average value. These variables described permanent entities. Here, calls to TIMST were used to monitor the status of the main machines in the system (see Table 5.3).

The variables which were used as a system status descriptor took a value of 1 if a machine was busy, and 0 if it was idle.

F. File Structure

There were twelve files in the simulation. Among them, File 1 was used by GASP for event scheduling. It was also called the event file. The eleven other files related to the queueing situations within the gluing/pressing area where panels were not considered on an individual basis. File 2 stored panel stacks between gluespreader and pre-press; file 3 and file 12 stored panel stacks between pre-press and 25-openings and 10-openings presses respectively; files 4

Table 5.3. Collection of statistics

Statistics based on observation:		
COLCT(1)	WAITOP	Open assembly time
COLCT(2)	TOAT	Total assembly time
COLCT(3)	HOTST	Time in hot stack
Time statistics:		
TIMST(1)	BUSPLG	Pluggers (IBUS(1))
TIMST(2)	BUSJNT	Jointer (IBUS(2))
TIMST(3)	BUSPPR	Pre-press (IBUS(3))
TIMST(4)	BUSPR(1)	25 openings press (IBUS(4))
TIMST(5)	BUSPR(2)	10 openings press (IBUS(5))
TIMST(6)	BUSPAT	Patch line (IBUS(6))
TIMST(7)	BUSSAW	Saw (IBUS(7))
TIMST(8)	BUSSND(1)	Main sander (IBUS(8))
TIMST(9)	BUSSND(2)	Touch sander (IBUS(9))

through 11 stored panel stacks within the hot stack stock. There was one file per panel code.

As discussed earlier, files stored temporary entities with their attributes, which was possible as long as they remained constant between events. A maximum of five attributes were used here to describe the characteristics of the entities. They were stored within the GASP IV array ATRIB(.) under coded or real values (Table 5.4).

Table 5.4. Files and attributes.

File/ Attribute	1	2	3 & 12	4 to 11
1	Event time			
2	Event code			
3	Panel code	Panel code	Panel code	Panel code
4	Hot-press code	Hot-press code	Hot-press code	Hot-press code
5	Time when start a stack / Arrival time in hot stack	Time when start a stack	Time when start a stack	Arrival time in hot stack

Note: Panel codes are defined in Table 6.2.

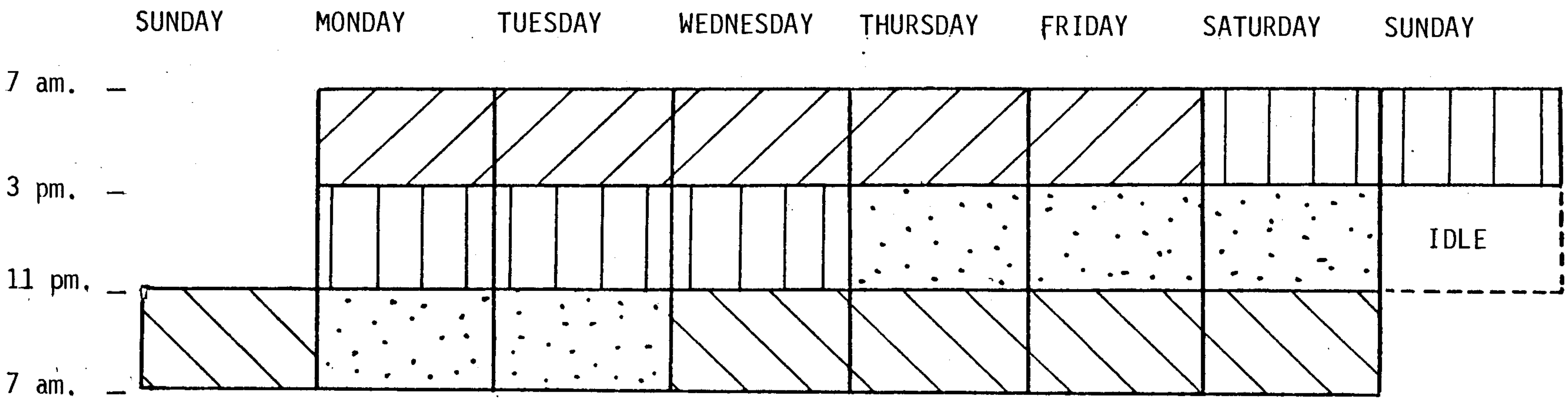
Independently, ATRIB(.) array was used for specific purposes in File 1 between consecutive events: ATRIB(3) was used to store the veneer code of the items which were being jointed between events ENTJNT and LEAJNT, ATRIB(4) was used to store the number of panels which were being processed between ENTSAW and LEASAW, ENTPAT and

LEAPAT, ENTSND and LEASND, and ATRIB(5) was used to indicate whether panels were being patched or repatched on the patch line between events ENTPAT and LEAPAT. ATRIB(5) was also used for storing the sander code which indicated which sander was currently engaged. This took place between ENTSND and LEASND.

G. Units and Time Organization

The simulation was meant to be run for one full working week. The time unit for the simulation was one minute. All entities were computed in terms of numbers of items, which were easier to handle than equivalent MSF units.

The time organization was a conventional four-shift schedule: Day, Swing, Relief, and Graveyard, each 8 hours long. Crews worked five shifts per week or 40 hours, the remaining 21st shift being idle (as far as production was concerned). This shift took place Sunday evenings between 3 and 11 pm and allowed needed maintenance and cleaning operations. Thus, all simulations started on Sunday night at 11 pm and ran until next Sunday at 3 pm. The maximum simulation time was 60 * 8 * 20 = 9600 minutes. The actual shift organization is shown in Figure 5.2. Within this pattern, machines could be programmed for different shifts according to the user's wishes.



	SUN	MON	TUE	WED	THU	FRI	SAT	SUN
7am -		480	1920	3360	4800	6240	7680	9120
3pm -		960	2400	3840	5280	6720	8160	9600
11pm -	0	1440	2880	4320	5760	7200	8640	
7am -	480	1920	3360	4800	6240	7680	9120	

Cumulated times in minutes

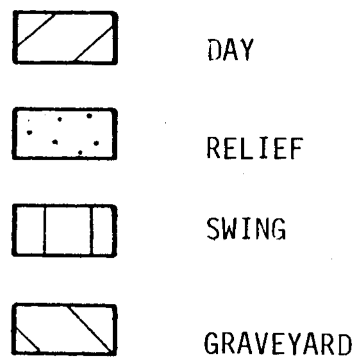


Figure 5.2. Shift organization

VI. SIMULATION PROGRAM

A. Simulation Logic and Flowcharts

The simulation logic has been set up in as realistic a way as possible. Deviations from real situations do exist and will be explained later.

1. Production. Production of the eight most frequent panel types was modeled. They were indexed through their panel code numbers. Each panel type was made according to two options or two different pre-programmed constructions with different levels of priority.

The first three panel codes related to the "heavy cores panels", or panels which were constructed with 1/6" cores. Panel code 8 related to the most common thickness which could be made in excess of the actual ordered amounts when needed. Panel constructions and codes are shown in the gluing/pressing section (Table 6.2).

Veneers which were necessary for the construction of these eight panel types were grouped into two thicknesses (1/10" and 1/6"), eight different grades, and three dimension types (Fulls 54", Halves 27", Strips/randoms). For simplification, only Douglas-fir veneers were considered in this model. Different veneer types can be recognized through their numerical codes, which were set up into an "easy to remember" pattern (Table 6.1).

As in the actual plant, the operation worked on a four shifts pattern and the various machines were organized under realistic conditions.

Table 6.1 Veneer codes.

Thickness-width	A	B	C	D	Center	Core C	Core D	Bpatch
1/10" - 54"	$\underline{11}$	$\underline{12}$	$\underline{13}$	$\underline{14}$	$\underline{15}$	16	17	$\underline{18}$
1/10" - 27"	21	22	$\underline{23}$	$\underline{24}$	$\underline{25}$	26	27	$\underline{28}$
1/10" - strips						$\underline{36}$	$\underline{37}$	
1/6" - 54"	41	42	$\underline{43}$	$\underline{44}$	$\underline{45}$	46	47	48
1/6" - 27"	51	52	53	54	55	56	57	58
1/6" - strips						$\underline{66}$	$\underline{67}$	

Veneers used in the simulation are underlined.

The general shift organization is shown in Figure 5.2. In the simulation, subroutine SHIFT calculated which day and shift the input TIME corresponded to. It also computed AMODUL which is the number of minutes that had elapsed since the last time it was 7am and the current TIME.

$$\text{AMODUL} = \text{TIME} - 480. \quad (\text{mod } 1440.), \text{ or}$$

$$\text{AMODUL} = \text{TIME} - 480. - \left[\frac{\text{TIME} - 480.}{1440.}\right] * 1440.$$

where the quantity between brackets is the largest integer value less than or equal to $\frac{\text{TIME} - 480.}{1440}$

1440 minutes is a 24 hour modulus increment (24*60), and 480 minutes is the current time Monday at 7 am., since the simulation started Sunday evening at 11 pm.

For example, if the input time was 5790 minutes, subroutine SHIFT would have:

ISHIFT = 4

IDAY = 4

AMODUL = 990. (Thursday, graveyard, 990 minutes after Thursday 7 am.).

The subroutine SHIFT flowchart and codes are shown in Figure 6.1.

2. Veneer Supply.

a. Dry veneer purchases. Subroutine INVNT defined the dry veneer deliveries according to the pattern of the actual situation shown earlier (page). The actual amounts were read from the data-file by the main program PLYSIM and could readily be changed. Deliveries took place at the very beginning of each Day shift. Veneers which came from another supplier were delivered at the beginning of the Monday morning Day shift.

In order to prevent the simulation from aborting when the necessary veneers did not exist in stock, an emergency delivery system has been included in the model. Subroutine VENPUR was called at every event time by subroutine EVNTS. It checked if inventories of veneer codes 13, 14, 15, 36, 37, 45, and 67 had gone under a pre-set reorder point of 500 equivalent veneers. These were the codes

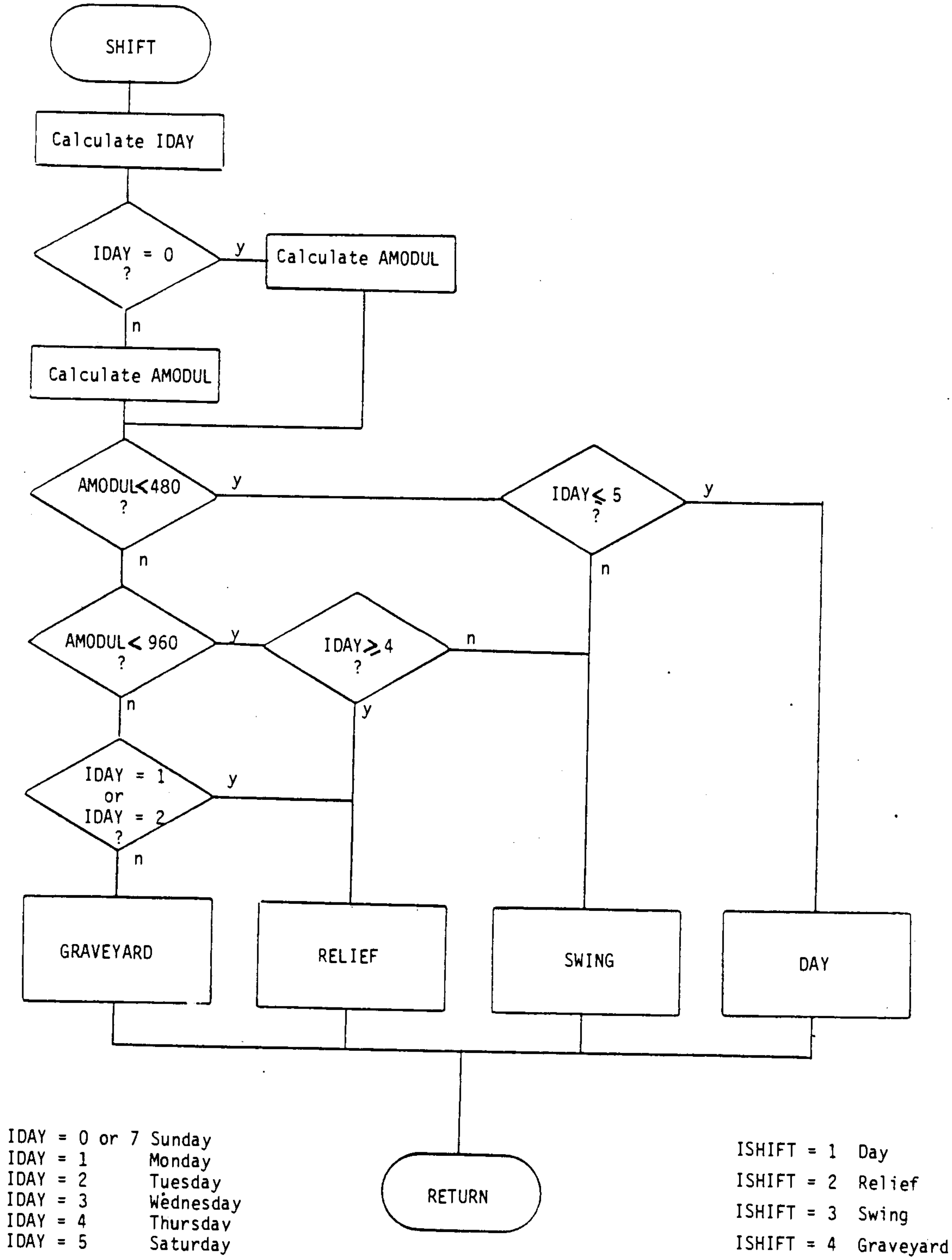


Figure 6.1. Flowchart of SHIFT subroutine

related to the most commonly used veneers. If there were less than 500 veneers, an immediate order and delivery was performed, and the current time, the veneer code, and the amount ordered were printed. The dry veneer stock was updated at the same moment. The subroutine VENPUR flowchart is shown in Figure 6.2.

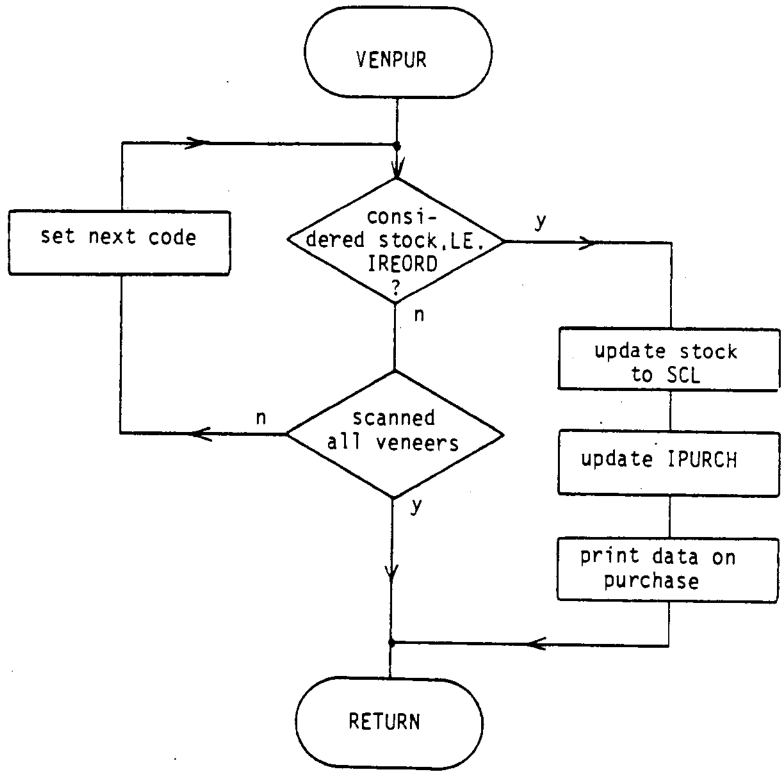
b. Drying. Subroutine DRYER organized this area. Its flow chart is shown in Figure 6.3. The dryer was considered a black box. As in the real world, its infeed was not limited by external factors. A batch dryer outfeed occurred every 30 minutes. At that moment, the dried veneers were sorted according to actual average percentages and sent into the dry veneer stock. The drying speeds were user-defined (shown in Appendix A), and took care of the average redry and veneer mix. They also included the total average veneer losses which occur in the real world between the dryer and the gluespreader. The model was simplified here since the veneer stock is usable without further losses of panel manufacturing.

Continuous operation had been preserved but the following policies had been added:

. During Swing and Graveyard, only 54" veneers were dried.

. Day and Relief. All Day shifts started with drying 1/6" veneers on a 50% strips-50% halves basis (DRDAY(4)) until this production had reached the average 1/6" daily needs. After this period the priorities considered were:

- Under a preset available stock of 1/10" cores (ISTOCO): Dry 1/10" cores exclusively (DRDAY(1)).



NOTE : Scanned veneers codes are 13 , 14 , 15 , 36 , 37 , 45 , 67

Figure 6.2. Flowchart of VENPUR subroutine

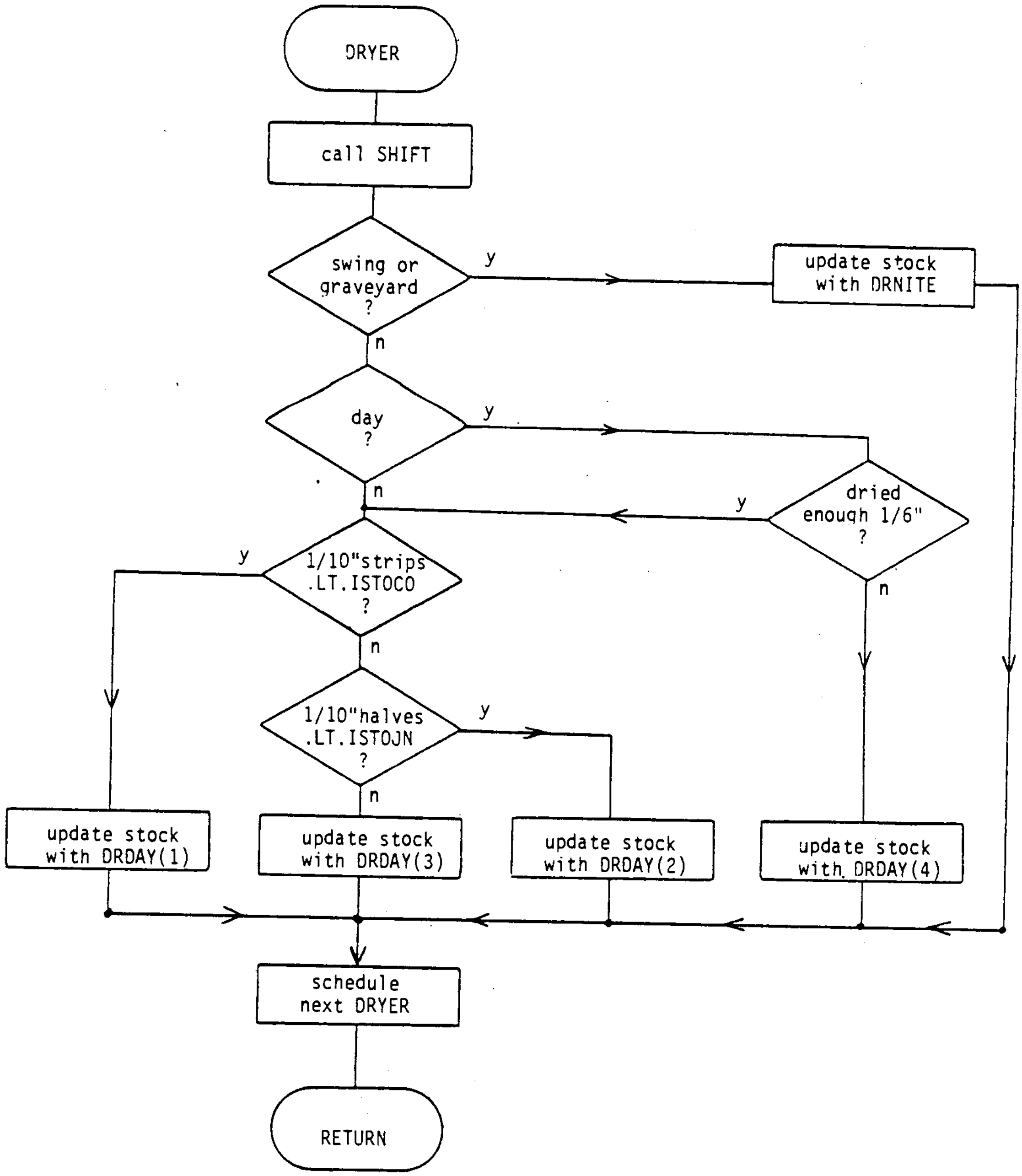


Figure 6.3. Flowchart of DRYER subroutine

- Under a preset available stock of 1/10"-27" veneers (ISTOJN): Dry 27" veneers exclusively (DRDAY(2)).
- If none of these conditions applied, dry 50% 1/10" cores and 50% 1/10"-27" (DRDAY(3)).

This was necessary in order to avoid problems with the veneer availability during the simulation. However, in the real world the same problem is also handled by monitoring the dry veneer stock and considering the weekly production objective.

3. Veneer upgrading. The PLUG subroutine took care of the pluggers and ENTJNT/LEAJNT defined the jointer line operation. Flow charts of PLUG and ENTJNT/LEAJNT are shown in Figures 6.4 and 6.5.

a. Pluggers. These were considered as one single blackbox which worked for consecutive periods of 30 minutes. For each period, PLUG removed the necessary quantity of 1/10" Bpatch veneers from the dry veneer stock and output back into the dry veneer stock the veneers upgraded during the last period. If the necessary veneers could not be found in the stock, the pluggers were set to idle and scheduled for the next day at 7am. All numerical data were input from the datafile, and thus can be changed by the user.

b. Jointer: As the jointer line components were directly coupled, they could be considered as one single permanent entity. Like the pluggers, the jointer worked for 30 minute periods and processed exclusively 1/10"-27" Bpatch into 54" Bpatch.

The jointer was stopped for the rest of the shift if the stock of Bpatch 1/10"-54" became greater than a user-defined limit in order to avoid jointing unneccessary material. The unjointed Bpatch veneers

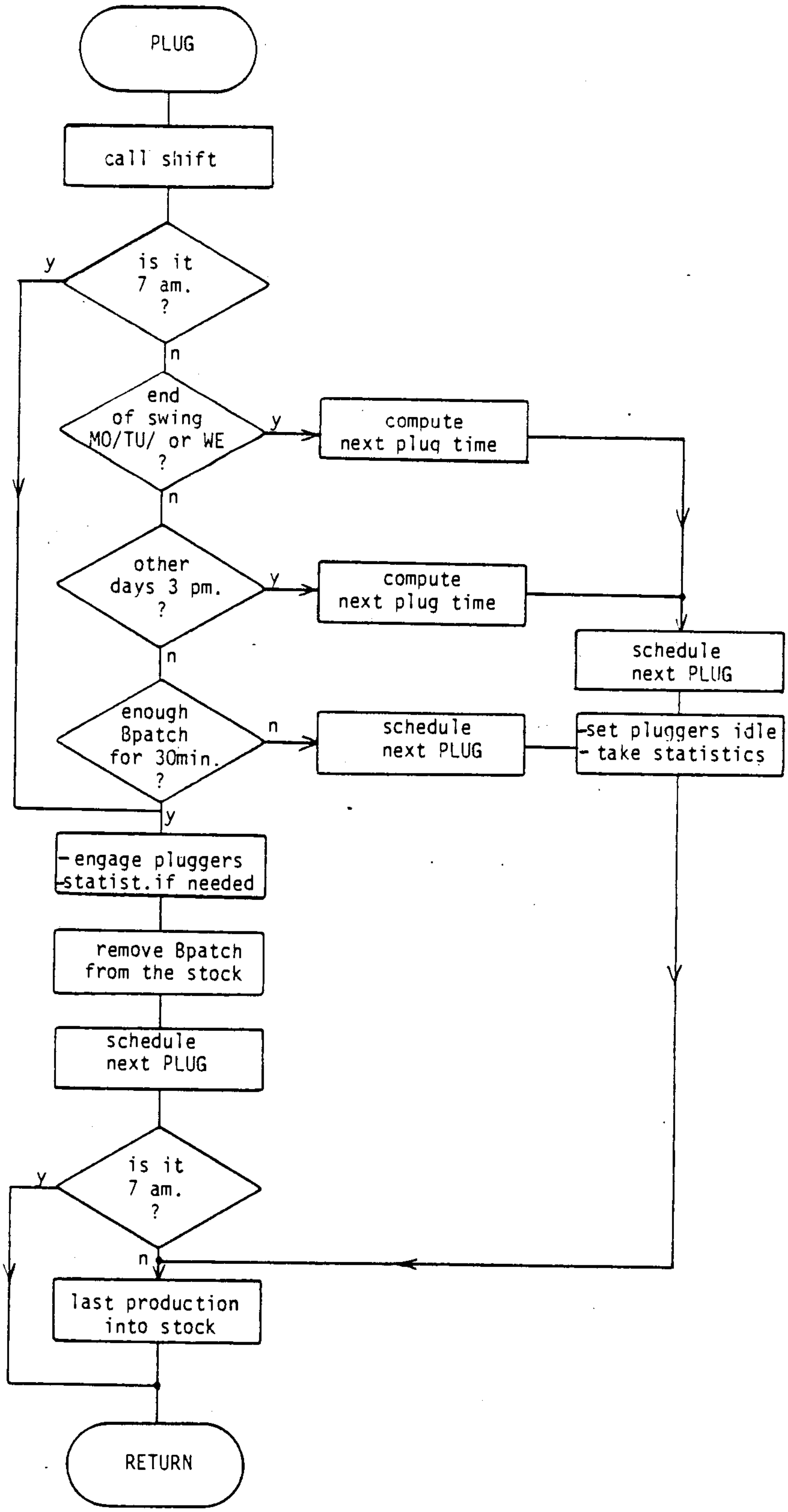


Figure 6.4. Flowchart of PLUG subroutine

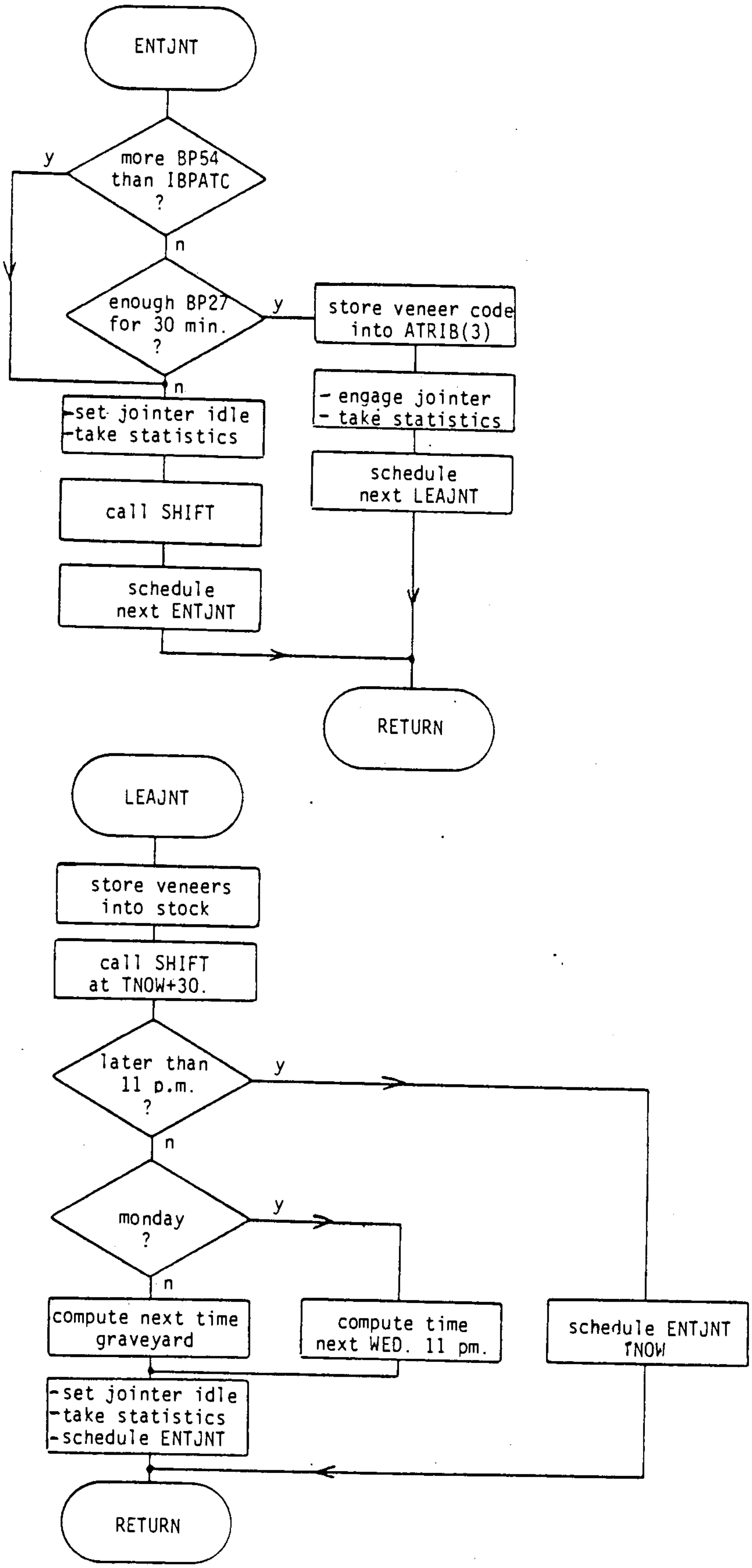


Figure 6.5. Flowchart of ENTJNT / LEAJNT subroutines

could be used as centers in panel construction. Subroutine ENTJNT checked the level of the 54" Bpatch stock and the availability of necessary 27" Bpatch input to the machine. When veneers were introduced to the jointer it stored the veneer code and scheduled the next call to LEAJNT.

Subroutine LEAJNT stored the upgraded veneers into the stock and checked if another 30 minutes jointing session could take place before the end of the graveyard shift. If enough time remained, an immediate call to ENTJNT was made but if time had run out, ENTJNT was scheduled at the beginning of the next graveyard shift.

4. Gluing and Pressing. The gluespreader was managed through ENTGLS and LEAGLS subroutines, the pre-press through LEAPPR, and both hot presses through LEAHPR.

a. Gluespreader. The gluespreader is maintained through the ENTGLS subroutine (Figure 6.6). In ENTGLS, the gluing of sanded panels started Sunday night on the Graveyard shift. This initial lay-up continued across shift changes as long as the weekly objectives were not met and the necessary veneers were available in the dry veneer stock while IFLAG was set to 1. When the sanding session was over, IFLAG was set to 0 and veneer availability for panels coded 1, 2, or 3 was tested ("heavy cores"), as well as the production figures for these thicknesses. Panel codes and constructions are shown in table 6.2.

Generally, except during this initial "sanded" session, every shift started with "heavy core" panel composition. This period stopped when the weekly objective had been reached, when the share of

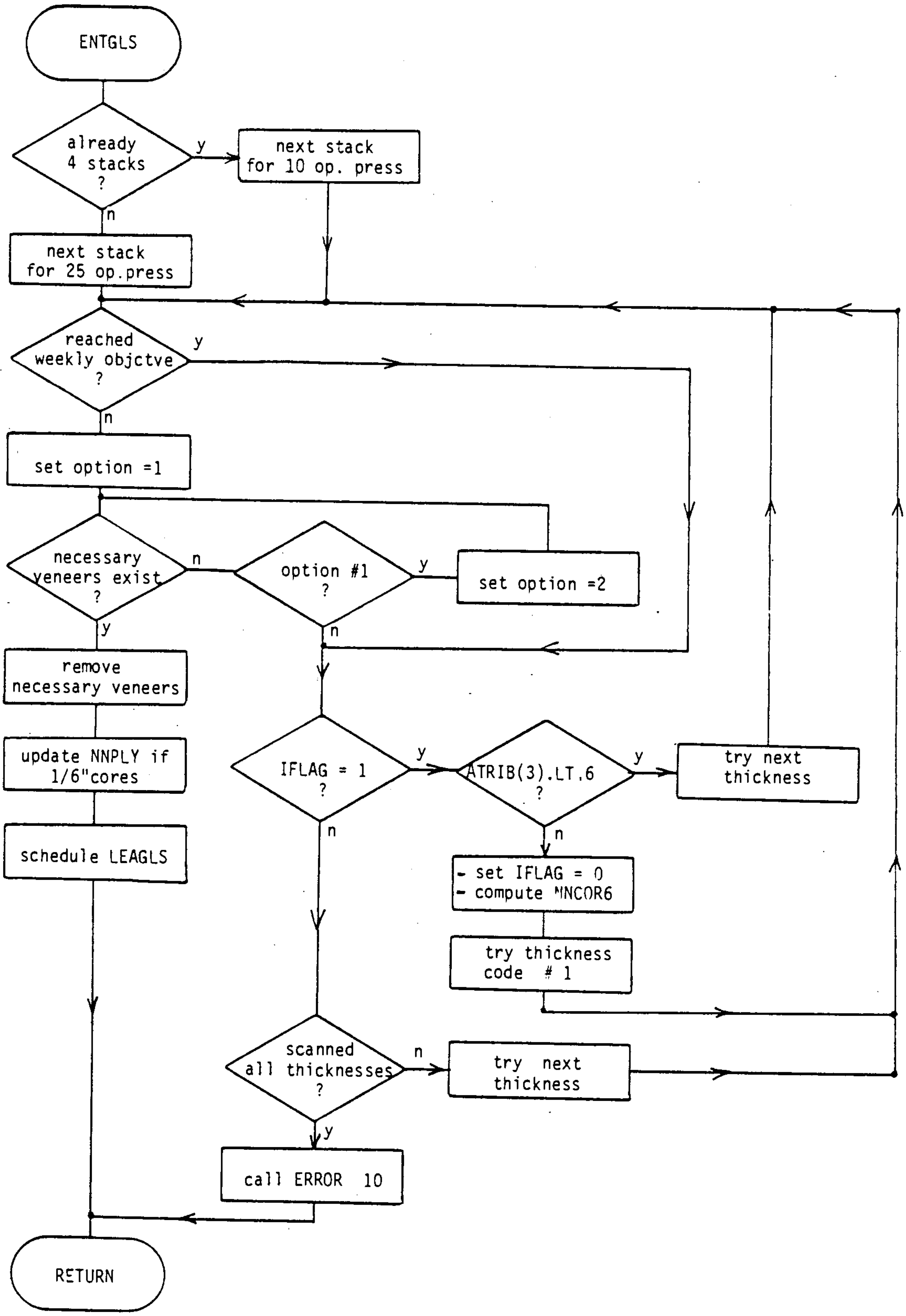


Figure 6.6. Flowchart of ENTGLS subroutine

Table 6.2. Panel codes and constructions

Product	3/8" CD	5/8" CD	3/4" CD	5/16" AC	15/32" CC	9/16" AC	5/16" CD	1/2" CD
Panel code	1	2	3	4	5	6	7	8

PANEL CONSTRUCTIONS

Panel Code	Construction				
1	1/10	1/6	1/10		
2	1/10	1/6	1/10	1/6	1/10
3	1/10	1/6	1/6	1/6	1/6
4	1/10	1/10	1/10		
5	1/10	1/10	1/10	1/10	1/10
6	1/10	1/10	1/6	1/10	1/10
7	1/10	1/10	1/10		
8	1/10	1/10	1/10	1/10	1/10

CONSTRUCTION OPTIONS

Panel Code	Veneer codes					Option number
1	13	67	24			1
1	13	66	14			2
2	13	67	25	67	23	1
2	13	67	15	67	14	2
3	13	67	45	67	44	1
3	14	66	45	66	43	2
4	11	36	13			1
4	12	36	13			2
5	13	36	15	36	13	1
5	13	36	15	36	23	2
6	13	36	45	36	11	1
6	13	36	45	36	12	2
7	13	27	28			1
7	13	37	24			2
8	13	37	25	37	23	1
8	13	37	15	37	14	2

1/6" cores had been reached for the shift, or when the necessary veneers were no longer available.

Panel codes were scanned by increasing values, starting from 1 and ending at 8. When the whole range had been scanned and all objectives had been reached (or no veneers were available for any panel thickness), an error message was sent, and the simulation stopped. (Error message #10 from ENTGLS, error message #20 from LEAGLS).

When scanning panel codes for the next stack, both construction options were considered, starting with option #1 at each attempt. The starting points of time for open and total assembly times were stored into Atrib(5).

As the gluespreader operation was continuous, there were no shift scheduling constraints. When the stack was finished at the gluespreader LEAGLS was scheduled.

In LEAGLS (Figure 6.7), the stack was terminated and sent to the pre-press (if the pre-press was available). At the end of pre-press time (3 min.) LEAPPR was scheduled. If the pre-press was busy, the stack was sent into a waiting line (file 2). The next tentative panel construction was then determined according to time or production objective constraints. An immediate call to ENTGLS was made at this time.

In summary, the ENTGLS routine dealt mainly with the veneer availability constraints and the LEAGLS routine dealt with the time and production objective constraints.

b. Prepress. In LEAPPR (Figure 6.8), a stack left the pre-

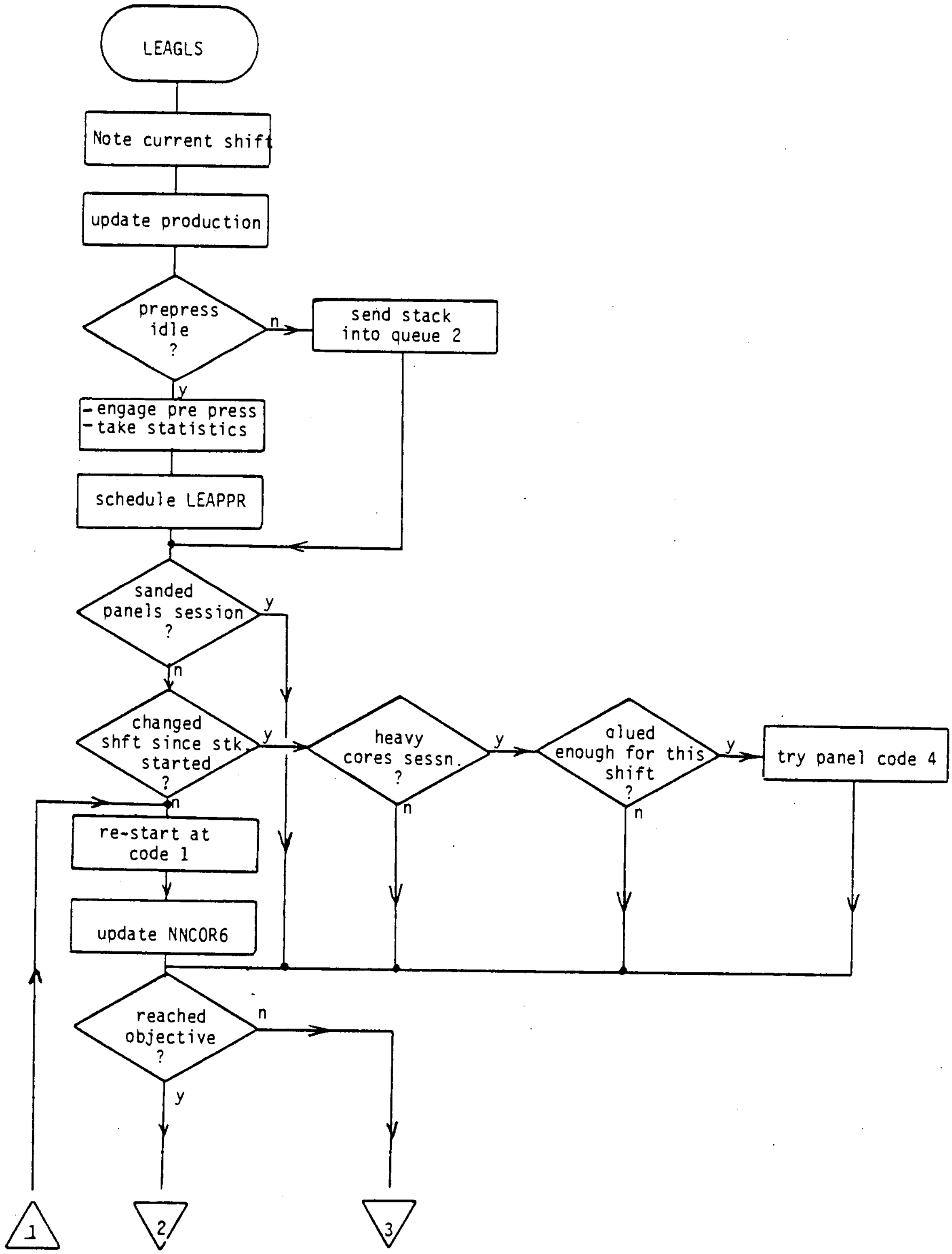


Figure 6.7. Flowchart of LEAGLS subroutine

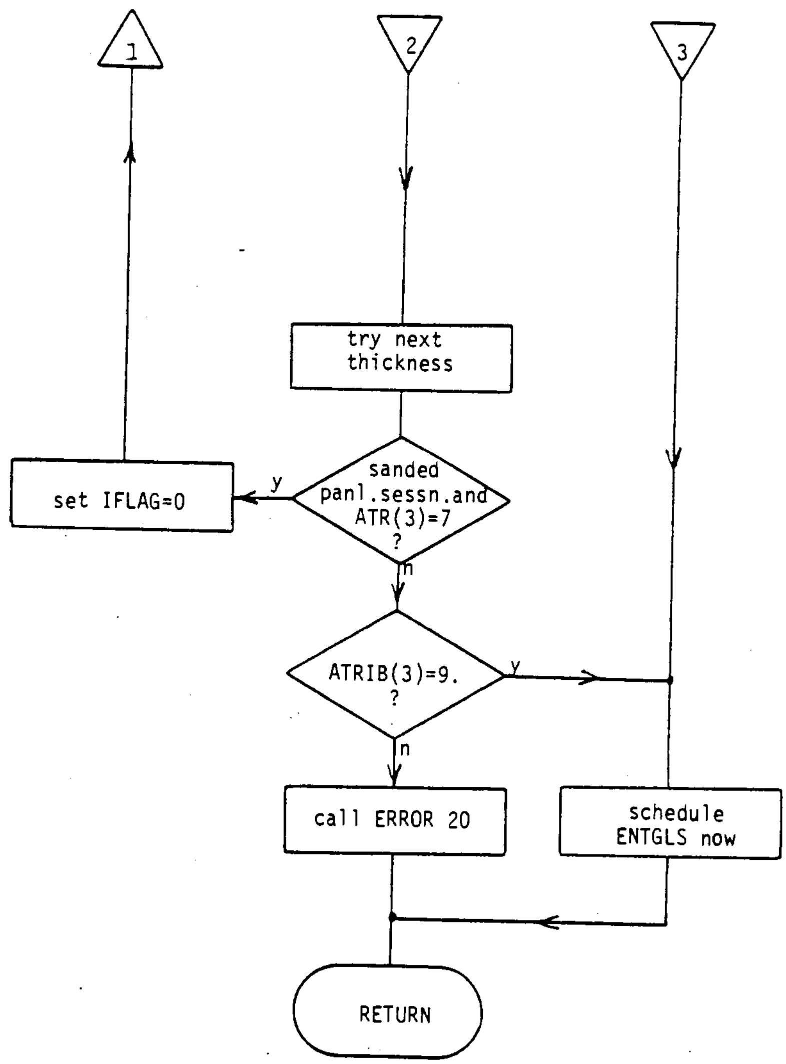


Figure 6.7. (continued). Flowchart of LEAGLS subroutine

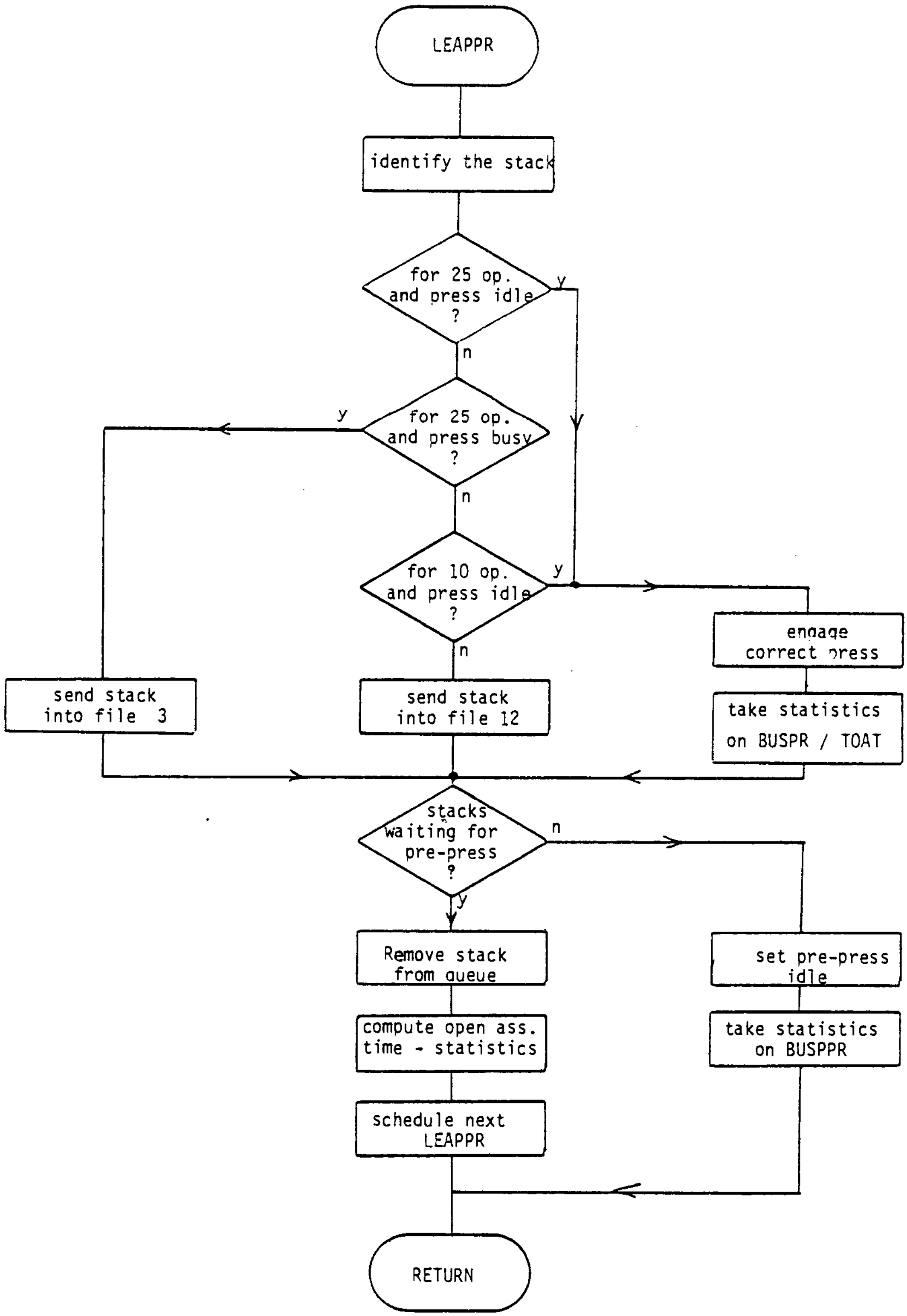


Figure 6.8. Flowchart of LEAPPR subroutine

press and entered the proper hot press (the press code was stored in Atrib(4)) if it was idle at that moment. Total assembly time was then computed. If the hot press was busy, the stack joined the proper queue (files 3 or 12). At the same moment if a stack was waiting in queue (file 2) to be prepressed, it left the queue and immediately engaged the pre-press. Open assembly time was computed and end of service was scheduled (LEAPPR). If no stacks were waiting to be pre-pressed, the pre-press was set to idle, statistics were recorded, and the pre-press was ready to immediately process the next stack coming from the gluespreader.

c. Hot presses. LEAHPR subroutine organized the production of both hot presses (Figure 6.9). It was called whenever a pressing cycle came to an end on either press. At that moment it sent the leaving stack into the hot stack and updated the glued production.

If stacks were waiting in the proper pre-pressed queue, (file 3 or 12), the oldest stack was immediately loaded into the press, and its LEAHPR event time programmed. If no stacks were waiting for service, the press was set to idle and a call to the proper TIMST() subroutine was performed. The press was now ready to process the next appropriate stack from the pre-press.

5. Finishing. Subroutine sets were not called by other subroutine sets but were time scheduled according to the shift organization. Panel availability and shift organization under production priorities generated the panel storage system.

For full understanding of the system, Figure 6.10 outlines the steps that the panels followed according to their grade categories.

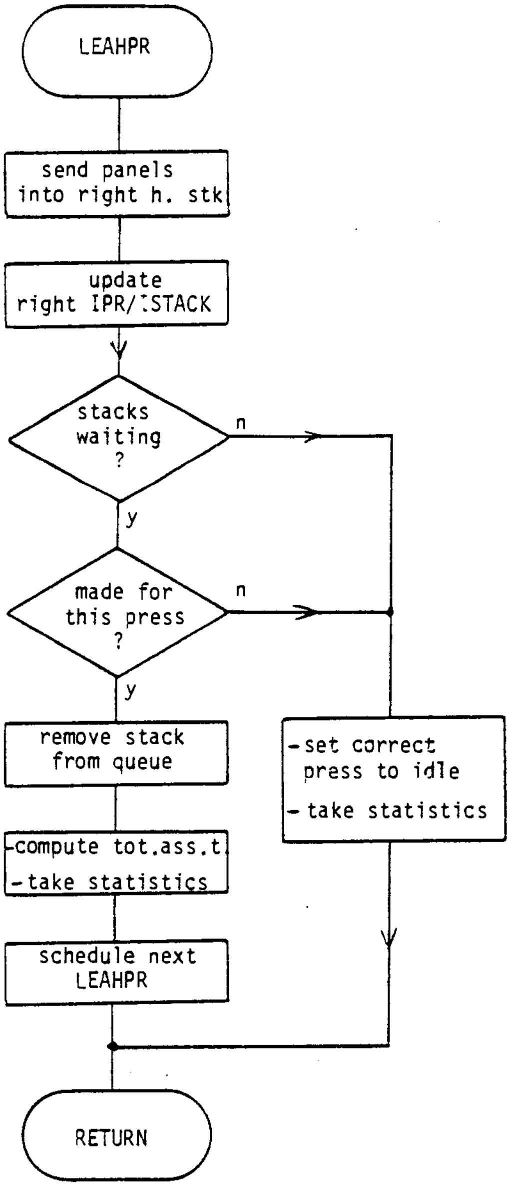


Figure 6.9. Flowchart of LEAHPR subroutine

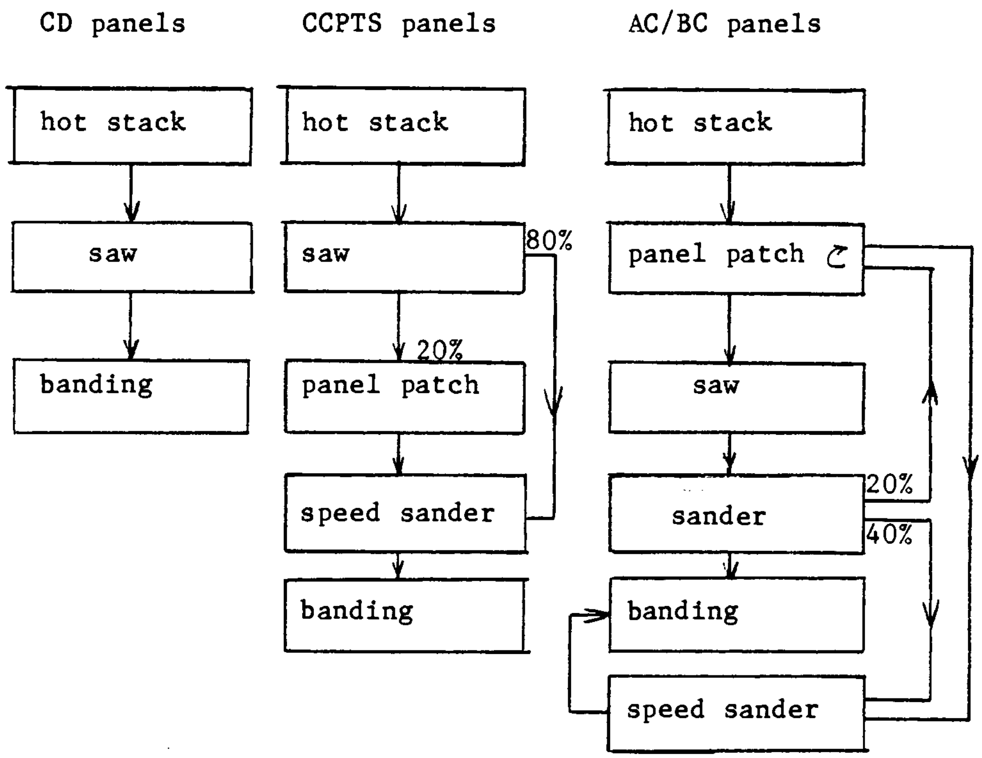


Fig. 6.10. Diagram of finishing operations.

a. <u>Saw</u>. Subroutines ENTSAW and LEASAW worked on the same principle. The input and output to the saw are shown in Fig. 6.11. Flowcharts of subroutines ENTSAW and LEASAW are shown in Figures 6.12 and 6.13.

When the proper panels were found, they were removed from the corresponding stock, the saw engaged, statistics taken, and LEASAW scheduled. If no panels were found or the working period over, the saw was set to idle, statistics were gathered, and the next ENTSAW scheduled at the start of the next day shift.

When a stack left the saw (or more precisely, when its panels had been sawn), these were sorted into several grades. CD panels were sorted according to given percentages into Good, Mill certified, Shop and Delaminated panels. At the same moment, standard loads of each of these categories were composed whenever possible. As soon as such a standard load could be created, it left the system. The accumulated production was computed and if the working period was not over, an immediate call to ENTSAW was made. The strapping operation for standard loads which had left the system was performed by forklift operators.

Sanded or touch-sanded grades were not ready to leave the system. They were sorted into two categories; acceptable for the next operation or delaminated. The delaminated panels were grouped whenever possible into standard loads prior to leaving the system and the others were sent into the proper stock preceeding the next operation.

In LEASAW and LEASND subroutines, a parallel panel count was performed with real variables in order to avoid truncation errors that would occur with a unique integer variable system. However, the main

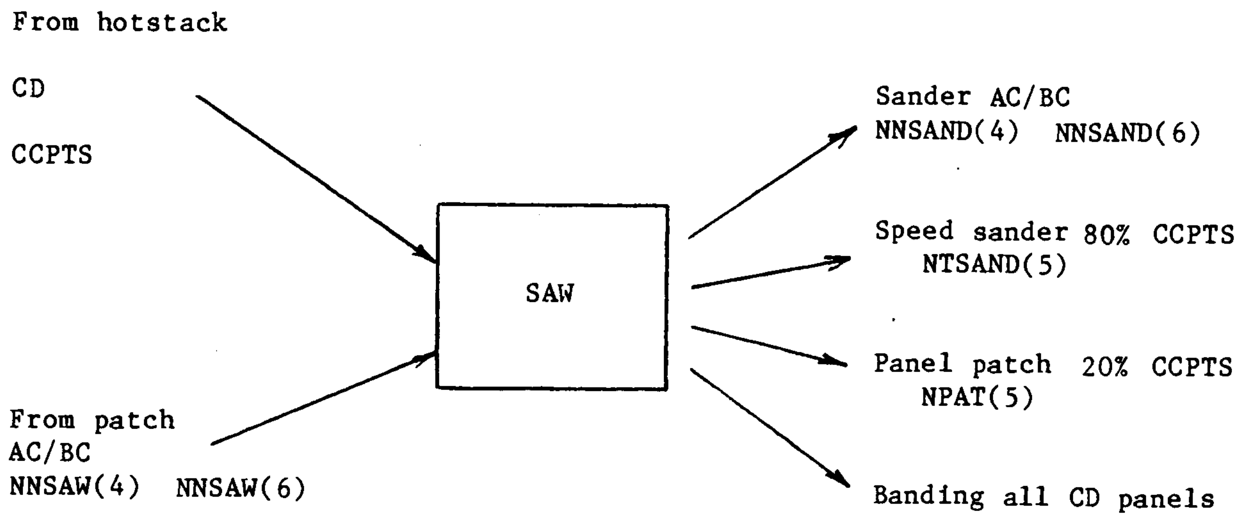


Figure 6.11. Input and output for the saw.

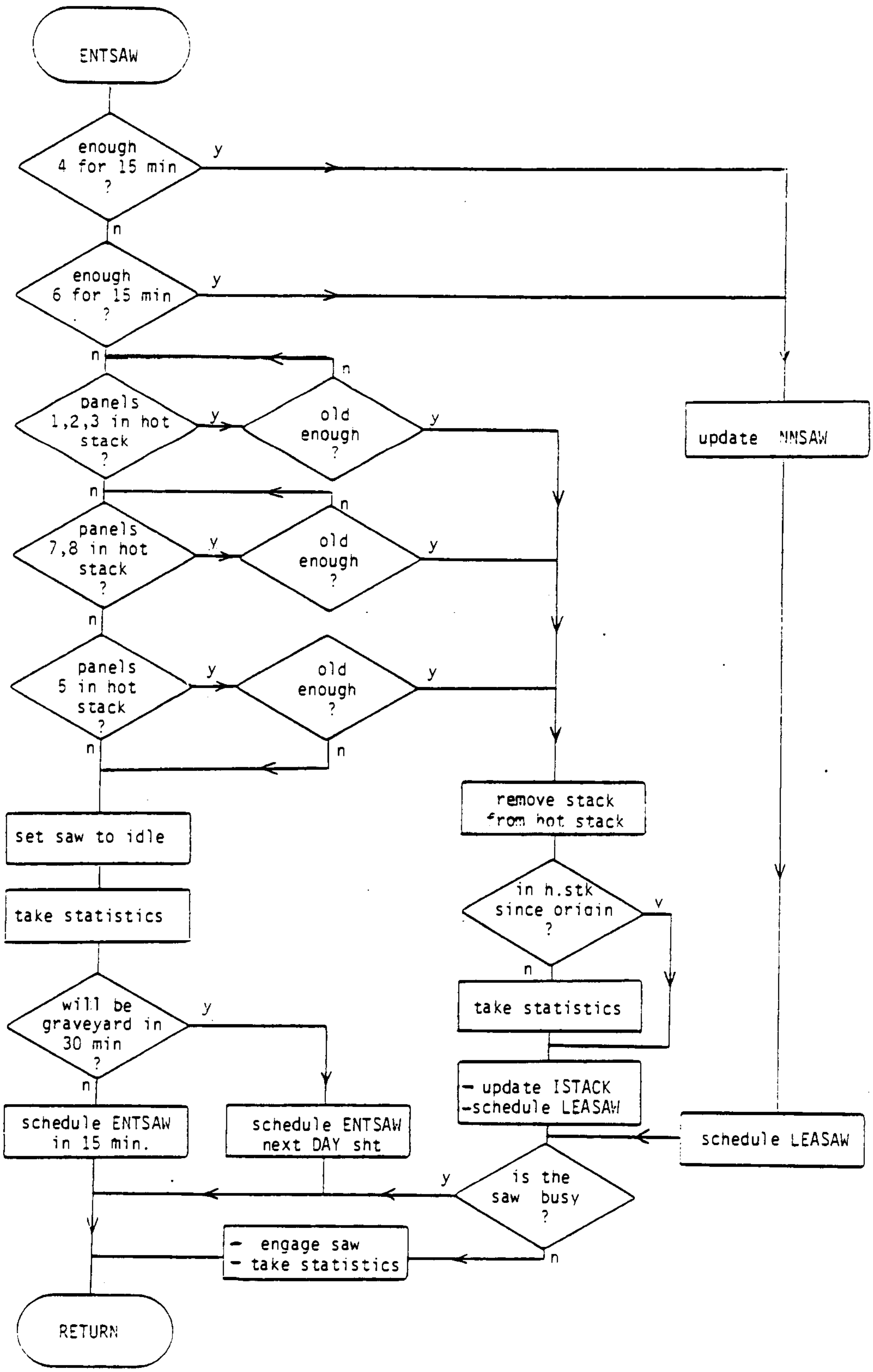


Figure 6.12. Flowchart of ENTSAW subroutine

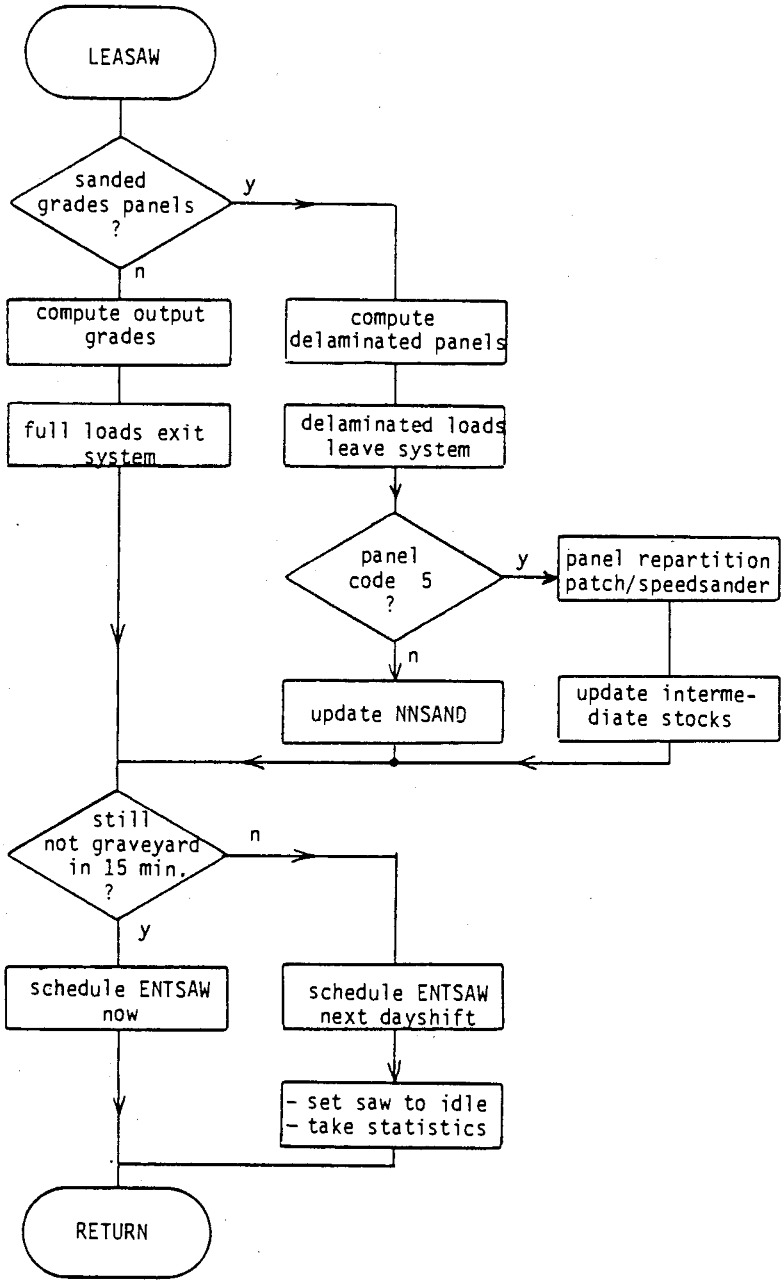


Figure 6.13. Flowchart of LEASAW subroutine

data collecting system remained an integer system.

b. Patch line. Subroutines ENTPAT and LEAPAT related to the events "enter patch" and "leave patch". The patch line operated on dayshifts only. Fig. 6.14 depicts input to and output from the patch line. ENTPAT and LEAPAT subroutines flowchoarts are shown in Figures 6.15-16.

ENTPAT was scheduled by LEAPAT or by itself at the beginning of Day shifts. If the call took place during Day shift before 2:30 pm, it proceeded to look for panels for input. The scanning order or priority was the following:

1. Process one stack from hotstack (old enough) (code 4)
2. Process one stack from hotstack (old enough) (code 6)
3. Process enough panels code 4 for a 15 minutes repatch session
4. Process enough panels code 6 for a 15 minutes repatch session
5. Process enough panels code 5 for a 15 minutes patch session

Availability of panels in the hot stack and the time they remained in it was checked through the use of the usual GASP subroutines and variables. If an acceptable stack could be found it was immediately removed from its file and input to the patch line. Statistics were gathered (if necessary) and the LEAPAT event scheduled.

If acceptable stacks of panels code 4 or 6 could not be found in the hot stack, then intermediate stocks were scanned

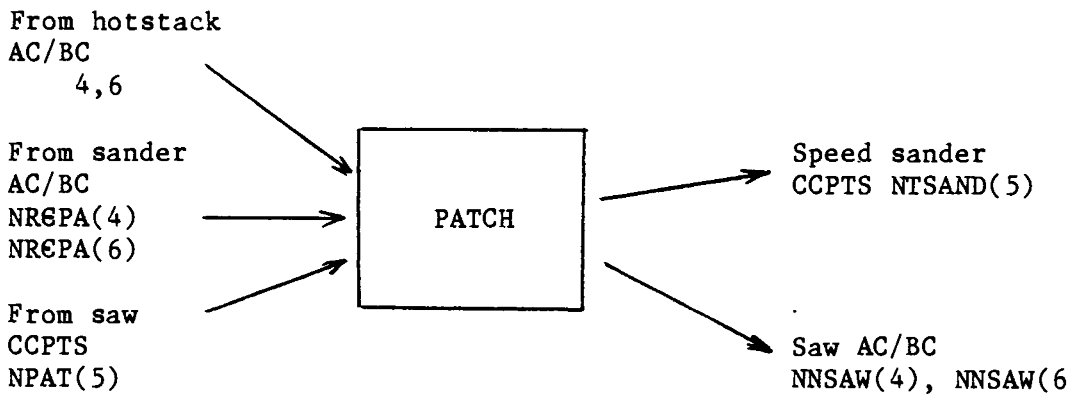


Figure 6.14 Input and output for the patchline.

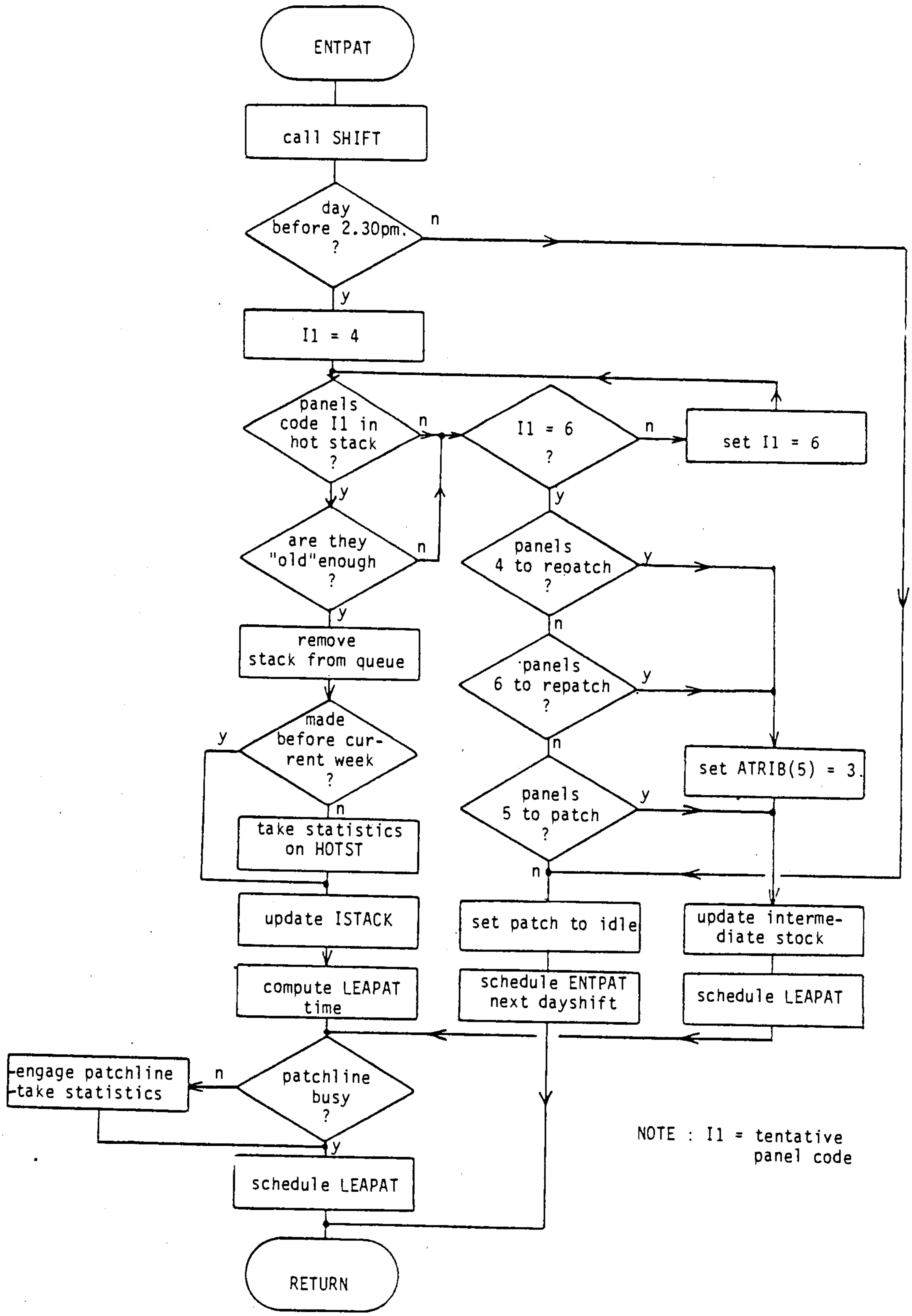


Figure 6.15. Flowchart of ENTPAT subroutine

according to priority. In these stocks, panels code 4 or 6 could be found when they had been classified "to repatch" at the sander, as well as panels code 5 (CCPTS) (which had already been sawn). Ordinary sanded grade panels (4 and 6) were patched for the first time before being sawn. This allowed for better repair of defects which were on the very edge of the panels. On the other hand, CCPTS panels were sawn prior to being patched because a large proportion of them were of acceptable quality to go to the speed sander directly from the saw.

If enough panels for a fifteen minute operation period could be found, the patch line was engaged, statistics gathered (if necessary), and the LEAPAT event scheduled. If not enough panels were available, or if the working period was over, the patchline was set to idle, statistics were gathered, and the next call to ENTPAT was scheduled for the next start of the Day shift.

The LEAPAT subroutine (Fig. 6.16) sent the patched panels into the proper intermediate stock: Stock before the speed sander for CCPTS grades, or stock before the saw for sanded grades. When this was done an immediate call to ENTPAT was made.

c. <u>Sanders.</u> Sanders were activated by subroutines ENTSND and LEASND. Both sanders had different functions and could not be operated at the same time. This made their scheduling easier. The input and output of both machines, their relationships to each other, the average actual grade percentages, and variable names are shown in Figure 6.17. ENTSND subroutine flowchart is shown in Figure 6.18.

Subroutine ENTSND was called by LEASND during the normal working periods or by itself on the next day when no more panels

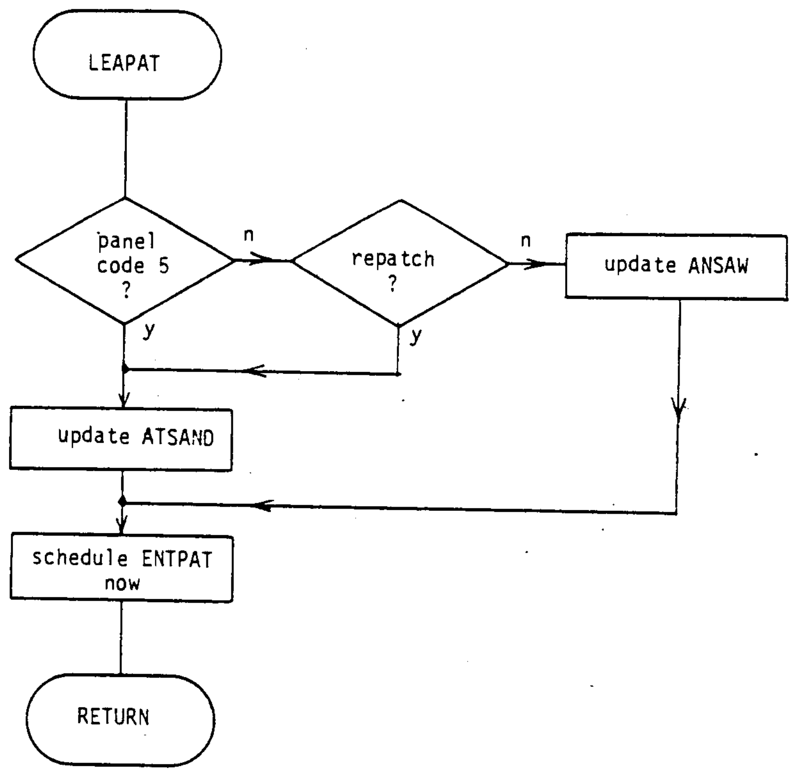


Figure 6.16. Flowchart of LEAPAT subroutine

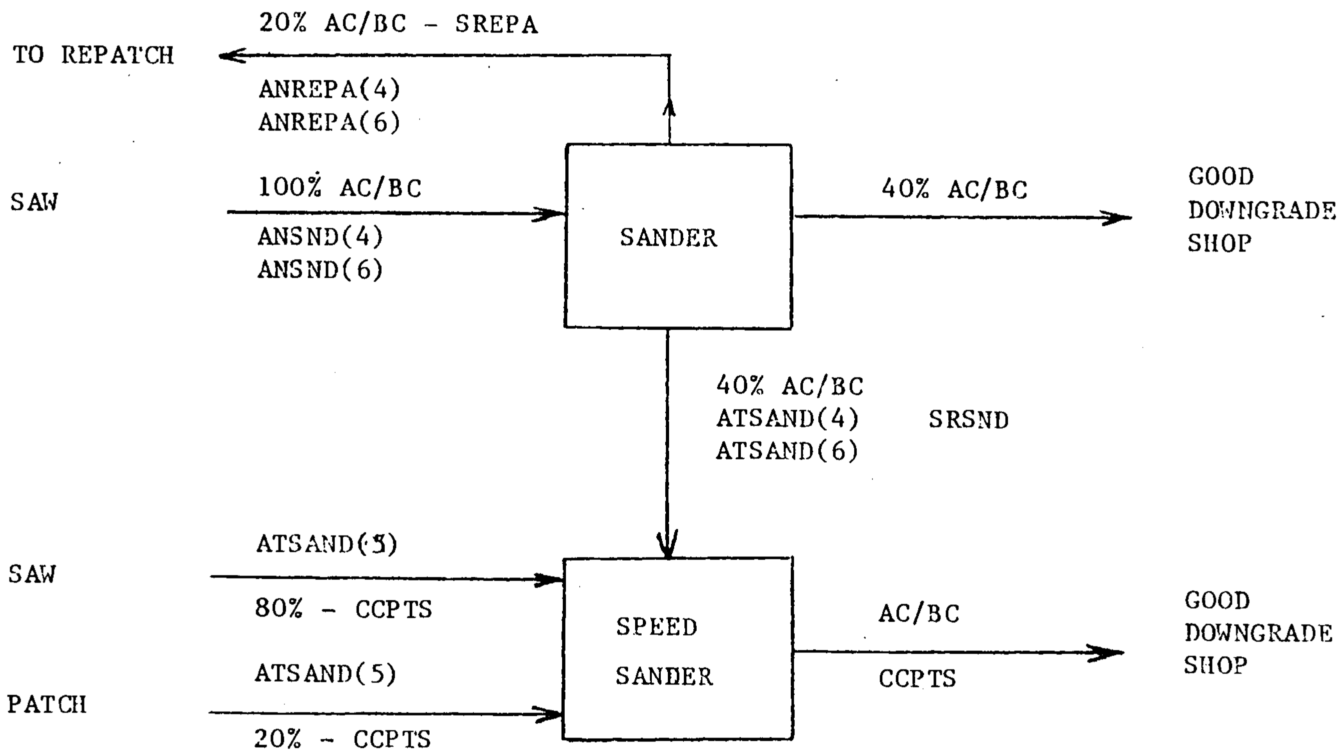


Figure 6.17. Input and output for the sanders

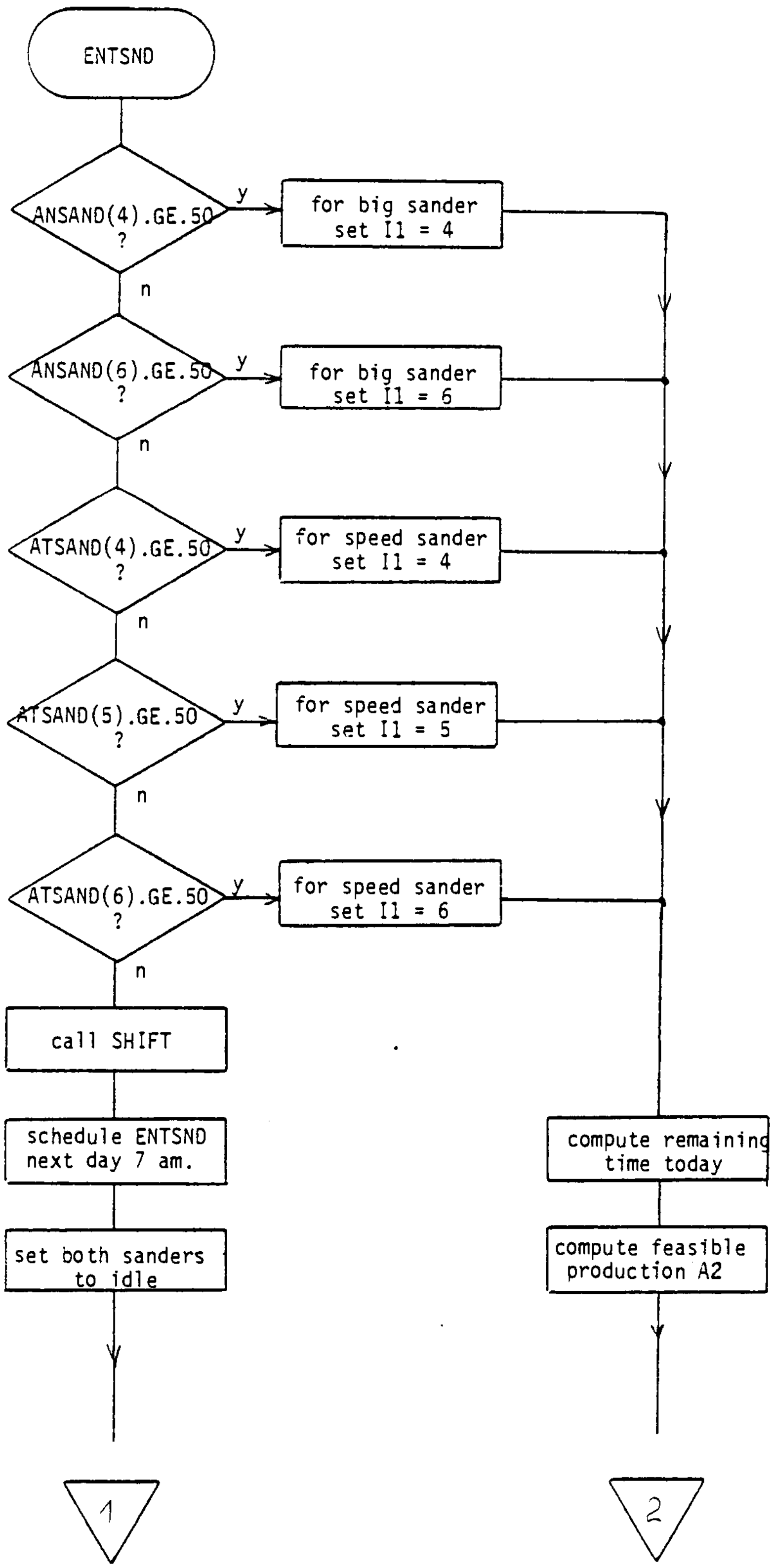


Figure 6.18. Flowchart of ENTSND subroutine

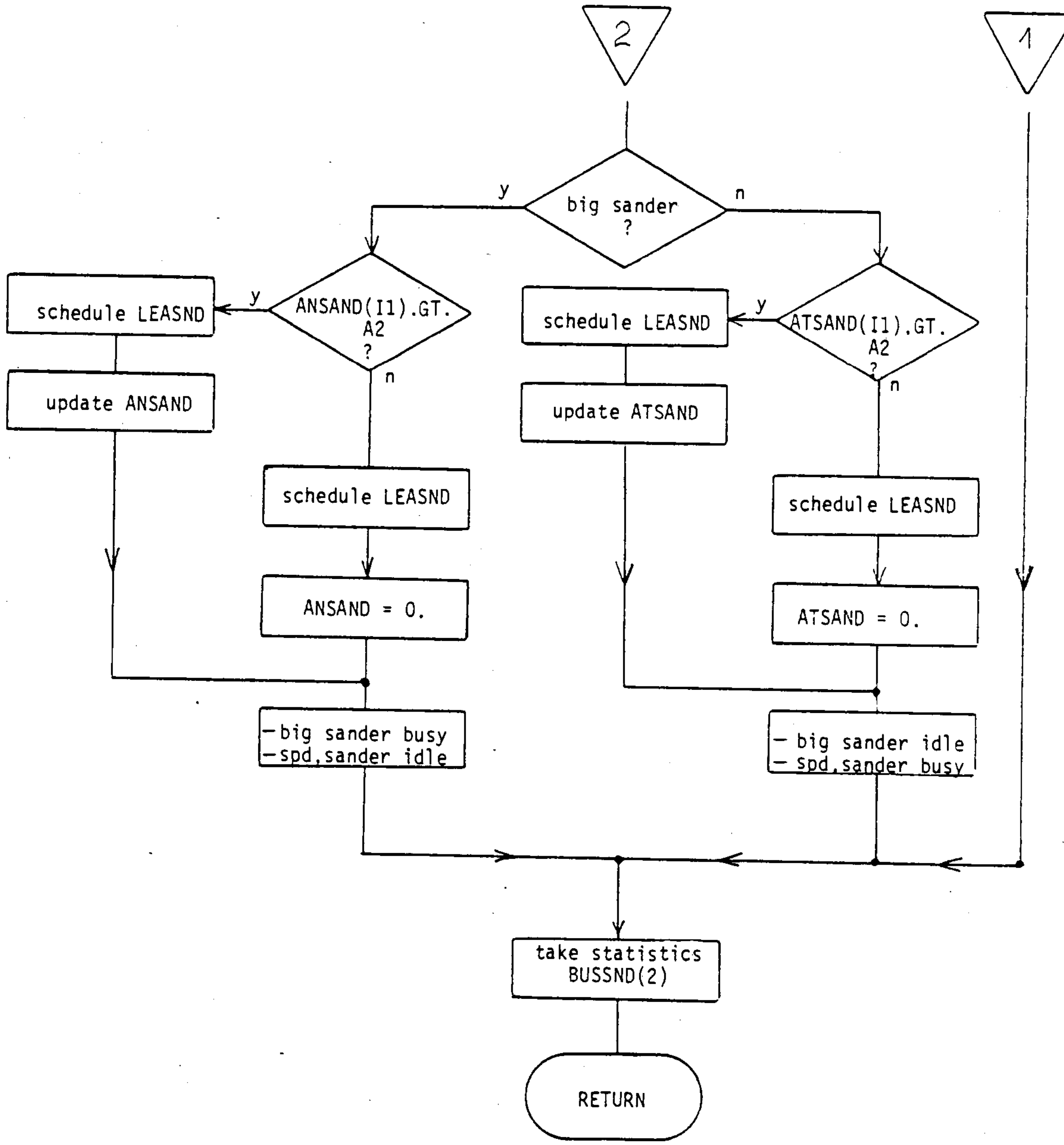


Figure 6.18. (continued). Flowchart of ENTSND subroutine

remained to be sanded.

Intermediate stocks were searched according to the following priority order:

- Panels code 4 — wide belt sander
- Panels code 6
- Panels code 4 after re-patch
- Panels code 5 from saw or patch — speed sander
- Panels code 6 after re-patch

In order to sand panels by batches, the remaining working time for that day was computed:

- If the whole intermediate stock could be sanded during the same day, the stock was emptied, the sander was engaged, statistics were collected (if necessary), and LEASND was scheduled.

- If the stock considered was too large to be completely sanded on that day, the number of panels which could be processed during the remaining time was then computed and the panels removed from the stock. The proper sander was then engaged, statistics collected (if necessary), and LEASND was scheduled at the end of the shift. If there were no more panels to be sanded, both sanders were set to idle, statistics collected, and the next call to ENTSND was scheduled for the start of the next day shift.

When one of the sanders started processing one panel batch, ATRIB(3), ATRIB(4), and ATRIB(5) were used to store the panel code, the number of panels of the batch, and the sander code, respectively between ENTSND and LEASND. ATRIB(5) took values of 1. or 2. as codes for the wide belt sander and speed sander respectively.

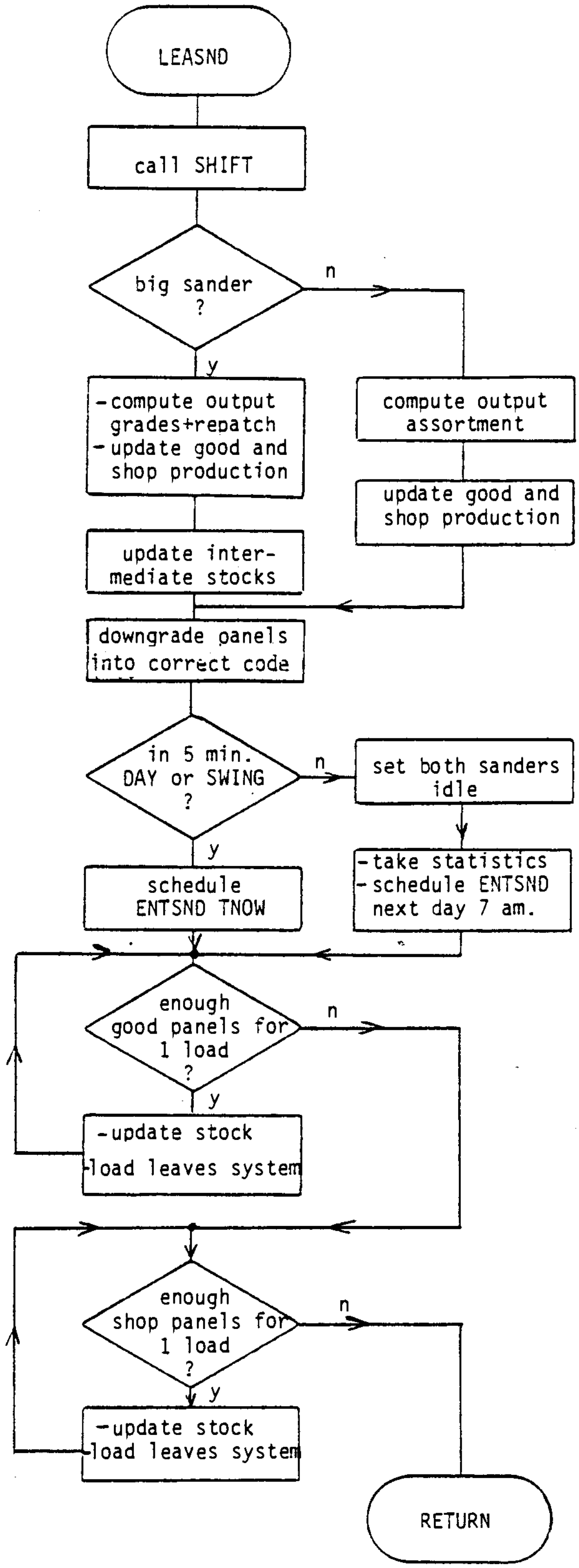


Figure 6.19. Flowchart of LEASND subroutine

Subroutine LEASND first read the ATRIB(5) value to identify the sander which was running during the last period. As shown in Figure 6.19, the batch was graded into various options and if they needed further processing, the resulting panels were sent back to the proper intermediate stock. They were grouped by grades and thicknesses if their manufacturing cycle was over. After proper recording, they left the system as soon as enough panels for one standard load could be gathered.

Special mention must be made of the downgrading practices. A given proportion of sanded and touch-sanded grade panels was downgraded into their corresponding sheathing thicknesses. The relationships are as follows:

Thicknesses	Panel code	Downgraded into	Panel code
5/16" AC/BC	4	5/16" CD	7
9/16" AC/BC	6	1/2" CD	8
15/32" CCPTS	5	1/2" CD	8

When this had been done, the next call to ENTSND was performed. A call to SHIFT indicated whether there was still some time left for this working period. If this was the case, an immediate call to ENTSND took place. If no time was left, the sanders were set to idle, statistics were collected, and a call to ENTSND was scheduled for the next day's Dayshift.

6. <u>Other subroutines.</u> All major subroutines of the system have now been explained. However, four user-defined subroutines remain: Subroutines INTLC, EVNTS, RECRD, and OTPUT.

a. <u>Subroutine INTLC.</u> Its main function was discussed earlier. Its various sections are explained in the order of computation:

. Set to zero all variables which will take cumulative values during the simulation. Set to zero all arrays, even if re-initialized later by selective readings from the datafile.

. Compute the total number of 1/6" veneers that will be needed for the required weekly production.

. Schedule the first DRYER event 30 minutes after the simulation has started.

. Read the panel construction options from the datafile.

. Read the initial dry veneers stock from the datafile.

. Initialize the current dry veneer stock.

. Schedule the first INVNT, PLUG, ENTJNT and ENTGLS events. The ENTLGS event was scheduled for the start of the initial sanded session with panel code 4.

. Read from the datafile the initial number of panel stacks within the hot stack. Store them with a dummy "time when entered stack" to avoid addition to the hotstack statistics.

. Read from the datafile the initial numbers of panels within all intermediate stocks.

. Initialize current intermediate stocks.

. Schedule ENTPAT, ENTSAW, and ENTSND events for the beginning of the next dayshift. ENTSND is scheduled on the wide belt sander.

b. <u>Subroutine EVNTS</u>. After each call to an event, a call is made to subroutine RECRD.

c. <u>Subroutine RECRD</u>. RECRD's function is to define the variables which are to be plotted against time before calling the GASP system GPLOT ( ) subroutine, which stores the datapoint values. Five plots are used:

- Plot #1 Veneer stocks for veneer codes 11,12,13,14,15,18
- Plot #2 Veneer stocks for veneer codes 23,24,25,27,28,36,37
- Plot #3 Veneer stocks for veneer codes 43,44,45,66,67
- Plot #4 Glued production for panel codes 1 to 8
- Plot #5 Production centers' occupation status IBUS(1) to IBUS(9)

d. Subroutine OTPUT. The following user-defined information was formatted and programmed to be displayed before the GASP summary report on the simulation output: A table of all numerical data considered in the simulation (appearing under the header "Constants for the Simulation"), the initial veneers and panel stocks which have been considered for that run (appearing under the header "Initial Conditions"), and the final veneer and panel stocks and accumulated production data (appearing under "Final Conditions").

7. Datafile organization. The datafile is comprised of three distinct sections:

a. Numerical data read by main program PLYSIM (Table 6.3).

b. Coded data cards for the GASP system:

GEN card. Mainly defines the headers (authors name, etc.).

STA card. Defines the statistics collection by COLCT and TIMST, the number of histograms and plots.

LIM card. Mainly defines the total maximum allowed number of entries in all files at any time, and the corresponding space that is saved to store them.

Table 6.3. Numerical variables read by PLYSIM

Row #	Variable names								Formats
1	CHLFB	DHLFB	CNHLFB	COHLFB	CHLFA				6F5.3
2	DHLFA	CNHLFA	COHLFA	BPFULA	DFULA				6F5.3
3	DRDAY(1)	DRDAY(2)	DRDAY(3)	DRDAY(4)	PCTGR6				6F6.1
4	COREC	CORED	DRYC	DRYD					5F5.3
5	ISTOJN	ISTOCO	NPROD	IBPATC					4I5
6	PLUGG	AJOINT	PPTIM	AMANUT					5F6.1
7	PLUGA	PLUGB	PLUGC	PLUGD					5F5.3
8	DRY(1)	DRY(2)	DRY(3)	DRY(4)	DRY(5)				6F8.1
9	GLSPT(1,1)	GLSPT(2,1)	GLSPT(3,1)	GLSPT(4,1)	GLSPT(6,1)	GLSPT(7,1)	GLSPT(8,1)	GLSPT(8,1)	8F5.2
10	GLSPT(1,2)	GLSPT(2,2)	GLSPT(3,2)	GLSPT(4,2)	GLSPT(5,2)	GLSPT(7,2)	GLSPT(8,2)	GLSPT(8,2)	8F5.2
11	IPROD(1)	IPROD	IPROD(3)	IPROD(4)	IPROD(5)	IPROD(7)	IPROD(8)	IPROD(8)	8I6
12	PRESS(1,1)	PRESS(2,1)	PRESS(3,1)	PRESS(4,1)	PRESS(5,1)	PRESS(7,1)	PRESS(8,1)	PRESS(8,1)	8F5.2
13	PRESS(1,2)	PRESS(2,2)	PRESS(3,2)	PRESS(4,2)	PRESS(5,2)	PRESS(7,2)	PRESS(8,2)	PRESS(8,2)	8F5.2
14	IPANEL(1,1)	IPANEL(2,1)	IPANEL(3,1)	IPANEL(4,1)	IPANEL(5,1)	IPANEL(7,1)	IPANEL(8,1)	IPANEL(8,1)	8I3
15	IPANEL(1,2)	IPANEL(2,2)	IPANEL(3,2)	IPANEL(4,2)	IPANEL(5,2)	IPANEL(7,2)	IPANEL(8,2)	IPANEL(8,2)	8I3
16	HOTCUR	PATCH	SAWSPD	SAND					4F5.1
17	GOOD	CERT	SHOP						3F4.2
18	SREPA	SOKP	SRSND	SDOWN	SSHOP				5F4.2
19	LOAD(1)	LOAD(2)	LOAD(3)	LOAD(4)	LOAD(5)	LOAD(6)	LOAD(7)	LOAD(8)	8I4
20	TSGOOD	TGSSHOP							2F4.2

COL card. Labels the variables that are handled through subroutine COLCT.

TIM card. Does the same for subroutine TIMST.

HIS card. Defines the histograms' classes and labels.

PLO card. Defines the tape numbers where data to be plotted will be stored by GASP and also fixes the time increments and options.

VAR card. Defines plot scales and labels.

INI card. Sets the time limits of the simulation and the initialization conditions.

FIN card. Indicates the end of the GASP datafile.

All specifications are given in the GASP IV simulation language manual (24), pp. 72-79.

c. Numerical data read by INTLC (Table 6.4). The listing of the datafile DATA is shown in Appendix B.

B. Remarks and Justifications.

1. Pre-set limits and priorities. As the simulation must proceed automatically along time, thoroughly defined decision sets were included in the subroutines.

Choosing which drying schedule must be adopted during days and relief shifts was rigidly defined for the length of a simulation run. However, upper and lower limits of veneer stocks and related drying strategies could be changed readily by the user by giving new values to ISTOCO and ISTOJN in the datafile as shown earlier, or by intro-

Table 6.4. Numerical variables read by INTLC

Row #	Variable names								Formats
1	IVENR(1,13,1)		IVENR(1,67,1)		IVENR(1,14,1)				3I2
2	IVENR(1,13,2)		IVENR(1,66,2)		IVENR(1,14,2)				3I2
3	IVENR(2,13,1)		IVENR(2,67,1)		IVENR(2,15,1)		IVENR(2,24,1)		4I2
4	IVENR(2,13,2)		IVENR(2,66,2)		IVENR(2,25,2)		IVENR(2,14,2)		4I2
5	IVENR(3,13,1)		IVENR(3,67,1)		IVENR(3,45,1)		IVENR(3,44,1)		4I2
6	IVENR(3,14,2)		IVENR(3,66,2)		IVENR(3,45,2)		IVENR(3,43,2)		4I2
7	IVENR(4,11,1)		IVENR(4,36,1)		IVENR(4,13,1)				3I2
8	IVENR(4,12,2)		IVENR(4,36,2)		IVENR(4,13,2)				3I2
9	IVENR(5,13,1)		IVENR(5,36,1)		IVENR(5,25,1)				3I2
10	IVENR(5,13,2)		IVENR(5,36,2)		IVENR(5,15,2)		IVENR(5,23,2)		3I2
11	IVENR(6,13,1)		IVENR(6,36,1)		IVENR(6,45,1)		IVENR(6,11,1)		4I2
12	IVENR(6,13,2)		IVENR(6,36,2)		IVENR(6,45,2)		IVENR(6,12,2)		4I2
13	IVENR(7,13,1)		IVENR(7,37,1)		IVENR(7,14,1)				3I2
14	IVENR(7,13,2)		IVENR(7,27,2)		IVENR(7,24,2)				3I2
15	IVENR(8,13,1)		IVENR(8,37,1)		IVENR(8,25,1)		IVENR(8,14,1)		4I2
16	IVENR(8,13,2)		IVENR(8,36,2)		IVENR(8,25,2)		IVENR(8,14,2)		4I2
17	ISTOKI(11)	ISTOCKI(12)	ISTOKI(13)	ISTOKI(14)	ISTOKI(15)	ISTOKI(16)	ISTOKI(17)	ISTOKI(18)	8I6
18	ISTOKI(21)	ISTOCKI(22)	ISTOKI(23)	ISTOKI(24)	ISTOKI(25)	ISTOKI(26)	ISTOKI(27)	ISTOKI(28)	8I6
19	ISTOKI(36)	ISTOCKI(37)							2I6
20	ISTOKI(41)	ISTOCKI(42)	ISTOKI(43)	ISTOKI(44)	ISTOKI(45)	ISTOKI(46)	ISTOKI(47)	ISTOKI(48)	8I6
21	ISTOKI(66)	ISTOCKI(67)							2I6
22	INHSTK(1)	INHSTK(2)	INHSTK(3)	INHSTK(4)	INHSTK(5)	INHSTK(6)	INHSTK(7)	INHSTK(8)	8I6
23	ISTOPP(1)	ISTOPP(2)	ISTOPP(3)	ISTOPP(4)	ISTOPP(5)	ISTOPP(6)	ISTOPP(7)	ISTOPP(8)	8I6
24	ISTOTS(1)	ISTOTS(2)	ISTOTS(3)	ISTOTS(4)	ISTOTS(5)	ISTOTS(6)	ISTOTS(7)	ISTOTS(8)	8I6
25	ISTOPA(1)	ISTOPA(2)	ISTOPA(3)	ISTOPA(4)	ISTOPA(5)	ISTOPA(6)	ISTOPA(7)	ISTOPA(8)	8I6
26	ISTORP(1)	ISTORP(2)	ISTORP(3)	ISTORP(4)	ISTORP(5)	ISTORP(6)	ISTORP(7)	ISTORP(8)	8I6
27	ISTSAW(1)	ISTSAW(2)	ISTSAW(3)	ISTSAW(4)	ISTSAW(5)	ISTSAW(6)	ISTSAW(7)	ISTSAW(8)	8I6

ducing proper program statements. This applies to the jointer operation as well; the Bpatch stock limit and the order in which jobs were scanned and started could be changed in the same way.

The operation of the gluespreader and presses was more rigid since the rules which were applied in the plant left little slack for options, and the complexity of the program was such that automatic panel scanning had to be set up within every shift. As a result it was impossible within a shift to scan panel codes downward or with upward increments not equal to one; there is no way in which panel code 2 could be glued after panel code 5 within the same shift. If panel codes had been scanned up to code 8, and if panel code 8 could not be layed-up for any reason, the simulation stopped with an error message. However, as panel codes were reset to code 1 at the beginning of every shift, this was not a problem. The real problem lies in the fact that scanning panel codes this way implied that panel codes 1,2,3 must be "heavy core" panels, 4 and 6 sanded grade panels, 5 CCPTS, and that panels of code 8 could be glued in excess of the real demand because this code was scanned last. This arrangement could not be changed without complete remodeling of the program. Because of this, the rest of the simulation had been based upon a fixed product line definition.

The order of priorities in which jobs were processed by the saw, patchline and sanders could be changed, however, with small modifications of program statements.

2. Definition of processing times for single jobs. Many production centers were programmed for 30 minute periods. No changes

could be made to their input definition at less than 30 minute intervals. This amount of time had been selected as "reasonable" when compared to real-world processing times for veneer stacks at machines such as dryers, jointers, or pluggers. This standard period could be modified easily.

Production centers in the finishing area worked differently. The saw and the patchline worked stack-by-stack when panels came from the stock in the hot stack. A stack was a small unit to work with, especially for the saw. Also, as the jobs are prioritized along a run, thickness changes did not occur often: jobs succession at the patcher and the saw matched the order in which stacks were glued at the gluespreader.

Panels from intermediate stocks were fed to the saw and the patch line in amounts that were equivalent to 15 minute processing periods.

The sander only processed panels coming from intermediate stocks. Here, panel availability was once more scanned in a given order, which could easily be modified between runs. To create fewer thickness changes, the whole intermediate stock of the considered batch was processed (if small enough) until the end of the working period. It it was too large, the sander processed that portion of the stock which could be sanded within this time constraint. This reduced the occurences of shifting from one sander to the other.

3. Limitations to the model's adaptability. The easy changes that could be made to priority rules and setting of limits and the freedom of setting any numerical variable to any value in the data-

file provided this model with great adaptability for considering "what if" situations. On the other hand, all changes which related to panel thicknesses of grades required important and time-consuming modifications to the program. Also, changes in product flow patterns and time variations were limiting factors. These limitations were the result of the very conception of the program which had been based upon the manufacture of eight types of panels in a given plant (according to given procedures).

In the future, a more general model could be built without major conceptual difficulties. But at this stage, this model can be used to simulate product flows and production and machine utilization over time without major program changes in the following cases:

- Changing the weekly product mix (within the eight given products)
- Changing panel construction options (within available veneers)
- Changing grade distributions created at any production center or through purchases
- Changing purchased amounts of dry veneers
- Changing the output rate of any machine (productivity changes)
- Changing the priority of orders at production centers
- Changing schedules of production centers

All the above "what if" situations could be evaluated. The output of the simulation would provide the same type of information in the same format as the basic computer. This would allow easy comparisons between runs before and after "What if" changes.

For instance, changing the 25-opening into a more modern

20-opening press could be easily programmed. The new set-up would not only show changes in the plant production, but also in stock levels, flows of veneers and panels, and in the utilization of all other production centers. Changes in the open and total assembly times and in residence time in the hot stack would compare the situations before and after the introduction of the new press.

4. Major difficulties encountered. Programming which had been required was rather straightforward. However, the program length and the intricate system of calls from subroutine to subroutine created unavoidable debugging problems. A practice which had been particularly helpful in order to monitor calls to subroutines and detect infinite loop locations had been to make trial runs which included the modified version of subroutine EVNTS shown in Appendix B.

Program interactions with GASP were not a problem, even though the system was very sensitive to integer/real definition as well as dimensions and consistency in defining GASP datacards.

VII. SAMPLE RUNS OF THE MODEL

A. Run #1

1. Production goals. The required production of good panels for the considered week is shown below in Table 7.1.

Table 7.1. Weekly production of good panels.

Goal: 1385 MSF (3/8")			
Sanded panels	5/16" AC/DC	6%	33%
	15/32" CCPTS	8%	
	9/16" AC/DC	19%	
Sheathing panels	5/16"CD	2%	67%
	3/8" CD	5%	
	1/2" CD	45%	
	5/8" CD	15%	

From these production figures of good panels, the actual number of panels to be glued for each type is computed by considering a proportion of about 89% of good panels among all sanded grades, as shown in Figure 7.1, and of 93% among all sheathing grades. After rounding into multiples of 50 panels, the gluespreader schedule for the week was (in numbers of panels):

3/8 CD	5/8CD	5/16AC	15/32CCPTS	9/16AC	5/16CD	1/2CD
2350	4200	3550	3150	6200	1150	15750

In this particular example, there was no demand for panel code 3 (3/4" CD).

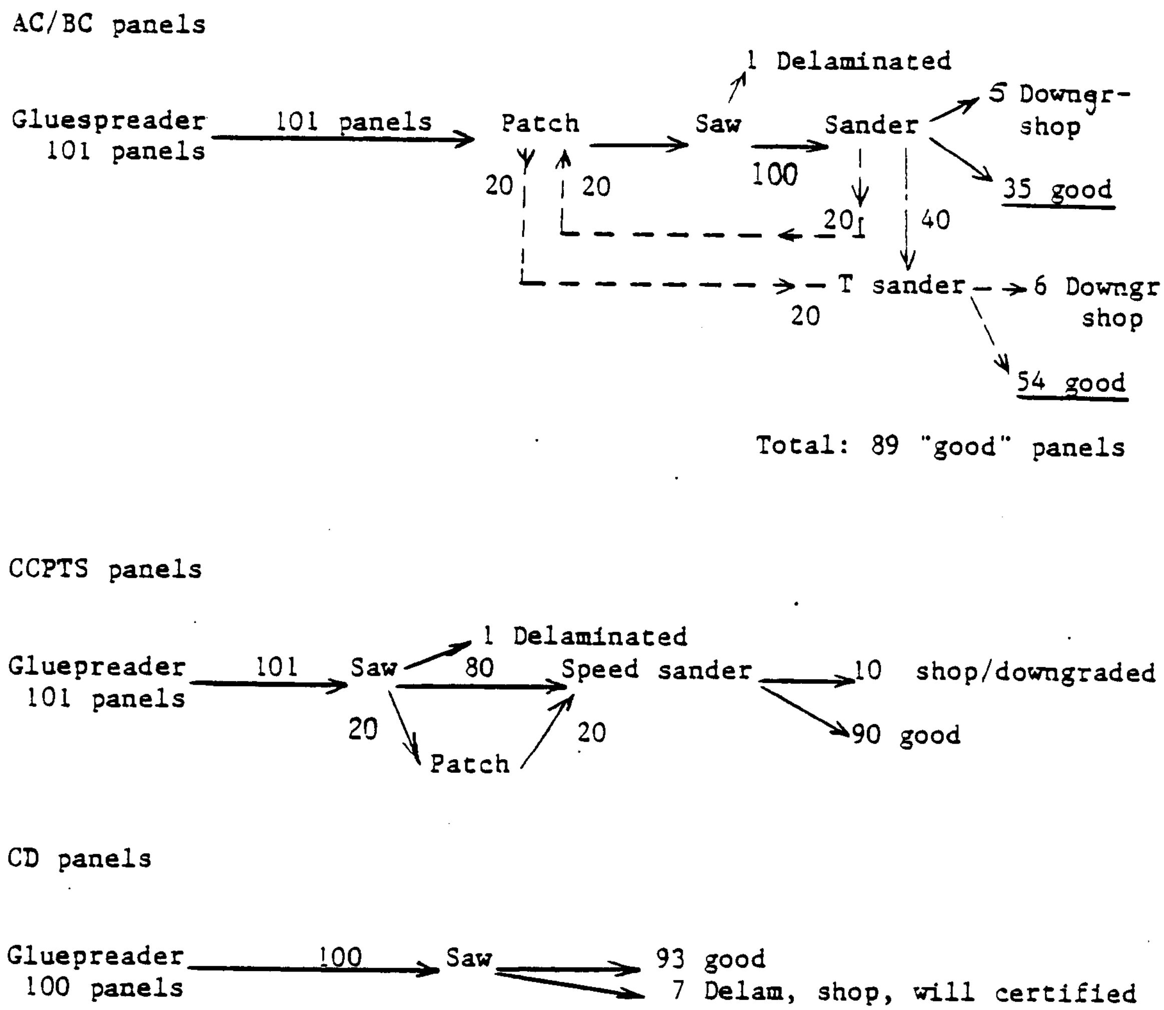


Figure 7.1. Panel grades after finishing operations.

It was assumed that 1/2" CD panels could be made in excess of the actual demand. This would only happen when all other panel codes had been scanned without success, or when all other orders had been met. The actual gluespreader schedule for this run had been set to produce 20000 panels.

2. Veneer deliveries. The normal dry veneer deliveries were scheduled as follows:

. 80 MSF (3/8") of 1/10" C and D core strips were delivered Monday at 7 am.

. 80 MSF (3/8") of 1/10" veneers were delivered at 7 am of the first five days of the week in the following constant proportion:

- 70% 54" veneers, 30% 27" veneers.

- Grades as already defined in Chapter IV (DRYC, DRYD, DRYCN).

As explained earlier, emergency deliveries of dry veneers of the most common items could be made anytime. These deliveries were immediate and were triggered when the veneer stock of any of these items hit the reorder point which is set to 500 veneers. Stock control level values had been set in such a way that each delivery was about 40 MSF (3/8") or one truckload.

3. Initial stock of dry veneer. It was fixed at 800 (3/8"). The proportion of various items is shown in Table 5.21.

4. Initial stock of panels. There were 100 MSF (3/8") in the hotstack and 100 MSF (3/8") in the intermediate panel stock before the sanders. The 100 (3/8") MSF in the hot stack were equally divided between panel codes 1, 4, and 5 as in Table 7.3. The 100 MSF of panels before the sander numbered 2083 were all of 9/16" AC construction.

Table 7.2. Initial stock of dry veneer

		MSF (3/8)	Number of good veneers
Center	1/6	100	7031
Core D	1/6	100	7031
Core C	1/6	50	5829
Core D	1/10	200	23637
A/B	1/10	40	4688
C	1/10	10	1172
D	1/10	10	1172
Cent	1/10	180	21093
BP	1/10	110	12890
Total		800	

Table 7.3. Panels initially in the hot stack.

	3/8 CD	5/16 AC	15/32 CCPTS
Number of panels	1050	1250	850

5. Purpose and scenario. The purpose of this first run was to show how to use the program practically. Starting from a given situation, the performance of the plant was simulated for one week. It pinpointed all discrepancies between production objectives and actual achievements. By making multiple runs and continually improving production policies on the basis of previous results, better results could be achieved.

B. Run #2

This second run focused on two possible improvements: first, the jointing of half sheet, C-veneers was to reduce the cost of purchasing full sheets; and second, the use of the patch line during a second shift was to process panels which accumulated behind the hot press and could not be finished. The following changes were implemented:

1. Veneer stock balance. Down grading 27"C into D backs ceased to take place. The necessary changes in the definitions for assembling of 5/8" CD, option 1, and 1/2" CD, option 1 were made in subroutine INTLC. Also jointed were 27" C grade veneers and 27" Bpatch veneers (if there were no more 27" C grade veneers). Subroutine ENTJNT was changed accordingly (Appendix B). In this particular case, and in order to avoid changing too many parameters at the same time, the purchase policy for dry veneer remained unchanged for this new run as did all other numerical variables and policies relating to veneer.

2. Patch line. The patch line was scheduled to work during two shifts, adding the Swing shift to the existing Dayshift. This was done through appropriate changes in the ENTPAT subroutine listing (Appendix B). All other stocks, policies or numerical variables relating to panels remained unchanged.

VIII. RESULTS AND DISCUSSION

A. Run #1

1. Actual production compared to objectives. Production figures that appear on the printout (Appendix C) are summarized and easily compared by using Tables 8.1 and 8.2. An example of how table 8.1 has been computed for "good" 3/8" production is shown below.

- initial stock in the hot stack consisted of 1050 panels (initial panel stock/output).

- production through the gluespreader and presses was 2350 panels (production/output).

- final panel stock was 0 (final panel stock/output)

- the resulting 3400 panels were:

in 35 loads of good panels (production/output), 1 load = 88 panels as seen on constants for the simulation/output.

81 unbanded good panels.

Thus, total good panels produced were 35*88 + 81 = 3161. The same pattern was used for all thicknesses and all grades. From these figures, a comparison was made between the production of available good panels and the initial production objectives for the whole week in Table 8.2.

Production that was ready for shipment was less than what was scheduled (-2.76%) and 43% of the required 9/16" panels were missing, which was not acceptable. On the other hand, other items had been produced in larger quantities due to the initial stocks being processed prior to the glued production.

Table 8.1. Panel production in run #1

Panel thickness	3/8"	5/8"	5/16"	15/32"	9/16"	5/16"	1/2"
PRODUCTION							
Good	3161	3905	3351	2850	3122	1343	15194
Mill certified	102	126	-	-	-	34	474
Shop	102	126	151	95	140	34	674
Delaminated	34	42	47	40	23	11	158
Total production (numbers of panels) (1)	3399	4199	3549	2985	3285	1422	16300
Initial stocks (numbers of panels) (2)	1050	0	1250	850	2083	0	0
Pressed production (numbers of panels) (3)	2350	4200	3550	3150	6200	1150	19600
FINAL STOCKS							
In hot stack	-	-	-	-	3800	-	3750
Before saw	-	-	30	-	60	-	(25)*
Before patch	-	-	944	791	879	-	-
Before sanders	-	-	-	-	-	-	-
Total final stock (numbers of panels) (4)	0	0	974	791	4739	0	3775
Theoretical pressed production (numbers of panels) (5)=(2)+(3)-(4)	3400	4200	3826	3209	3544	1150	15825
Difference (5)-(1)	1	1	277**	224**	259**	-272**	-475*

*At the end of the simulation, 25 1/2" panels were being sawn (File 1).

**277 5/16" AC/BC panels have been downgraded into 5/16" BC
221 15/32" CC and 259 9/16" AC/BC panels have been downgraded into 1/2" CD

Rounding errors totalled 15 panels

Table 8.2. Available production of good panels vs. the production objective

Run # 1

Panel thickness	3/8"	5/8"	5/16"	15/32"	9/16"	5/16"	1/2"	Total
Good products production objective								
. Number of panels:	2164	3895	3116	2770	5482	1038	14607	
. MSF (3/8")	69.25	207.75	83.10	110.80	263.15	27.70	623.25	1385.00
Actual "good" production								
. Number of panels	3161	3905	3351	2850	3122	1343	15194	
. MSF (3/8")	101.15	208.28	89.37	114.00	149.86	35.84	648.30	1346.80
Difference (percent)	+46.0	+0.2	+7.5	+2.9	-43.0	+29.4	+4.0	-2.76

The gluespreader had worked according to the schedule, and all objectives had been reached. The reason for the shortage of 15/32" and 9/16" panels was found downstream within the finishing area.

Quantities of equivalent veneers used at the gluespreader are shown in Table 8.3. The total 1693.4 MSF (3/8") figure is computed before compression losses.

2. Veneer stocks and deliveries. All scheduled deliveries took place. Four emergency deliveries also occurred at times shown in the first lines of the printout. They show an important shortage of 1/10" C cores and 1/6" D cores. From these results, the final veneer inventory and control was computed (Table 8.4). It appears that the overall veneer stock was decreased by 6% (from 800 to 752 MSF (3/8") in spite of the unscheduled deliveries of 160 MSF (3/8) of 1/10" and 1/6" core strips. This variation is quite reasonable, however, because it corresponds to a need to buy low cost veneers.

The variations of the veneer stock (Table 8.5) is explained in detail as follows:

- The pluggers upgraded veneers beyond production needs of the week: The 15% increase of the 1/10"-54"/27" stock came from an excess of A, B and C upgraded veneers. In contrast, the corresponding centers had dropped sharply. This result raised the question, "should some Bpatch veneers be used for centers if this week's production should be a 'low grade product mix'? And, is reselling the excess of high grade veneers a possibility?"

- The 1/10"-27" C and D veneers stock increased as the jointer did not process them. It only joints Bpatch veneers. The only end

Table 8.3. Veneers used at the gluespreader

(Numbess of equivalent veneers)

Veneer types	3/8"	5/8"	5/16"	15/32"	9/16"	5/16"CD	1/2"	Total
1/10" - 54/27"	4700	12600	7100	9450	12400	2300	58950	107500
1/10" strips			3550	6300	12400	1150	39300	62700
1/6" - 54/27"					6200			6200
1/6" strips	2350	8400						10750

NOTE ; The total amounts to 1963.4 MSF (3/8")

Table 8.4. Dry veneer inventory of Run #1

Veneer types	1/10"-54"/27"	1/10" strips	1/6"-54"/27"	1/6" strips
Real initial stock				
. Number of veneers (1)	41015	39296	7031	7031
. MSF (3/8")	350	250	100	100
Dryer production (number of veneers) (2)	69960	29040	6880	7040
Dry veneer purchases (number of veneers) (3)	44090	22078	0	2662
Veneers used at the glue-spreader (number of veneers (4)	107500	62700	6200	10750
Theoretical final stock (number of veneers) (1)+(2)+(3)-(4)	47565	17714	7711	5983
Real final stock				
. Number of veneers	47505	17714	7711	5983
. MSF (3/8")	405.9	151.1	109.7	85.1
Percentage of variation	+15.0	-39.5	+9.6	-14.9

Total percentage of variation (MSF 3/8"): -6%.

Table 8.5. Net changes of the dry veneer inventories between the start and the end of the simulation (MSF 3/8") - Run #1

Veneer dimensions- Veneer grades	1/10"-54"	1/10"-27"	1/10" strips	1/6"27"-54"	1/6" strips
A	+ 6.3				
B	+ 42.3				
C	+206.5	+39.7		+66.0	
D	+ 4.2	+14.8		+19.3	
Centers	-170.4	+ 0.08		-75.7	
Cores C			+ 95.5		+ 56.3
Cores D			-194.4		- 71.2
BPatch	-33.9	-53.8			

use for 1/10"- 27"-C grade veneer was defined as replacing D veneers for thick sheathing panels. Is this a good policy? Would it be wiser to start joining C veneers before Bpatch? On the other hand, by cutting down C veneer deliveries at the same time, a better balance could be reached at a better cost.

- There was a general shortage of core strips. There was also a shift towards C grade cores at the end of the simulation. This would have allowed for a better start for the gluing of sanded grade panels starting on the next Sunday night shift. If solutions could be found to the overabundance of high grade 1/10" veneers, it seemed advisable not to change policies at the dryer, but to make the necessary purchases of low cost dry core veneers.

-1/6" C and D veneer stocks had increased also: They were used for lay-up because the production of 3/4" CD panels was not scheduled. The policy at the dryer could be changed by sorting 1/6" veneers only into centers and cores. However by doing this, some production potential might be lost. Can 1/6" C and D veneers be sold on the open market? Is it unusual to have a week's plywood order without 3/4"-CD panels?

3. Production centers utilization. The results are summarized in Table 8.6.

The pluggers showed a 79% utilization. They experienced a shortage of Bpatch veneers around time 3810 min. (printout in Appendix C). This could have been avoided with a slightly higher initial Bpatch stock. If the jointer was to joint C grades before Bpatch, some additional difficulties might occur in the pluggers activity, as less

Table 8.6. Utilization of various production centers during run #1

Production centers	Number of shifts	Activity percentage of a total of 9600 minutes (%)	Theoretical maximum	Actual percentage of activity (%)	
Pluggers	2	44.69	50	79.4	
Jointer	1	13.13	25	52.0	
Pre-press	4	45.87	100	45.9	
25 openings hot press	4	88.87	100	88.9	
10 openings hot press	4	0	100	0	
Patch line	1	23.94	25	95.8	
Saw	3	61.96	75	82.6	
Sander	2	18.21	50	34.6	63.6
Speed sander		13.61		27.2	

27" Bpatch veneers would be jointed.

The jointer was underutilized since there was a serious shortage of 27"-Bpatch veneers. The reason for this was that the stock assortment was such that the dryer did not process 27" veneers. As explained earlier it could dry 1/10 core strips, 1/10 27", or 50% of each during part of the day shift and relief shift. Here, the core strips shortage was such that the dryer did not process any 1/10"-27" veneers. However, having the jointer process 27" C-grade veneers should help and provide this area with a better production balance.

The glue spreader, pre-press and 25-opening press were employed during the whole production time at various degrees of utilization as shown in Table 8.6. However, the 10 openings press was never used. As the inter-arrival time of stacks from the gluespreader was constant and superior to the time which was needed for the hot press to process them, no queue could appear and there was consequently always less than 4 panel stacks present in the system. Open assembly times, histograms, and the reported emptiness of files 2, 3 and 12 confirmed the 10 openings press was not utilized.

The work at the patch line was well organized during the day shift. However, panels accumulated behind the hot press because of insufficient work time for patching within the existing time schedule. An additional shift could have solved this problem.

The saw utilization was low since it could not process the 9/16" panels waiting in the hot stack for transport to the patch line. The utilization of the sanders was also low. There were not enough panels to process as sanded and PTS grade panels were waiting too long to get patched or repatched. Here again, another shift on the patchline would have improved the activity.

There appeared to be a shortage of storage space for the hot stack. At the end of the simulation, it contained 3800 9/16" panels and 3750 1/2" panels, which amounted to a total of more than 342 MSF (3/8").

Residence time in the hot stack was variable. The longest residence time was observed with sanded grade panels which were processed very late through the patchline. Looking at the contents of file 9 (hot stack queue 9/16") showed that the oldest stacks left the hot press at time 1894 minutes (more than five days before the end of the simulation).

4. Remarks on the printout. After a printout of the user-defined output, the GASP summary report displayed statistics for observation-based and time-persistent variable statistics. This was followed by the printouts of GASP files showing a listing of the entities and attributes that were present at the end of the simulation. Each row corresponded to an entity, and its five attributes were displayed in columns.

The printout of file #1 at the end of the simulation showed the events which were scheduled to be called at a time greater or equal to 9600 minutes. For each event, ATRIB(1) displayed in the first column the scheduled time for the current event and ATRIB(2) displayed the event code.

For all files, important statistics were computed. They included the average and the maximum number of entries that stayed within them at any moment. QQTIM was the last time a change occurred in the contents of that file.

In run 1, all files were empty at the end of the simulation, except files 9 and 11 (panel codes 6 and 8 in the hot stack stock).

The three histograms showed the distribution of the open and total assembly times and the time in the hot stack. In this particular case, a line never formed between the gluespreader and the pre-press or between the pre-press and the hot presses and therefore the histograms were reduced to their simplest form. This would have been different with other thicknesses or with randomly distributed stack assembly times at the gluespreader.

The histograms were followed by five plots. Each started with a table showing the maximum and minimum values of variables considered in the simulation. The scales and the symbols used for each variable were then defined. Classes were 30 minutes wide.

The first three plots showed the variations of the dry veneer stock versus time. Plot #4 showed the cumulative number of glued panels over time. The scale is set in such a way that the 100% level was reached when the gluing objective had been met. Plot #5 showed the availability of the main machines. For all of them, scale 0 meant that they were idle. When production started, their indexes increased.

On all plots, superimposed datapoints were defined in the "Duplicate" columns. Their symbols are shown in Table 8.7.

5. Conclusions for run #1. The plant could not meet its production requirements during this first simulation run. The basic reason

Table 8.7. Plot symbols

	Symbols								
Plot #	1	2	3	4	5	6	7	8	9
Plot #1 Veneer stocks	A 54" 1/10"	B54" 1/10"	C 54" 1/10"	D 54" 1/10"	Center 54"-1/10	Bpatch 54"-1/10			
Plot #2 Veneer stocks	C 27" 1/10"	D 27" 1/10"	Center 27"-1/10	Core D 27"-1/10	Bpatch 27"-1/10	Core C str. 1/10	Core D str. 1/10		
Plot #3 Veneer stocks	C 27/54" 1/6"	D 27/54" 1/6"	Center 1/6-27/54	Core C str. 1/6"	Core D str. 1/6"				
Plot #4: Number of assembled panels/gluespread	CD3/8"	CD5/8"	CD3/4"	AC5/16"	15/32" CCPts	AC9/16"	CD5/16"	CD1/2"	
Plot #5: Activity of production centers	Pluggers	Jointer	Pre-press	25 openings hot press	10 openings hot press	Patch-line	Saw	Sander	Speed sander

for this was the patch line was not available long enough when working only during one shift. Expanding work on the patch line during the Swing shift would have to be tried on another run. Ideas for other improvements in veneer flows and inventories are:

- Increase purchases of centers and decrease the proportion of 1/10"-27" and especially of 54" C grade veneers.

- Joint C grade halves as well as Bpatch. However, discontinue downgrading 27" C into D backs for thick CD grade panels.

B. Run #2

1. Comparison of the actual with the target production. Tables 8.8 and 8.9 summarize the results of the run. The production now exceeded the requirements by an average of 13%, and all needed good panels were available at the end of the week. This definite improvement was the result of the addition of one shift on the patchline. However, the gluespreader processed the same amount of veneers as in run #1 and the final intermediate stock were reduced.

2. Veneer stocks and deliveries. The total veneer movements along run #2 are shown in Tables 8.10 and 8.11. A fifth emergency delivery took place, i.e. a truckload of 1/10" 54"-D veneers. Instead of downgraded 27"-C veneers as backs of thick sheathing panels, D-veneers were now used. The additional purchase of these low cost veneers and a small shortage which occurred at time 8962 did not seem important in view of the remaining 4077 of the 4421 purchased veneers still available at the end of the run. At the same

Table 8.8. Panel production in run #2

Panel thickness	3/8"	5/8"	5/16"	15/32"	9/16"	5/16"	1/2"
PRODUCTION							
Good	3161	3905	4197	3315	7217	1409	14745
Mill certified	102	126	-	-	-	34	448
Shop	102	126	179	110	308	34	448
Delaminated	34	42	47	40	61	11	149
Total production (numbers of panels) (1)	3399	4199	4423	3465	7586	1488	15790
Initial stocks (numbers of panels) (2)	1050	0	1250	850	2083	-	-
Pressed production (numbers of panels) (3)	2350	4200	3550	3150	6200	1150	19600
FINAL STOCKS							
In hot stack	-	-	-	-	-	-	4625
Before saw	-	-	30	-	80	-	(25)*
Before patch	-	-	4	39	30	-	-
Before sanders	-	-	-	235	-	-	-
Total final stock (numbers of panels) (4)	0	0	34	274	110	0	4650
Theoretical pressed production (numbers of panels) (5)=(2)+(3)-(4)	3400	4200	4766	3726	8173	1150	14950
Difference (5)-(1)	1	1	343**	261**	587**	-338**	-840*

*At the end of the simulation, 25 1/2" panels were being sawn (File 1).

**343 5/16" AC/BC panels have been downgraded into 5/16" BC
261 15/32" CC and 587 9/16" AC/BC panels have been downgraded into 1/2" CD

Rounding errors totalled 15 panels

Table 8.9. Available production of good panels vs. the production objective

Run # 2

Panel thickness	3/8"	5/8"	5/16"	15/32"	9/16"	5/16"	1/2"	Total
Good products production objective								
. Number of panels:	2164	3895	3116	2770	5482	1038	14607	
. MSF (3/8")	69.25	207.75	83.10	110.80	263.15	27.70	623.25	1385.00
Actual "good: production								
. Number of panels	3161	3905	4197	3315	7217	1409	14745	
. MSF (3/8")	101.15	208.28	111.93	132.60	346.43	37.60	629.14	1567.13
Difference (percent)	+46.0	+0.2	+34.7	+19.7	+31.6	+35.7	+0.9	+13.1

Table 8.10. Dry veneer inventory of Run # 2

Veneer types	1/10"-54"/27"	1/10" strips	1/6"-54"/27"	1/6" strips
Real initial stock				
. Number of veneers (1)	41015	29296	7031	7031
. MSF (3/8")	350	250	100	100
Dryer production (number of veneers) (2)	69960	29040	6880	7040
Dry veneer purchases (number of veneers) (3)	48511	22078	0	2662
Veneers used at the glue-spreader (number of veneers (4)	107500	62700	6200	10750
Theoretical final stock (number of veneers) (1)+(2)+(3)-(4)	51986	17714	7711	5983
Real final stock				
. Number of veneers	51986	17714	7711	5983
. MSF (3/8")	443.6	151.2	109.7	85.1
Percentage of variation	+26.7	-39.5	+9.7	-14.9

Total percentage of variation (MSF 3/8"): - 1.3%.

Table 8.11 Net changes of the dry veneer inventories between the start and the end of the simulation (MSF 3/8") - Run #2

	Veneer dimensions				
Veneer grades	1/10"-54"	1/10"-27"	1/10" strips	1/6"27"-54"	1/6" strips
A	+ 3.0				
B	+ 36.3				
C	+259.6	+0.2		+66.0	
D	+ 24.8	+14.8		+19.3	
Centers	-170.7	+ 0.8		-75.7	
Cores C					
Cores D			+ 95.6		+56.3
Bpatch	-34.9	-39.7	-194.4		-71.2

time, the jointer's activity was improved. All 27"-C veneers had been jointed while the number of jointed 27"-BPatch decreased only slightly. However, the priority given to the jointing of C-veneers before Bpatch-veneers resulted in a slight decrease in the flow of the 54" Bpatch veneer to the pluggers. These were short of veneers on several occasions (at 6450 and 8130 min.), and their activity decreased somewhat as compared to the first run.

C-veneer stock increased by this new jointed veneer supply amounted to over 31500 veneers at the end of the simulation. Plot #1 shows that it is possible to cancel the last four deliveries of dry 54"-C without falling short. This would decrease the final stock by:

4/5 * DRY(1) * DRYC = 12000 veneers

and would set its final level to 20000 veneers or 171 MBF(3/8), which is still an oversupply of C veneers.

Two other ideas for drying would improve the input of dry veneers to the system. These are based on the observation that there was a huge deficit of 54"-centers and, to a lesser extent, of D-veneers, and that too many 54"-veneers were dried during swing and graveyard shifts, while the strip core production was too low. The ideas could be implemented by the following practical steps:

- Lower the average quality of purchased 54"-green veneers, if feasible. Start sorting centers and increase the quantity of D-veneers at the outfeed of the dryer. This could be simulated by changing CFULA and DFULA values, introducing a new variable for centers and new statements in subroutine DRYER.

- Change the dryer organization (if the necessary labor could be made available during Swing or Graveyard shifts), and dry more strips instead of 54"-veneers. This would require more difficult changes in the simulation program as well as in the work organization of the actual plywood plant.

If these steps were taken, or if it was possible to sell the excess of dry 54"-1/10"-C veneers, the decision of jointing C-veneers in this simulation would upgrade the 6600 jointed C-veneers, provide better utilization of the jointer, and produce better quality of 5/8"- and 1/2"-panels. The only disadvantage of this decision would be a slight Bpatch veneer shortage at the pluggers, which would disappear with a slightly higher initial stock.

3. Utilization of production centers. The main changes from run #1 occurred at the jointer and in the finishing area. It reached nearly 94% of the time from an initial value of 52%. The reasons for the improvement of the jointer utilization were discussed earlier.

The addition of another shift on the patchline leveled the flow of panels throughout the finishing area. The waiting material was reduced to a minimum amount of 17 MSF (3/8"), and the hot stack decreased from 342 MSF at the end of run #1 to only 131 MSF at the end of run #2. This regulated flow allowed production centers to improve their operation. The saw and especially the sanders had operated longer as shown Table 8.12.

The decision of adding one shift to the patch line resulted in the good panels reaching the production objectives for increasing the number of available good panels by 16% (from 1347 MSF (3/8") to

Table 8.12. Utilization of various production centers during run # 2

Production centers	Number of shifts	Activity percentage of a total of 9600 minutes (%)	Theoretical maximum	Actual percentage of activity (%)	
Pluggers	2	41.56	50	83.1	
Jointer	1	23.44	25	93.8	
Pre-press	4	45.87	100	45.9	
25 openings hot press	4	88.87	100	88.8	
10 openings hot press	4	0	100	0	
Patch line	2	47.51	25	95.0	
Saw	3	67.01	75	89.3	
Sander	2	25.68	50	51.4	96.8
Speed sander		22.70		45.4	

1567 MSF), improving the utilization of the finishing line, and solving the storage space problems encountered with the hot stack and intermediate stocks. This was accomplished at the cost of employing 3 persons during one shift and of operating for an extra shift, which was necessary anyway.

4. Conclusions for run #2. This second run allowed the hypothetical plant manager to "experiment" based on ideas developed from the results of run #1. Both changes made in the second simulation run appeared to be advantageous, giving the manager the necessary elements to calculate the financial results. However, the veneer assortment problem had not been completely solved. New ideas were suggested by the results, but the next run would help to see how applicable they were in improving the plant performance.

The two runs of the model showed how the simulation model could be used: it had really been used as a decision-helping tool. The improvements made from run #1 and #2 had been chosen in such a way that the gluespreader activity would not be altered, hence making the differences between the two outcomes obvious.

IX. LIMITATIONS OF THE PRESENT MODEL AND OUTLOOK

A. Randomness

There is no randomness in this model. In the real world, the fact that machines are handled by men will generate randomness in any system. Moreover, the veneer quality and characteristics are extremely variable. As a result, machines do not have constant productions over time as it appears in this model.

Averages are accurate enough as long as time factors are not essential. As queuing situations are considered, the lack of randomness introduces a systematic bias in the results. A good example is the gluing and pressing operations. When the lay-up of a stack of 3/8" takes 7.28 minutes and its press time is 6.75 minutes, a queue will never form between the gluespreader and the press. In the real world, there are variations in both these times and queues do occur. As a consequence, the 10-openings press is used.

There are two basic reasons why randomness has not been included in this model. For the first modeling approach the accuracy did not seem to be as important as other factors. Also, not all the production data that was available from the plywood plant was incorporated in the model. A full knowledge of the probability distribution of functions which determine the time events or the production flows of the system would have been extremely time costly to gather.

B. Missing elements

The most important missing element is the handling system. As long as all machines show limited input and output and storage capacities, the effectiveness with which they are loaded and unloaded is essential. In this case, too, a very important time study must be performed in order to include the randomness of the forklift availability into the model.

Veneer delivery and purchases have been simplified in the simulation. Limits to the variations of the green veneer inventory have not been considered either. In actuality, there were practical limitations to green or dry veneer availability. Also, the actual availability of labor has not been taken into account. In this model, production centers were stopped when material was not available. The problem of how workers could be best used was not solved. Neither have cost calculations been included, though it would be quite feasible to include estimates of manufacturing costs in such a simulation in the future. However, this would require that the other missing features be included first.

C. Limitations to the use of the model

The model is not universal. It cannot be used in a different mill without modifications. Differences between existing plants and manufacturing practices do not allow the building of a "general purpose" model within reasonable size limits. However, the conception of a different model should be much faster and easier, if this example is known and understood.

Running the program requires an access to at least a middle size computer as discussed in Chapter X. The increasing use of modems for remote access to computational facilities should allow any company, however, to employ this sort of model.

This simulation is not an arcade game. It is not interactive and it is doubtful that it could thoroughly be made that way. Even simple changes in numerical variables would require modification of the datafile. Most changes require actual program modifications and users must be trained, which seems to be a major limitation to the method. In a given corporation, who will be in charge of the system?

The same problem has been experienced and solved with linear programming in most major companies. However, when it comes to simulation, the problem is somewhat different. Production standards and average yields must be known accurately and the processing steps carefully considered.

In this model, the rules governing the process are specific to the particular plant and need to be familiar to those in charge of production. This would be difficult since production managers would not likely know all the different programs that are necessary for each production. As no real decision-helping methods exist at the level of plant production management, these policies are the personal working tool of plant superintendents or managers and have been built by trial-and-error experience. This model may help them to better know the future implications of their decisions.

D. Future developments

1. Widening product mixes. To make this model useful to the plant manager, the product mix, veneer types and panel constructions should be expanded as much as possible. This would require significant programming efforts. However, the main problems would be encountered with panel codes and necessary policy changes. In this model, panel codes 1, 2, and 3 must be sheathing panels with "heavy cores", panel codes 4 and 6 must be sanded panels with 1/10" cores, panel code 5 must be PTS graded with 1/10" cores, and panel codes 7 and 8 must be sheathing panels with 1/10" cores (code 8 is the "overflow" item). All these limitations come from the rules "sanded grade panels first" and the "equal heavy cores numbers for all bushelers" at the gluespreader, as panel codes are scanned by a counter.

Such programming is not difficult but is time consuming since it would mainly consist of expanding the size of arrays.

2. Implementing different production rules and flows. The operating rules and policies should be refined and expanded. Depending upon the degree of refinement achieved, the difficulty of the remodeling would be low to medium. However, it would require a

fair amount of time. These changes would be very beneficial because it would make the model more realistic.

3. <u>Gathering other information</u>. Other possibilities of enhancements might include the use of labor in the model and the handling and forklifts operation. These additions would certainly be costly in programming time and level but would provide more information to the user.

The benefits of computer modeling of material handling are hard to evaluate. Other enhancements such as reducing the size of the black boxes, introducing randomness or adding cost figures would require heavy programming efforts and yield uncertain benefits.

All these improvements are best utilized because GASP IV provides the user with excellent printout information containing up to ten plots of up to ten variables each, and up to 25 histograms. All variables can be printed in table form. This extended capability allows the user to study any time dependent variable. For example, panel stock, good panel production, or any computed variable such as total volume (in MSF) of various veneer or panel stocks can be monitored over time.

Any computation can be programmed in any subroutine, and the results can be printed according to the user's wishes. They can be displayed through the use of subroutine OTPUT like the results of the present runs, or over time through the use of formatted WRITE statements within subroutines. This last way of displaying results has been used to record the emergency dry veneer deliveries.

X - TECHNICAL CHARACTERISTICS OF THE MODEL

The user-defined program and associated subroutines include over 1700 lines of Fortran IV program statements.

On the Oregon State University CDC CYBER 170 model 720 computer, the approximate CPU times required to compile and execute the program are the following (for 1 week compilation) :

Compilation	:	13 seconds
Execution	:	190 seconds

The length of a week run output is 446 PRUs or over 285,000 characters.

The total approximate costs associated with a one-week run are the following : (prime rate - Summer 1982)

Compilation	:	$ 1.45
Execution	:	21,28
Printing	:	3,37
Total	:	$ 26,10

This total does not include data transfer and disk file storage expenses.

The total memory space required is 76300 octal Cyber words (60 bits/word).

XI - CONCLUSION

The conclusions of this study are:

1 - It was demonstrated for the first time that the GASP IV simulation language can be used for modeling of the plywood manufacturing process. The contribution of this work lies in the adaptation of a simulation approach, not in the remodeling of a specific plant.

2. This first attempt to simulate the plywood manufacturing process on the computer should be useful to other operations researchers for further improvements and refinements to fit more accurately to real world conditions. It demonstrates how a simulation language like GASP IV can provide knowledge of potential variations of manufacturing parameters. The model, however, is incomplete. Plant managers may not be able to use it in this form.

3 - The simplified user-defined model of a plywood plant, starting at the dryer and ending with the sanding operation, yields results that reflect the state of the production system during the entire simulation period.

4 - The two computer runs made demonstrated how this technique can provide valuable decision elements for a given production objective and defined manufacturing practices. The decision elements can be tested and evaluated in future runs of the program.

5 - Development and modification of the simulation program requires well trained users. "What if" investigations can be performed

without major changes to the program in the case of variations in the weekly product mix within the eight considered products, in the panel construction options using the considered veneers, or in the dry veneer purchases. The activities of the production centers can be investigated through small changes in the program when changes in their schedules, their output rates, their output grade-distributions or their priority of orders are desired. Other modifications like changes in the process layout or in the modeled definitions of veneers or panels would require additional programming efforts.

6 - The cost of software development is rather high, comparable with other operations research methods used in the industry. However, individual computer runs appear inexpensive.

XII. BIBLIOGRAPHY

1. Ashour, S. and Vasvani, S.D. 1972. A GASP simulation study of a job shop scheduling. Simulation 18(1):1-10.

2. Baldwin, R.F. 1981. Plywood manufacturing practices. Revised 2nd edition. Miller Freeman Publications. San Francisco, California.

3. Bradley, D.P. and Winsauer, J. 1978. Simulated full tree chipping: Model compares to the real world. Forest Prod J. 28(10):85-88.

4. Bryan, E.L. 1974. Computerized planning for maximum profit. Modern Plywood Techniques, Volume 1. Miller Freeman Publications. San Francisco, California.

5. Bryan, E.L. and Lang, J.R. 1974. Computerized planning for maximum profit. Modern Sawmill Techniques, Volume 3. Miller Freeman Publications. San Francisco, California.

6. Carino, H.F. and Bowyer, J.L. 1979. New tool for solving materials flow problems: A computer based model for maximizing outputat minimum cost. Forest Prod. J. 29(10)84-90.

7. Clapham, J.C. and Lambe, T.A. 1961. An operations research approach to lumber sorting. Forest Prod. J. 11(4):181-184.

8. Dunning, K.A. 1981. Getting started in GPSS. Engineering Press. San Jose, California.

9. Fishman, G.S. 1973. Concepts and methods in discrete event digital simulation. John Wiley and Sons. New York.

10. Gordon, G. 1978. System simulation. Second edition. Prentice Hall. Englewood Cliffs, New Jersey.

11. Goulet, G.V. Iff, R.H., and Sirois, D.L. 1979. Tree-to-mill forest harvesting simulation models: Where are we? Forest Prod. J. 29(10):50-55.

12. Hiller, F.S. and Lieberman, G.J. 1980. Introduction to Operations Research. 3rd Edition. Holden Day. San Francisco, California.

13. Hurst, N.R. and Pritsker, A.A.B. 1973. Simulation of a chemical reaction process using GASP IV. Simulation 21(3):71-75.

14. Huss, W.R. and Cooper, R.E. 1981. Simulation of gasoline queuing. Simulation 36(5):203-213.

15. Johnson, L.R. 1976. Saplos: Documentation and use. College of Forestry, University of Idaho. Moscow, Idaho.

16. Koenigsberg, E. 1960. Applying linear programming to the plywood industry. Forest Prod. J. 10(9):481-486.

17. Kuzdrall, N.K., Kwak, N.K., and Schmitz, H.H. 1981. Simulating space requirements and scheduling policies in a hospital surgical suite. Simulation 36(5):163-171.

18. Law, A.M. and Kelton, W.D. 1982. Simulation modeling and analysis. McGraw Hill, New York.

19. Levi, A. and deLuca Cardillo, D. 1977. Simulation of a rotating track production line. Simulation 31(5):212-217.

20. Lewis, D. and Hallock, H. 1974. Best opening face programme. Australian Forest Industries Journal.

21. Lindholm, H.R. 1979. Linear programming: Fast way to classify production variables. Forest Industries 106(11):54-55.

22. Mater, M.H. 1967. PERT: A new technique for reducing sawmill modernization costs. Forest Industries 94(7):36-39.

23. Pneumaticos, S.M. and Mann, S.H. 1972. Dynamic programming in tree bucking. Forest Prod. J. 22(2):26-30.

24. Pritsker, A.A.B. 1974. The GASP IV simulation language. John Wiley and Sons, New York. 6th printing.

25. Pritsker, A.A.B. 1979. Compilation of definitions of simulation. Simulation 33(2):61-63.

26. Ragazzini, J. and Tapiero, C.S. 1972. Optimum shuttle scheduling: A GPSS simulation. Simulation 27(3):97-104.

27. Ramsing, K.D. 1968. Linear programming for the plywood mix problem. Forest Prod. J. 18(4):89-101.

28. Resch, H. and Scheurman, H.L. 1977. Computer simulation of the softwood veneer drying operation. Forest Prod. J. 27(2):32-36.

29. Sims, M.K. 1981. Designing a production line for Howitzer projectiles. Simulation 36(4):119-124.

30. Suhr, D.S. and Talavage, J.J. 1977. A GASP IV model of steel ingot processing. Simulation 28(3):49-55.

31. Webster, D.B. 1975. Development of a flexible timber harvesting simulation model. Forest Prod. J. 25(1):40-45.

32. Wellwood, E.W. 1971. Scheduling and control of a Douglas-fir plywood plant aided by linear programming. Forest Prod. J. 21(11):42-50.

33. Yaptenco, R.C. and Wylie, A.E. 1970. A quantitative approach to plywood production scheduling. Forest Prod. J. 20(3):54-59.

N.B. Simulation is published by Simulation Councils Inc., La Jolla, California.

APPENDICES

DRYER

The production figures DRNITE and DRDAY(1) to DRDAY(4) were computed with the following hypothesis:

- Heartwood is 30% of the total veneer surface, and sapwood 70%.
- Redry is 10% for 1/10" 54" veneers, 8% for all others.
- Losses from dry to good veneers (occuring at the gluespreader but computed when veneers are input to the dry veneers stock in order to make the program easier) are:

  6% for 1/10" veneers and 6.7% for 1/6" veneers.

Basic standards used at the plant are the following (SF (3/8")) per minute:

	54 1/10"	27 1/10"	Strips 1/10"	54" 1/6"	27" 1/6"	Strips 1/6"
Heart	177.5	132	119	113	107	152
Sap	132	125	118	85	56	80
Redry	195	132	126.5	113	107	152

Sample calculation of DRNITE shown as an example:

Considering 100 SF of GOOD DRY veneers:

They are generated from 100/.94 = 106.4 SF of dry veneers which include 74.5 SF of sapwood, 31.9 SF of heartwood, and 10.6 SF that had to be redried.

The time which necessary to process them was:

74.5/132 + 31.9/177.5 + 10.6/195 = .79847 minutes.

On the other hand, 100 SF (38") equals:

100/(4 * 8) * 3/8 * 10/1 = 11.7187 equivalent veneers.

Thus,

DRDAY = 60 * 11.7187 / .79847 = 880.6 equivalent veneers dried per hour. With the same method:

DRDAY(1) = 727.3,DRDAY(2) = 779.5,DRDAY(3) = 753.4,DRDAY(4) = 349.7

GLUESPREADER

Basic data: Average production: 13000 SF coreline 1/6" per hour

15000 SF coreline 1/10" per hour

25 openings press

Panel code	Thickness	Panels per stack	Plies	Time (min)	Panels per stack	Plies	Time (min)
1	3/8 CD	50	50	7.28	20	20	2.91
2	5/8 CD	25	50	7.28	10	20	2.91
3	3/4 CD	25	50	7.28	10	20	2.91
4	5/16 AC	50	50	6.41	20	20	2.56
5	15/32PTS	25	50	6.41	20	40	5.13
6	9/16 AC	25	50	6.41	10	20	2.56
7	5/16 CD	50	50	6.41	20	20	2.56
8	1/2 CD	25	50	6.41	20	40	5.13

Note: Panel codes 5 and 8 require two cycles per stack on the 10 op. press.

HOT PRESSES

Basic data: Nominal press cycles suggested by Monsanto, Inc.

Panel codes	1	2	3	4	5	6	7	8
Panels per stack/25 op.	50	25	25	50	25	25	50	25
Panels per open/25 op.	2	1	1	2	1	1	2	1
Panel per stack/10 op.	20	10	10	20	20	10	20	20
Panels per open/10 op.	2	1	1	2	1	1	2	1
Nominal press time/Monsanto PF3098 300 F	5.5	5.0	6.25	4.25	4.25	4.75	4.25	4.25
Total press cycle/25 op. per stack	6.75	6.35	7.70	5.60	5.60	6.10	5.60	5.60
Total press cycle/10 op. per stack	7.35	6.85	8.10	6.10	12.20	6.60	6.10	12.20

Note: Included in these times are:

- A regular .25 to .5 minute "plant security time" added to Monsanto official figures.
- A constant loading/unloading time of 1.0 minutes for the 20 openings press and 1.5 minutes for the 10 openings.

A - GASP DATAFILE

```
GEN,ULRICH,1,7,1,82,1,,,N*
STA,3,9,3,4*
LIM,0,0,500,5,12,3500*
COL,1,OPAT,2,TOAT,3,HOTST*
TIM,1,BUSPLG,0.0,2,BUSJNT,0.0,3,BUSPPR,0.0*
TIM,4,BUS25,0.0,5,BUS10,0.0,6,BUSPAT,0.0*
TIM,7,BUSSAW,0.0,8,BUSSND,0.0,9,BUSTSN,0.0*
HIS,1,OPAT,10,5.0,5.0*
HIS,2,TOAT,15,10.0,5.0*
HIS,3,HOTST,20,120.,60.*
PLO,1,TIME,1,6,0,30.*
VAR,1,1,1,A54,1,1,0.,12000.*
VAR,1,2,2,B54,1,1,0.,12000.*
VAR,1,3,3,C54,1,1,0.,24000.*
VAR,1,4,4,D54,1,1,0.,24000.*
VAR,1,5,5,CN54,1,1,0.,24000.*
VAR,1,6,6,BP54,1,1,0.,12000.*
PLO,2,TIME,2,7,0,30.*
VAR,2,1,1,C27,1,1,0.,12000.*
VAR,2,2,2,D27,1,1,0.,12000.*
VAR,2,3,3,CENT27,1,1,0.,12000.*
VAR,2,4,4,CORD27,1,1,0.,12000.*
VAR,2,5,5,BP27,1,1,0.,12000.*
VAR,2,6,6,CORCST,1,1,0.,30000.*
VAR,2,7,7,CORDST,1,1,0.,30000.*
PLO,3,TIME,3,5,0,30.*
VAR,3,1,1,C1/6,1,1,0.,12000.*
VAR,3,2,2,D1/6,1,1,0.,12000.*
VAR,3,3,3,CNT1/6,1,1,0.,12000.*
VAR,3,4,4,CORC1/6,1,1,0.,20000.*
VAR,3,5,5,CORD1/6,1,1,0.,20000.*
PLO,4,TIME,4,8,0,30.*
VAR,4,1,1,3/8CD,1,1,0.0,2350.*
VAR,4,2,2,5/8CD,1,1,0.,4200.*
VAR,4,3,3,3/4CD,1,1,0.,6000.*
VAR,4,4,4,5/16AC,1,1,0.,3550.*
VAR,4,5,5,15/32CC,1,1,0.,3150.*
VAR,4,6,6,9/16AC,1,1,0.,6200.*
VAR,4,7,7,5/16CD,1,1,0.,1150.*
VAR,4,8,8,1/2CD,1,1,0.,20000.*
PLO,5,TIME,8,9,0,30.*
VAR,5,1,1,PLUG,1,1,0.,10.*
VAR,5,2,2,JOINT,1,1,0.,9.*
VAR,5,3,3,PPRESS,1,1,0.,8.*
VAR,5,4,4,25HPR,1,1,0.,7.*
VAR,5,5,5,10HPR,1,1,0.,6.*
VAR,5,6,6,PATCH,1,1,0.,5.*
VAR,5,7,7,SAW,1,1,0.,4.*
VAR,5,8,8,SANDER,1,1,0.,3.*
VAR,5,9,9,TSNDER,1,1,0.,2.*
INI,1,Y,Y,0.0,9600.,Y*
FIN*
```

Numerical datafile

```
.65  .20  .13  .02  .163 .543
.163 .109 .022 .167 .667 .166
727.3 779.5 753.4 349.7 880.6 1.0
.65  .35  .50  .35  .15
 500040000    8 9999
306.  300.  3.    0.    8820.
.25  .45  .25  .03  .02
30850.  13250.  0.      0.      0.      0.
7.28 7.28 7.28 6.41 6.41 6.41 6.41 6.41
2.91 2.91 2.91 2.56 5.13 2.56 2.56 5.13
  2350  4200     0  3550  3150  6200  1150 20000
6.75 6.35 7.70 5.60 5.60 6.10 5.60 5.60
7.35 6.85 8.10 6.10 12.2 6.60 6.10 12.2
 50 25 25 50 25 25 50 25
 20 10 10 20 20 10 20 20
120. 188. 360. 313.
.93 .03 .03
.20 .35 .40 .03 .02
  83  53  44 132  66  66 105  66
.90 .03
  3123  4905   500
```

```
1 1 1
1 1 1
1 2 1 1
1 2 1 1
1 2 1 1
1 2 1 1
1 1 1
1 1 1
2 2 1
```

```
1 2 1 1
1 2 1 1
1 2 1 1
1 1 1
1 1 1
1 2 1 1
1 2 1 1
  2344  2344  1172  1172 21093     0     0  6445
     0     0     0     0     0     0     0  6445
  5859 23437
     0     0     0     0  7031     0     0     0
     0  7031
    21     0     0    25    34     0     0     0
     0     0     0     0     0  2083     0     0
     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0
     0     0     0     0     0     0     0     0
```

B - PROGRAM LISTING - RUN # 1

```
      PROGRAM PLYSIM(INPUT,OUTPUT,TAPE7,TAPE1,TAPE2,TAPE3,TAPE4,
     1TAPE8,TAPE5=INPUT,TAPE6=OUTPUT)
C
      DIMENSION NSET(3500)
      COMMON QSET(3500)
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(3),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      EQUIVALENCE(NSET(1),QSET(1))
      NCRDR=5
      NPRNT=6
      READ(5,100)CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA
      READ(5,100)DHLFA,CNHLFA,COHLFA,BPFULA,CFULA,DFULA
      READ(5,110)DRDAY(1),DRDAY(2),DRDAY(3),DRDAY(4),DRNITE,PCTGR6
      READ(5,120)COREC,CORED,DRYC,DRYD,DRYCN
      READ(5,130)ISTOJN,ISTOCO,NPROD,IBPATC
      READ(5,140)PLUGG,AJOINT,PPTIM,AMANUT,DRYCOR
      READ(5,120)PLUGA,PLUGB,PLUGC,PLUGD,PLUGU
      READ(5,150)DRY(1),DRY(2),DRY(3),DRY(4),DRY(5),DRY(6)
      READ(5,160)GLSPT(1,1),GLSPT(2,1),GLSPT(3,1),GLSPT(4,1),
     1GLSPT(5,1),GLSPT(6,1),GLSPT(7,1),GLSPT(8,1)
      READ(5,160)GLSPT(1,2),GLSPT(2,2),GLSPT(3,2),GLSPT(4,2),
     1GLSPT(5,2),GLSPT(6,2),GLSPT(7,2),GLSPT(8,2)
      READ(5,170)IPROD(1),IPROD(2),IPROD(3),IPROD(4),IPROD(5),
     1IPROD(6),IPROD(7),IPROD(8)
      READ(5,160)PRESS(1,1),PRESS(2,1),PRESS(3,1),PRESS(4,1),
     1PRESS(5,1),PRESS(6,1),PRESS(7,1),PRESS(8,1)
      READ(5,160)PRESS(1,2),PRESS(2,2),PRESS(3,2),PRESS(4,2),
     1PRESS(5,2),PRESS(6,2),PRESS(7,2),PRESS(8,2)
      READ(5,180)IPANEL(1,1),IPANEL(2,1),IPANEL(3,1),IPANEL(4,1),
     1IPANEL(5,1),IPANEL(6,1),IPANEL(7,1),IPANEL(8,1)
      READ(5,180)IPANEL(1,2),IPANEL(2,2),IPANEL(3,2),IPANEL(4,2),
     1IPANEL(5,2),IPANEL(6,2),IPANEL(7,2),IPANEL(8,2)
      READ(5,190)HOTCUR,PATCH,SAWSPD,SAND
      READ(5,200)GOOD,CERT,SHOP
      READ(5,210)SREPA,SOKP,SRSND,SDOWN,SSHOP
      READ(5,220)LOAD(1),LOAD(2),LOAD(3),LOAD(4),LOAD(5),
     1LOAD(6),LOAD(7),LOAD(8)
      READ(5,230)TSGOOD,TSSHOP
      READ(5,240) ISCL6,ISCL10,IREORD
C
      CALL GASP
```

```
  100 FORMAT(6F5.3)
  110 FORMAT(6F6.1)
  120 FORMAT(5F5.3)
  130 FORMAT(4I5)
  140 FORMAT(5F6.1)
  150 FORMAT(6F8.1)
  160 FORMAT(8F5.2)
  170 FORMAT(8I6)
  180 FORMAT(8I3)
  190 FORMAT(4F5.1)
  200 FORMAT(3F4.2)
  210 FORMAT(5F4.2)


  220 FORMAT(8I4)
  230 FORMAT(2F4.2)
  240 FORMAT(3I6)
C
      STOP
      END
```

```
      SUBROUTINE INTLC
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNAIR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      DO 12 I=1,8
      DO 11 J=1,67
      DO 10 K=1,2
      IVENR(I,J,K)=0
   10 CONTINUE
   11 CONTINUE
   12 CONTINUE
C
      DO 20 I=1,NPROD
      IGLUED(I)=0
      IPR(I)=0
      ISTACK(I)=0
      ISTAKI(I)=0
      NNPLY=0
      AGOOD(I)=0.
      ACERT(I)=0.
      ASHOP(I)=0.
      ADELAM(I)=0.
      IGOODL(I)=0
      IMCL(I)=0
      ISHOPL(I)=0
      IDELL(I)=0
      ISTOPP(I)=0
   20 CONTINUE
C
      ICOR6=IPROD(1)+(IPROD(2)+IPROD(3))*2
      ICENT6=IPROD(6)+IPROD(3)
      IFACE6=IPROD(3)
      DO 40 I=1,67
      ISTOCK(I)=0
      ISTOKI(I)=0
      IPURCH(I)=0
      IDRY(I)=0
   40 CONTINUE
C
      DO 50 I=1,9
      IBUS(I)=0
   50 CONTINUE
C
      ATRIB(1)=30.
      ATRIB(2)=1.
      CALL FILEM(1)
```

```
      READ(5,200)IVENR(1,13,1),IVENR(1,67,1),IVENR(1,24,1)
      READ(5,200)IVENR(1,13,2),IVENR(1,66,2),IVENR(1,14,2)
      READ(5,210)IVENR(2,13,1),IVENR(2,67,1),IVENR(2,25,1),
     1IVENR(2,23,1)
      READ(5,210)IVENR(2,13,2),IVENR(2,67,2),IVENR(2,15,2),
     1IVENR(2,14,2)
      READ(5,210)IVENR(3,13,1),IVENR(3,67,1),IVENR(3,45,1),
     1IVENR(3,44,1)
      READ(5,210)IVENR(3,14,2),IVENR(3,66,2),IVENR(3,45,2),
     1IVENR(3,43,2)
      READ(5,200)IVENR(4,11,1),IVENR(4,36,1),IVENR(4,13,1)
      READ(5,200)IVENR(4,12,2),IVENR(4,36,2),IVENR(4,13,2)
      READ(5,200)IVENR(5,13,1),IVENR(5,36,1),IVENR(5,15,1)
      READ(5,210)IVENR(5,13,2),IVENR(5,36,2),IVENR(5,15,2),
     1IVENR(5,23,2)
      READ(5,210)IVENR(6,13,1),IVENR(6,36,1),IVENR(6,45,1),
     1IVENR(6,11,1)
      READ(5,210)IVENR(6,13,2),IVENR(6,36,2),IVENR(6,45,2),
     1IVENR(6,12,2)
      READ(5,200)IVENR(7,13,1),IVENR(7,27,1),IVENR(7,28,1)
      READ(5,200)IVENR(7,13,2),IVENR(7,37,2),IVENR(7,24,2)
      READ(5,210)IVENR(8,13,1),IVENR(8,37,1),IVENR(8,25,1),
     1IVENR(8,23,1)
      READ(5,210)IVENR(8,13,2),IVENR(8,37,2),IVENR(8,15,2),
     1IVENR(8,14,2)
C
      READ(5,240) (ISTOKI(I),I=11,18)
      READ(5,240) (ISTOKI(I),I=21,28)
      READ(5,250)ISTOKI(36),ISTOKI(37)
      READ(5,240) (ISTOKI(I),I=41,48)
      READ(5,250)ISTOKI(66),ISTOKI(67)
C
      DO 100 I=1,67
      ISTOCK(I)=ISTOKI(I)
  100 CONTINUE
C
      ATRIB(1)=480.
      ATRIB(2)=2.
      CALL FILEM(1)
C
      ATRIB(1)=480.
      ATRIB(2)=3.
      CALL FILEM(1)
C
      ATRIB(1)=0.
      ATRIB(2)=4.
      CALL FILEM(1)
C
      ATRIB(1)=0.
      ATRIB(2)=6.
      ATRIB(3)=4.
      CALL FILEM(1)
      IFLAG=1
C
      READ(5,240) (INHSTK(I),I=1,NPROD)
      DO 140 I=1,NPROD
  130 IF(INHSTK(I).EQ.0) GOTO 140
      INHSTK(I)=INHSTK(I)-1
      ISTACK(I)=ISTACK(I)+IPANEL(I,1)
      ISTAKI(I)=ISTACK(I)
      ATRIB(3)=FLOAT(I)
      ATRIB(4)=1.
      ATRIB(5)=-200.
      CALL FILEM(I+3)
      GOTO 130
  140 CONTINUE
```

```
      READ(5,240) (ISTOPP(I),I=1,NPROD)
      READ(5,240) (ISTOTS(I),I=1,NPROD)
      READ(5,240) (ISTOPA(I),I=1,NPROD)
      READ(5,240) (ISTORP(I),I=1,NPROD)
      READ(5,240) (ISTSAW(I),I=1,NPROD)
C
      DO 150 I=1,NPROD
      ANSAND(I)=FLOAT(ISTOPP(I))
      ATSAND(I)=FLOAT(ISTOTS(I))
      ANPAT(I)=FLOAT(ISTOPA(I))
      ANREPA(I)=FLOAT(ISTORP(I))
      ANSAW(I)=FLOAT(ISTSAW(I))
  150 CONTINUE
C
      ATRIB(5)=0.
      ATRIB(1)=480.
      ATRIB(2)=10.
      CALL FILEM(1)
C
      ATRIB(1)=480.
      ATRIB(2)=12.
      CALL FILEM(1)
C
      ATRIB(1)=480.
      ATRIB(2)=14.
      ATRIB(3)=6.
      ATRIB(5)=1.


      CALL FILEM(1)
C
  200 FORMAT(3I2)
  210 FORMAT(4I2)
  240 FORMAT(8I6)
  250 FORMAT(2I6)
C
      RETURN
      END
```

```
      SUBROUTINE EVNTS(IX)
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      GOTO(101,102,103,104,105,106,107,108,109,110,111,112,113,114,
     1115),IX
C
  101 CALL DRYER
      GOTO 200
C
  102 CALL INVNT
      GOTO 200
C
  103 CALL PLUG
      GOTO 200
C
  104 CALL ENTJNT
      GOTO 200
C
  105 CALL LEAJNT
      GOTO 200
C
  106 CALL ENTGLS
      GOTO 200
C
  107 CALL LEAGLS
      GOTO 200
C
  108 CALL LEAPPR
      GOTO 200
C
  109 CALL LEAHPR
      GOTO 200
C
  110 CALL ENTPAT
      GOTO 200
C
  111 CALL LEAPAT
      GOTO 200
C
  112 CALL ENTSAW
      GOTO 200
C
  113 CALL LEASAW
      GOTO 200
C
  114 CALL ENTSND
      GOTO 200
C
  115 CALL LEASND
C
  200 CALL RECRD
      CALL VENPUR
      RETURN
      END
```

```
      SUBROUTINE RECRD
C
      DIMENSION PLOT(9)
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHFLB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,


     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      DO 10 I=11,15
      PLOT(I-10)=FLOAT(ISTOCK(I))
   10 CONTINUE
      PLOT(6)=FLOAT(ISTOCK(18))
      CALL GPLOT(PLOT,TNOW,1)
C
      PLOT(1)=FLOAT(ISTOCK(23))
      PLOT(2)=FLOAT(ISTOCK(24))
      PLOT(3)=FLOAT(ISTOCK(25))
      PLOT(4)=FLOAT(ISTOCK(27))
      PLOT(5)=FLOAT(ISTOCK(28))
      PLOT(6)=FLOAT(ISTOCK(36))
      PLOT(7)=FLOAT(ISTOCK(37))
      CALL GPLOT(PLOT,TNOW,2)
C
      PLOT(1)=FLOAT(ISTOCK(43))
      PLOT(2)=FLOAT(ISTOCK(44))
      PLOT(3)=FLOAT(ISTOCK(45))
      PLOT(4)=FLOAT(ISTOCK(66))
      PLOT(5)=FLOAT(ISTOCK(67))
      CALL GPLOT(PLOT,TNOW,3)
C
      DO 20 I=1,8
      PLOT(I)=FLOAT(IGLUED(I))
   20 CONTINUE
      CALL GPLOT(PLOT,TNOW,4)
C
      DO 30 I=1,9
      PLOT(I)=FLOAT(IBUS(I))
   30 CONTINUE
      CALL GPLOT(PLOT,TNOW,5)
C
      RETURN
      END
```

```
      SUBROUTINE SHIFT
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      A1=(TIME-480.)/1440.
      IF(A1.LT.0.0) A1=-1.
      IDAY=INT(A1)+1
      IF(IDAY.EQ.0) GOTO 5
      AMODUL=TIME-430.-FLOAT(IDAY-1)*1440.
    1 IF(AMODUL.LT.480.) GOTO 10
      IF(AMODUL.LT.960.) GOTO 20
      IF(IDAY.EQ.1.OR.IDAY.EQ.2) GOTO 30
      ISHIFT=4
      GOTO 50
C
    5 AMODUL=TIME+960.
      GOTO 1
   10 IF(IDAY.LE.5) GOTO 40
   15 ISHIFT=3
      GOTO 50
C
   20 IF(IDAY.GE.4) GOTO 30
      GOTO 15
C
   30 ISHIFT=2
      GOTO 50
C
   40 ISHIFT=1
C
   50 RETURN
      END
```

```
      SUBROUTINE VENPUR
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSFLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSFPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      DO 10 I=13,15
      IF(ISTOCK(I).LE.IREORD) GOTO 200
   10 CONTINUE
      DO 20 I=36,37
      IF(ISTOCK(I).LE.IREORD) GOTO 200
   20 CONTINUE
      I=45
      IF(ISTOCK(I).LE.IREORD) GOTO 300
      I=67
      IF(ISTOCK(I).LE.IREORD) GOTO 300
      GOTO 600
C
  200 IPURCH(I)=IPURCH(I)+ISCL10-ISTOCK(I)
      I1=ISCL10-ISTOCK(I)
      I2=I
      ISTOCK(I)=ISCL10
      GOTO 400
C
  300 IPURCH(I)=IPURCH(I)+ISCL6-ISTOCK(I)
      I1=ISCL6-ISTOCK(I)
      I2=I
      ISTOCK(I)=ISCL6
C
  400 WRITE(6,500) I1,I2,TNOW
C
  500 FORMAT(1H ,T2,"PURCHASED",T15,I5,T25,"GOOD DRY VENEERS - CODE",
     1T49,I2,T54,"AT TIME",T62,F6.1,//)
C
  600 RETURN
      END
```

```
      SUBROUTINE DRYER
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPK,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPAIC,NNCOR6
C
      TIME=TNOW-1.
      CALL SHIFT
      IF(ISHIFT.EQ.3.OR.ISHIFT.EQ.4) GOTO 40
      IF(ISHIFT.EQ.1) GOTO 50
C
   10 IF(ISTOCK(36)+ISTOCK(37).LT.ISTOCO)GOTO 30
      IF(ISTOCK(28)+ISTOCK(25).LT.ISTOJN) GOTO 20
      A1=DRDAY(3)/4.
      B1=A1*COREC
      B2=A1*BPHLFA
      B3=A1*DHLFA
      B4=A1*CNHLFA
      B5=A1*COHLFA
      ISTOCK(36)=ISTOCK(36)+INT(B1)
      ISTOCK(37)=ISTOCK(37)+INT(A1)-INT(B1)
      ISTOCK(28)=ISTOCK(28)+INT(B2)
      ISTOCK(23)=ISTOCK(23)+INT(A1)-INT(B2)-INT(B3)-INT(B4)-INT(B5)
      ISTOCK(24)=ISTOCK(24)+INT(B3)
      ISTOCK(25)=ISTOCK(25)+INT(B4)
      ISTOCK(27)=ISTOCK(27)+INT(B5)
      IDRY(36)=IDRY(36)+INT(B1)
      IDRY(37)=IDRY(37)+INT(A1)-INT(B1)
      IDRY(28)=IDRY(28)+INT(B2)
      IDRY(23)=IDRY(23)+INT(A1)-INT(B2)-INT(B3)-INT(B4)-INT(B5)
      IDRY(24)=IDRY(24)+INT(B3)
      IDRY(25)=IDRY(25)+INT(B4)
      IDRY(27)=IDRY(27)+INT(B5)
      GOTO 60
```

```
   20 A1=DRDAY(2)/2.
      B1=A1*BPHLFA
      B2=A1*DHLFA
      B3=A1*CNHLFA
      B4=A1*COHLFA
      ISTOCK(28)=ISTOCK(28)+INT(B1)
      ISTOCK(23)=ISTOCK(23)+INT(A1)-INT(B1)-INT(B2)-INT(B3)-INT(B4)
      ISTOCK(24)=ISTOCK(24)+INT(B2)
      ISTOCK(25)=ISTOCK(25)+INT(B3)
      ISTOCK(27)=ISTOCK(27)+INT(B4)
      IDRY(28)=IDRY(28)+INT(B1)
      IDRY(23)=IDRY(23)+INT(A1)-INT(B1)-INT(B2)-INT(B3)-INT(B4)
      IDRY(24)=IDRY(24)+INT(B2)
      IDRY(25)=IDRY(25)+INT(B3)
      IDRY(27)=IDRY(27)+INT(B4)
      GOTO 60
C
   30 A1=DRDAY(1)/2.
      B1=A1*CORED
      ISTOCK(36)=ISTOCK(36)+INT(A1)-INT(B1)
      ISTOCK(37)=ISTOCK(37)+INT(B1)
      IDRY(36)=IDRY(36)+INT(A1)-INT(B1)
      IDRY(37)=IDRY(37)+INT(B1)
      GOTO 60
C
   40 A1=DRNITE/2.
      B1=A1*BPFULA
      B2=A1*DFULA
      ISTOCK(18)=ISTOCK(18)+INT(B1)
      ISTOCK(13)=ISTOCK(13)+INT(A1)-INT(B1)-INT(B2)
      ISTOCK(14)=ISTOCK(14)+INT(B2)
      IDRY(18)=IDRY(18)+INT(B1)
      IDRY(13)=IDRY(13)+INT(A1)-INT(B1)-INT(B2)
      IDRY(14)=IDRY(14)+INT(B2)
      GOTO 60
C
   50 A1=FLOAT(ICENT6+IFACE6+ICOR6)*PCTGR6/5.
      A2=A1/DRDAY(4)*60.
      IF(AMOLUL.GE.A2) GOTO 10
      A1=DRDAY(4)/4.
      B1=A1*CORED
      B2=A1*DHLFB
      B3=A1*CNHLFB
      B4=A1*COHLFB
      ISTOCK(66)=ISTOCK(66)+INT(A1)-INT(B1)
      ISTOCK(67)=ISTOCK(67)+INT(B1)
      ISTOCK(43)=ISTOCK(43)+INT(A1)-INT(B2)-INT(B3)-INT(B4)
      ISTOCK(44)=ISTOCK(44)+INT(B2)
      ISTOCK(45)=ISTOCK(45)+INT(B3)
      ISTOCK(67)=ISTOCK(67)+INT(B4)
      IDRY(66)=IDRY(66)+INT(A1)-INT(B1)
      IDRY(67)=IDRY(67)+INT(B1)
      IDRY(43)=IDRY(43)+INT(A1)-INT(B2)-INT(B3)-INT(B4)
      IDRY(44)=IDRY(44)+INT(B2)
      IDRY(45)=IDRY(45)+INT(B3)
      IDRY(67)=IDRY(67)+INT(B4)
C
   60 ATRIB(1)=TNOW+30.
   70 ATRIB(2)=1.
      CALL FILEM(1)
C
  110 RETURN
      END
```

```
      SUBROUTINE INVNT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      IF(TNOW.GE.6300.) GOTO 60



      IF(TNOW.NE.480.) GOTO 10
      ISTOCK(36)=ISTOCK(36)+INT(DRYCOR*COREC)
      ISTOCK(37)=ISTOCK(37)+INT(DRYCOR*CORED)
      IPURCH(36)=IPURCH(36)+INT(DRYCOR*COREC)
      IPURCH(37)=IPURCH(37)+INT(DRYCOR*CORED)
C
   10 I=13
      J=1
   20 ISTOCK(I)=ISTOCK(I)+INT(DRY(J)/5.*DRYC)
      ISTOCK(I+1)=ISTOCK(I+1)+INT(DRY(J)/5.*DRYD)
      ISTOCK(I+2)=ISTOCK(I+2)+INT(DRY(J)/5.*DRYCN)
      IPURCH(I)=IPURCH(I)+INT(DRY(J)/5.*DRYC)
      IPURCH(I+1)=IPURCH(I+1)+INT(DRY(J)/5.*DRYD)
      IPURCH(I+2)=IPURCH(I+2)+INT(DRY(J)/5.*DRYCN)
      IF(J.NE.1) GOTO 30
      J=2
      I=23
      GOTO 20
   30 IF(J.NE.2) GOTO40
      J=4
      I=43
      GOTO 20
   40 IF(J.NE.4) GOTO 50
      J=5
      I=43
      GOTO 20
C
   50 ISTOCK(36)=ISTOCK(36)+INT(DRY(3)/5.*COREC)
      ISTOCK(37)=ISTOCK(37)+INT(DRY(3)/5.*CORED)
      ISTOCK(66)=ISTOCK(66)+INT(DRY(6)/5.*COREC)
      ISTOCK(67)=ISTOCK(67)+INT(DRY(6)/5.*CORED)
      IPURCH(36)=IPURCH(36)+INT(DRY(3)/5.*COREC)
      IPURCH(37)=IPURCH(37)+INT(DRY(3)/5.*CORED)
      IPURCH(66)=IPURCH(66)+INT(DRY(6)/5.*COREC)
      IPURCH(67)=IPURCH(67)+INT(DRY(6)/5.*CORED)
C
      ATRIB(1)=TNOW+1440.
      ATRIB(2)=2.
      CALL FILEM(1)
C
   60 RETURN
      END
```

```
      SUBROUTINE PLUG
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      TIME=TNOW
      CALL SHIFT
      IF(AMODUL.EQ.0.) GOTO 20
      IF(IDAY.LE.3.AND.AMODUL.EQ.960.) GOTO 60
      IF(IDAY.GT.3.AND.AMODUL.EQ.480.) GOTO 40
      IF(ISTOCK(18).GE.INT(PLUGG/2.)) GOTO 20
C
      ATRIB(1)=FLOAT(IDAY*1440)+480.
      GOTO 50
C
   20 IF (IBUS(1).EQ.0)IBUS(1)=1
      BUSPLG=1.
      CALL TIMST(BUSPLG,TNOW,1)
      ISTOCK(18)=ISTOCK(18)-INT(PLUGG/2.)
      ATRIB(1)=TNOW+30.
      ATRIB(2)=3.
      CALL FILEM(1)
      IF(AMODUL.NE.0.) GOTO 70
      GOTO 80
C
   40 ATRIB(1)=TNOW+960.
   50 ATRIB(2)=3.
      CALL FILEM(1)



      IBUS(1)=0
      BUSPLG=0.
      CALL TIMST(BUSPLG,TNOW,1)
      GOTO 70
C
   60 ATRIB(1)=TNOW+480.
      GOTO 50
C
   70 A1=PLUGG/2.
      B1=A1*PLUGA
      B2=A1*PLUGC
      B3=A1*PLUGD
      B4=A1*PLUGU
      ISTOCK(11)=ISTOCK(11)+INT(B1)
      ISTOCK(12)=ISTOCK(12)+INT(A1)-INT(B1)-INT(B2)-INT(B3)-INT(B4)
      ISTOCK(13)=ISTOCK(13)+INT(B2)
      ISTOCK(14)=ISTOCK(14)+INT(B3)
      ISTOCK(15)=ISTOCK(15)+INT(B4)
C
   80 RETURN
      END
```

```
      SUBROUTINE ENTJNT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPFR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      IF(ISTOCK(18).GT.IBPATC) GOTO 1
      I1=INT(AJOINT/2.)
      IF(ISTOCK(28).GE.I1) GOTO 10
    1 IF(IBUS(2).EQ.1)IBUS(2)=0
      BUSJNT=0.
      CALL TIMST(BUSJNT,TNOW,2)
      TIME=TNOW
      CALL SHIFT
      IF(IDAY.EQ.0) GOTO 5
      ATRIB(1)=FLOAT(IDAY+1)*1440.
      GOTO 65
    5 ATRIB(1)=4320.
      GOTO 65
C
   10 ISTOCK(28)=ISTOCK(28)-I1
      ATRIB(3)=28.
      ATRIB(1)=TNOW+30.
      ATRIB(2)=5.
      CALL FILEM(1)
C
      IF(IBUS(2).NE.0) GOTO 70
      BUSJNT=1.
      CALL TIMST(BUSJNT,TNOW,2)
      IBUS(2)=1
      GOTO 70
C
   65 ATRIB(2)=4.
      CALL FILEM(1)
C
   70 RETURN
      END
```

```
      SUBROUTINE LEAJNT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,


     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      I1=INT(ATRIB(3)-10.)
      ISTOCK(I1)=ISTOCK(I1)+INT(AJOINT/2.)
      TIME=TNOW+30.
      CALL SHIFT
      IF(AMODUL.GT.960.) GOTO 10
      IF(IDAY.EQ.1) GOTO 5
      ATRIB(1)=FLOAT(IDAY*1440)
      GOTO 7
    5 ATRIB(1)=4320.
    7 IBUS(2)=0
      BUSJNT=0.
      CALL TIMST(BUSJNT,TNOW,2)
      GOTO 20
C
   10 ATRIB(1)=TNOW
   20 ATRIB(2)=4.
      CALL FILEM(1)
C
      RETURN
      END
```

```
      SUBROUTINE ENTGLS
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      IF(IBUS(4).EQ.0) GOTO 10
      IF(NNQ(2)+NNQ(3)+NNQ(12)+IBUS(3)+IBUS(4)+IBUS(5)-4) 10,10,20
   10 ATRIB(4)=1.
      GOTO 30
   20 ATRIB(4)=2.
   30 I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      IF(IGLUED(I1).GE.IPROD(I1)) GOTO 70
      J=1
C
   35 DO 40 I=11,67
      I3=IVENR(I1,I,J)*IPANEL(I1,I2)
      IF(ISTOCK(I).LT.I3) GOTO 60
   40 CONTINUE
C
      DO 50 I=11,67
      I3=IVENR(I1,I,J)*IPANEL(I1,I2)
      IF(I.LT.65) GOTO 45
      NNPLY=NNPLY+I3
   45 ISTOCK(I)=ISTOCK(I)-I3
   50 CONTINUE
C
      ATRIB(1)=TNOW+GLSPT(I1,I2)
      ATRIB(2)=7.
      ATRIB(5)=TNOW
      CALL FILEM(1)
      ATRIB(5)=0.
      GOTO 90
C
   60 IF(J.NE.1) GOTO 70
      J=2
      GOTO 35
C
   70 IF(IFLAG.EQ.1) GOTO 75
      IF(ABS(ATRIB(3)-FLOAT(NPROD)).LE..1) GOTO 80
   72 ATRIB(3)=ATRIB(3)+1.
      GOTO 30
C



   75 IF(ATRIB(3).LT.6.) GOTO 72
      IFLAG=0
      ATRIB(3)=1.
      I4=ICOR6-2*(IGLUED(2)+IGLUED(3))-IGLUED(1)
      I5=20-(INT(TNOW/480.))
      NNCOR6=INT(FLOAT(I4)/FLOAT(I5))
      GOTO 30
C
   80 CALL ERROR(10)
      MSTOP=-1
C
   90 RETURN
      END
```

```
      SUBROUTINE LEAGLS
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      TIME=TNOW
      CALL SHIFT
      I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      I3=ISHIFT
      IGLUED(I1)=IGLUED(I1)+IPANEL(I1,I2)
C
      IF(IBUS(3).EQ.1) GOTO 10
      IBUS(3)=1
      BUSPPR=1.
      CALL TIMST(BUSPPR,TNOW,3)
      WAITOP=TNOW-ATRIB(5)
      CALL COLCT(WAITOP,1)
      CALL HISTO(WAITOP,1)
C
      ATRIB(1)=TNOW+PPTIM+AMANUT
      ATRIB(2)=8.
      CALL FILEM(1)
      GOTO 25
C
   10 CALL FILEM(2)
C
   25 TIME=ATRIB(5)
      CALL SHIFT
      IF(IFLAG.EQ.1) GOTO 35
      IF(ISHIFT.EQ.I3) GOTO 30
   27 ATRIB(3)=1.
      I1=INT(ATRIB(3))
      NNPLY=0
      I4=ICOR6-2*(IGLUED(2)+IGLUED(3))-IGLUED(1)
      I5=20-(INT(TNOW/480.))
      NNCOR6=INT(FLOAT(I4)/FLOAT(I5))
      GOTO 35
```

```
   30 IF(ATRIB(3).LE.3.) GOTO 50
   35 IF(IGLUED(I1).LT.IPROD(I1)) GOTO 40
      ATRIB(3)=FLOAT(I1)+1.
      IF(ATRIB(3).EQ.7..AND.IFLAG.EQ.1) GOTO 60
      IF(ATRIB(3).GT.FLOAT(NPROD)) GOTO 45
   40 ATRIB(1)=TNOW
      ATRIB(2)=6.
      CALL FILEM(1)
      GOTO 70
C
   45 CALL ERROR(20)
      MSTOP=-1
      GOTO 70
C
   50 IF(NNPLY.LT.NNCOR6) GOTO 35
      ATRIB(3)=4.
      I1=4
      GOTO 35
   60 IFLAG=0
      GOTO 27
C
   70 RETURN
      END
```

```
      SUBROUTINE LEAPPR
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      IF(I2.EQ.1.AND.IBUS(4).EQ.0) GOTO 20
      IF(I2.EQ.1.AND.IBUS(4).EQ.1) GOTO 10
      IF(I2.EQ.2.AND.IBUS(5).EQ.0) GOTO 20
      CALL FILEM(12)
      GOTO 30
   10 CALL FILEM(3)
      GOTO 30
C
   20 I3=I2+3
      IBUS(I3)=1
      BUSPR(I2)=1.
      CALL TIMST(BUSPR(I2),TNOW,I3)
C
      ATRIB(1)=TNOW+PRESS(I1,I2)
      ATRIB(2)=9.
      CALL FILEM(1)
C
      TOAT=TNOW-ATRIB(5)
      CALL COLCT(TOAT,2)
      CALL HISTO(TOAT,2)
C
   30 IF(NNQ(2).EQ.0) GOTO 40
      CALL RMOVE(MFE(2),2)
      WAITOP=TNOW-ATRIB(5)
      CALL COLCT(WAITOP,1)
      CALL HISTO(WAITOP,1)
      IBUS(3)=1
      BUSPPR=1.
      CALL TIMST(BUSPPR,TNOW,3)
C
      ATRIB(1)=TNOW+PPTIM
      ATRIB(2)=8.
      CALL FILEM(1)
      GOTO 50
C
   40 IBUS(3)=0
      BUSPPR=0.
      CALL TIMST(BUSPPR,TNOW,3)
C
   50 RETURN
      END
```

```
      SUBROUTINE LEAHPR
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,


     4BUSJN1,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUEU(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPAIC,NNCOR6
C
      I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      A1=ATRIB(4)
      ATRIB(5)=TNOW
      CALL FILEM(I1+3)
      IPR(I1)=IPR(I1)+IPANEL(I1,I2)
      ISTACK(I1)=ISTACK(I1)+IPANEL(I1,I2)
C
      I4=I2*I2*3
      IF(NNQ(I4).EQ.0) GOTO 10
      CALL RMOVE(MFE(I4),I4)
      TOAT=TNOW-ATRIB(5)
      CALL COLCT(TOAT,2)
      CALL HISTO(TOAT,2)
C
      ATRIB(1)=TNOW+PRESS(I1,I2)
      ATRIB(2)=9.
      ATRIB(5)=0.
      CALL FILEM(1)
      GOTO 20
C
   10 I3=I2+3
      IBUS(I3)=0
      BUSPR(I2)=0.
      CALL TIMST(BUSPR(I2),TNOW,I3)
C
   20 RETURN
      END
```

```
      SUBROUTINE ENTPAT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      TIME=TNOW
      CALL SHIFT
      IF(ISHIFT.EQ.1.AND.AMODUL.LE.450.) GOTO 10
      GOTO 120
C
   10 A1=TNOW-HOTCUR
      I1=4
   15 I2=I1+3
      IF(NNQ(I2).EQ.0) GOTO 40
      CALL COPY(MFE(I2))
      IF(ATRIB(5).GT.A1) GOTO 40
      CALL RMOVE(MFE(I2),I2)
      IF(ATRIB(5).LT.0.0) GOTO 60
      HOTST=TNOW-ATRIB(5)
      CALL COLCT(HOTST,3)
      CALL HISTO(HOTST,3)
      GOTO 60
C
   40 IF(I1.EQ.6) GOTO 50
      I1=6
      GOTO 15
   50 IF(ANREPA(4).GE.PATCH/4.) GOTO 70
      IF(ANREPA(6).GE.PATCH/4.) GOTO 80
      IF(ANPAT(5).GE.PATCH/4.) GOTO 90
      GOTO 120
C
   60 I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      ISTACK(I1)=ISTACK(I1)-IPANEL(I1,I2)
      A1=FLOAT(IPANEL(I1,I2))/PATCH*60.
      ATRIB(1)=TNOW+A1
      ATRIB(4)=FLOAT(IPANEL(I1,I2))
      ATRIB(5)=0.
      GOTO 100
```

```
   70 ANREPA(4)=ANREPA(4)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=4.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=3.
      GOTO 100
C
   80 ANREPA(6)=ANREPA(6)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=6.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=3.
      GOTO 100
C
   90 ANPAT(5)=ANPAT(5)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=5.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=0.
C
  100 IF(IBUS(6))110,110,115
  110 IBUS(6)=1
      BUSPAT=1.
      CALL TIMST(BUSPAT,TNOW,6)
C
  115 ATRIB(2)=11.
      CALL FILEM(1)
      GOTO 130
C
  120 IBUS(6)=0
      BUSPAT=0.
      CALL TIMST(BUSPAT,TNOW,6)
      IF(IDAY.GT.4) GOTO 130
      ATRIB(1)=FLOAT(IDAY*1440)+480.
      ATRIB(2)=10.
      ATRIB(5)=0.
      CALL FILEM(1)
C
  130 RETURN
      END
```

```
      SUBROUTINE LEAPAT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      I1=INT(ATRIB(3))
      IF(ABS(ATRIB(3)-5.).LE..1) GOTO 10
      IF(ATRIB(5).EQ.3.) GOTO 10
      ANSAW(I1)=ANSAW(I1)+ATRIB(4)
      GOTO 20
C
   10 ATSAND(I1)=ATSAND(I1)+ATRIB(4)
   20 ATRIB(1)=TNOW
      ATRIB(2)=10.
      ATRIB(5)=0.
      CALL FILEM(1)
C
      RETURN
      END
```

```
      SUBROUTINE ENTSAW
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)


C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      IF(ANSAW(4).LE.SAWSPD/4.) GOTO 10
      ATRIB(3)=4.
      ANSAW(4)=ANSAW(4)-FLOAT(INT(SAWSPD/4.))
      GOTO 50
C
   10 IF(ANSAW(6).LE.SAWSPD/4.) GOTO 15
      ATRIB(3)=6.
      ANSAW(6)=ANSAW(6)-FLOAT(INT(SAWSPD/4.))
      GOTO 50
C
   15 A2=TNOW-HOTCUR
      DO 20 I=4,6
      IF(NNQ(I).EQ.0) GOTO 20
      CALL COPY(MFE(I))
      IF(ATRIB(5).LE.A2) GOTO 40
   20 CONTINUE
C
      DO 30 I=10,11
      IF(NNQ(I).EQ.0) GOTO 30
      CALL COPY(MFE(I))
      IF(ATRIB(5).LE.A2) GOTO 40
   30 CONTINUE
C
      IF(NNQ(8).EQ.0) GOTO 90
      CALL COPY(MFE(8))
      IF(ATRIB(5).GT.A2) GOTO 90
      CALL RMOVE(MFE(8),8)
      GOTO 41
```

```
   40 CALL RMOVE(MFE(I),I)
   41 IF(ATRIB(5).LT.0.) GOTO 42
      HOTST=TNOW-ATRIB(5)
      CALL COLCT(HOTST,3)
      CALL HISTO(HOTST,3)
   42 I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      ISTACK(I1)=ISTACK(I1)-IPANEL(I1,I2)
      ATRIB(4)=FLOAT(IPANEL(I1,I2))
      ATRIB(5)=0.
      ATRIB(2)=13.
      ATRIB(1)=TNOW+ATRIB(4)/SAWSPD*60.
      CALL FILEM(1)
      GOTO 60
C
   50 ATRIB(4)=FLOAT(INT(SAWSPD/4.))
      ATRIB(1)=TNOW+ATRIB(4)/SAWSPD*60.
      ATRIB(2)=13.
      ATRIB(5)=0.
      CALL FILEM(1)
C
   60 IF(IBUS(7))70,70,80
   70 IBUS(7)=1
      BUSSAW=1.
      CALL TIMST(BUSSAW,TNOW,7)
   80 GOTO 110
   90 IBUS(7)=0
      BUSSAW=0.
      CALL TIMST(BUSSAW,TNOW,7)
      TIME=TNOW+30.
      CALL SHIFT
      IF(ISHIFT.LE.3) GOTO 100
C
      ATRIB(1)=FLOAT(IDAY)*1440.+480.
   95 ATRIB(2)=12.
      ATRIB(5)=0.
      CALL FILEM(1)
      GOTO 110
C
  100 ATRIB(1)=TIME-15.
      GOTO 95
C
  110 RETURN
      END
```

```
      SUBROUTINE LEASAW
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOIST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      IF(I1.GT.3.AND.I1.LT.7) GOTO 35
      A1=ATRIB(4)
      AGOOD(I1)=AGOOD(I1)+A1*GOOD
      ACERT(I1)=ACERT(I1)+A1*CERT
      ASHOP(I1)=ASHOP(I1)+A1*SHOP
      ADELAM(I1)=ADELAM(I1)+A1*(1.-GOOD-CERT-SHOP)
C
   10 IF(INT(AGOOD(I1)).LT.LOAD(I1)) GOTO 20
      AGOOD(I1)=AGOOD(I1)-FLOAT(LOAD(I1))
      IGOODL(I1)=IGOODL(I1)+1
      GOTO 10
C
   20 IF(INT(ACERT(I1)).LT.LOAD(I1)) GOTO 30
      ACERT(I1)=ACERT(I1)-FLOAT(LOAD(I1))
      IMCL(I1)=IMCL(I1)+1
      GOTO 20
   30 IF(INT(ADELAM(I1)).LT.LOAD(I1)) GOTO 31
      ADELAM(I1)=ADELAM(I1)-FLOAT(LOAD(I1))
      IDELL(I1)=IDELL(I1)+1
      GOTO 30
```

```
   31 IF(INT(ASHOP(I1)).LT.LOAD(I1)) GOTO 32
      ASHOP(I1)=ASHOP(I1)-FLOAT(LOAD(I1))
      ISHOPL(I1)=ISHOPL(I1)+1
      GOTO 31
C
   32 GOTO 60
C
   35 A1=ATRIB(4)*(1.-GOOD-CERT-SHOP)
      ADELAM(I1)=ADELAM(I1)+A1
   37 IF(ADELAM(I1).LT.FLOAT(LOAD(I1))) GOTO 40
      ADELAM(I1)=ADELAM(I1)-FLOAT(LOAD(I1))
      IDELL(I1)=IDELL(I1)+1
      GOTO 37
C
   40 A2=FLOAT(I2)-A1
      IF(I1.NE.5) GOTO 50
      ANPAT(5)=ANPAT(5)+A2*.2
      ATSAND(5)=ATSAND(5)+A2*.8
      GOTO 60
C
   50 ANSAND(I1)=ANSAND(I1)+A2
C
   60 TIME=TNOW+15.
      CALL SHIFT
      IF(ISHIFT.LE.3) GOTO 70
      ATRIB(1)=FLOAT(IDAY*1440)+480.
      IBUS(7)=0
      BUSSAW=0.
      CALL TIMST(BUSSAW,TNOW,7)
      GOTO 80
C
   70 ATRIB(1)=TNOW
   80 ATRIB(2)=12.
      ATRIB(5)=0.
      CALL FILEM(1)
C
      RETURN
      END
```

```
      SUBROUTINE ENTSND
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      IF(ANSAND(4).GE.50.) GOTO 10
      IF(ANSAND(6).GE.50.) GOTO 20
      IF(ATSAND(4).GE.50.) GOTO 40
      IF(ATSAND(5).GE.50.) GOTO 50
      IF(ATSAND(6).GE.50.) GOTO 60
C
      TIME=TNOW
      CALL SHIFT
      ATRIB(1)=FLOAT(IDAY*1440)+480.
      ATRIB(2)=14.
      CALL FILEM(1)
C
      IBUS(8)=0
      IBUS(9)=0
      BUSSND(1)=0.
      BUSSND(2)=0.
      CALL TIMST(BUSSND(1),TNOW,8)
      CALL TIMST(BUSSND(2),TNOW,9)
      GOTO 160
C
   10 I1=4
      GOTO 30
   20 I1=6
   30 I2=1
      GOTO 80
C
   40 I1=4
      GOTO 70
   50 I1=5
      GOTO 70
   60 I1=6
   70 I2=2
C
   80 TIME=TNOW
      CALL SHIFT
      IF(IDAY.LE.3) GOTO 90
      A1=480.-AMODUL
      GOTO 100
   90 A1=960.-AMODUL
  100 A2=A1/60.*SAND
      IF(I2.EQ.1) GOTO 130
```

```
      IF(ATSAND(I1).GE.A2) GOTO 110
      ATRIB(1)=TNOW+FLOAT(INT(ATSAND(I1)))/SAND*60.
      ATRIB(2)=15.
      ATRIB(3)=FLOAT(I1)
      ATRIB(4)=FLOAT(INT(ATSAND(I1)))
      ATSAND(I1)=ATSAND(I1)-FLOAT(INT(ATSAND(I1)))
      GOTO 120
C
  110 ATRIB(1)=TNOW+FLOAT(INT(A2))/SAND*60.
      ATRIB(2)=15.
      ATRIB(3)=FLOAT(I1)
      ATRIB(4)=FLOAT(INT(A2))
      ATSAND(I1)=ATSAND(I1)-ATRIB(4)
C
  120 ATRIB(5)=2.
      CALL FILEM(1)
      IF(IBUS(9).EQ.1) GOTO 160
      IBUS(9)=1
      BUSSND(2)=1.
      CALL TIMST(BUSSND(2),TNOW,9)
      BUSSND(1)=0.
      IBUS(8)=0
      CALL TIMST(BUSSND(1),TNOW,8)
      GOTO 160
C
  130 IF(ANSAND(I1).GT.A2) GOTO 140
      ATRIB(1)=TNOW+FLOAT(INT(ANSAND(I1)))/SAND*60.
      ATRIB(2)=15.
      ATRIB(3)=FLOAT(I1)
      ATRIB(4)=FLOAT(INT(ANSAND(I1)))
      ANSAND(I1)=ANSAND(I1)-ATRIB(4)
      GOTO 150
C


  140 ATRIB(1)=TNOW+FLOAT(INT(A2))/SAND*60.
      ATRIB(2)=15.
      ATRIB(3)=FLOAT(I1)
      ATRIB(4)=FLOAT(INT(A2))
      ANSAND(I1)=ANSAND(I1)-ATRIB(4)
C
  150 ATRIB(5)=1.
      CALL FILEM(1)
      IF(IBUS(8).EQ.1) GOTO 160
      IBUS(8)=1
      IBUS(9)=0
      BUSSND(1)=1.
      BUSSND(2)=0.
      CALL TIMST(BUSSND(1),TNOW,8)
      CALL TIMST(BUSSND(2),TNOW,9)
C
  160 RETURN
      END
```

```
      SUBROUTINE LEASND
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNAIR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      TIME=TNOW
      CALL SHIFT
      I1=INT(ATRIB(3))
      IF(ATRIB(5).NE.1.) GOTO 30
      ANREPA(I1)=ANREPA(I1)+ATRIB(4)*SREPA
      AGOOD(I1)=AGOOD(I1)+ATRIB(4)*SOKP
      ATSAND(I1)=ATSAND(I1)+ATRIB(4)*SRSND
      ASHOP(I1)=ASHOP(I1)+ATRIB(4)*SSHOP
      A1=ATRIB(4)*(1.-SREPA-SOKP-SRSND-SSHOP)
C
      IF(I1.EQ.4) GOTO 10
      AGOOD(8)=AGOOD(8)+A1
      GOTO 41
C
   10 AGOOD(7)=AGOOD(7)+A1
      GOTO 41
C
   30 AGOOD(I1)=AGOOD(I1)+ATRIB(4)*TSGOOD
      ASHOP(I1)=ASHOP(I1)+ATRIB(4)*TSSHOP
      A2=ATRIB(4)*(1.-TSGOOD-TSSHOP)
      IF(I1.EQ.4.OR.I1.EQ.5) GOTO 40
      AGOOD(8)=AGOOD(8)+A2
      GOTO 41
C
   40 AGOOD(I1+3)=AGOOD(I1+3)+A2
   41 TIME=TNOW+5.
      CALL SHIFT
      IF(ISHIFT.NE.1.AND.ISHIFT.NE.3) GOTO 50
C
      ATRIB(1)=TNOW
   45 ATRIB(2)=14.
      CALL FILEM(1)
      GOTO 70
C
   50 ATRIB(1)=FLOAT(IDAY*1440)+480.
      I4=INT(ATRIB(5)+7.)
      I5=INT(ATRIB(5))
      IBUS(I4)=0
      BUSSND(I5)=0.
      CALL TIMST(BUSSND(I5),TNOW,I4)
      GOTO 45
C
   70 IF(AGOOD(I1).LT.FLOAT(LOAD(I1))) GOTO 80
      AGOOD(I1)=AGOOD(I1)-FLOAT(LOAD(I1))
      IGOODL(I1)=IGOODL(I1)+1
      GOTO 70
C
   80 IF(ASHOP(I1).LT.FLOAT(LOAD(I1))) GOTO 90

      ASHOP(I1)=ASHOP(I1)-FLOAT(LOAD(I1))
      ISHOPL(I1)=ISHOPL(I1)+1
      GOTO 80
C
   90 RETURN
      END
```

```
      SUBROUTINE OTPUT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,CORED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC,NNCOR6
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      WRITE(6,1)
C
    1 FORMAT(1H ,///T2,"CONSTANTS FOR THE SIMULATION",/T2,
     1"----------------------------",///)
C
      WRITE(6,15)
C
      WRITE(6,2) (IPROD(I),I=1,NPROD)
C
    2 FORMAT(1H ,T2,"WEEKLY OBJECTIVE",T30,I6,T40,I6,T50,I6,T60,I6,
     1T70,I6,T80,I6,T90,I6,T100,I6,///)
C
      WRITE(6,3) BPFULA,CFULA,DFULA,BPHLFA,CHLFA,DHLFA,CNHLFA,COHLFA,
     1CHLFB,DHLFB,CNHLFB,COHLFB,COREC,CORED,ISTOCO,ISTOJN,DRNITE,
     2(DRDAY(I),I=1,4)
C
    3 FORMAT(1H ,T2,"BPFULA=",T10,F5.3,T22,"CFULA=",T30,F5.3,T42,
     1"DFULA=",T50,F5.3,//T2,"BPHLFA=",T10,F5.3,T22,"CHLFA=",T30,F5.3,
     2T42,"DHLFA=",T50,F5.3,T62,"CNHLFA=",T70,F5.3,T82,"COHLFA=",T90,
     3F5.3,//T2,"CHLFB=",T10,F5.3,T22,"DHLFB=",T30,F5.3,T42,"CNHLFB=",
     4T50,F5.3,T62,"COHLFB=",T70,F5.3,//T2,"COREC=",T10,F5.3,T22,
     5"CORED=",T30,F5.3,//T2,"ISTOCO=",T10,I5,T22,"ISTOJN=",T30,I5,
     6//T2,"DRNITE=",T10,F6.1,T22,"DRDAY(1)=",T30,F6.1,T42,"DRDAY(2)=",
     7T50,F6.1,T62,"DRDAY(3)=",T70,F6.1,T82,"DRDAY(4)=",T90,F6.1,///)
C
      WRITE(6,4) DRYC,DRYD,DRYCN,(DRY(I),I=1,6),PCTGR6,DRYCOR
C
    4 FORMAT(1H ,T2,"DRYC=",T10,F5.3,T22,"DRYD=",T30,F5.3,T42,"DRYCN=",
     1T50,F5.3,//T2,"DRY(1)=",T10,F8.1,T22,"DRY(2)=",T30,F8.1,T42,
     2"DRY(3)=",T50,F8.1,T62,"DRY(4)=",T70,F8.1,T82,"DRY(5)=",T90,F8.1,
     3T102,"DRY(6)=",T110,F8.1,//T2,"PCTGR6=",T10,F6.1,T22,"DRYCOR=",
     4T30,F6.1,///)
C
      WRITE(6,5) PLUGG,PLUGA,PLUGB,PLUGC,PLUGD,PLUGU
C
    5 FORMAT(1H ,T2,"PLUGG=",T10,F6.1,//T2,"PLUGA=",T10,F5.3,T22,
     1"PLUGB=",T30,F5.3,T42,"PLUGC=",T50,F5.3,T62,"PLUGD=",T70,F5.3,
     2T82,"PLUGU=",T90,F5.3,///)
C
      WRITE(6,6) AJOINT,IBPATC,ICOR6,ICENT6,IFACE6
C
    6 FORMAT(1H ,T2,"AJOINT=",T10,F6.1,T22,"IBPATC=",I5,//T2,"ICOR6=",
     1T10,I6,T22,"ICENT6=",T30,I6,T42,"IFACE6=",I6,///)
```

```
      WRITE(6,15)
C
      WRITE(6,7) (GLSPT(I,1),I=1,NPROD),(GLSPT(I,2),I=1,NPROD),
     1(PRESS(I,1),I=1,NPROD),(PRESS(I,2),I=1,NPROD)
C
    7 FORMAT(1H ,T2,"GLUESPR.TIME TO 25 OP.HPR.",T31,F5.2,T41,F5.2,
     1T51,F5.2,T61,F5.2,T71,F5.2,T81,F5.2,T91,F5.2,T101,F5.2,//T2,
     2"GLUESPR.TIME TO 10 OP.HPR.",T31,F5.2,T41,F5.2,T51,F5.2,T61,
     3F5.2,T71,F5.2,T81,F5.2,T91,F5.2,T101,F5.2,//T2,
     4"25 OP. PRESS TIME",T31,F5.2,T41,F5.2,T51,F5.2,T61,F5.2,T71,
     5F5.2,T81,F5.2,T91,F5.2,T101,F5.2,//T2,"10 OP. PRESS TIME",T31,
     6F5.2,T41,F5.2,T51,F5.2,T61,F5.2,T71,F5.2,T81,F5.2,T91,F5.2,
     7T101,F5.2,///)
C
      WRITE(6,8) (IPANEL(I,1),I=1,NPROD),(IPANEL(I,2),I=1,NPROD),
     1(LOAD(I),I=1,NPROD)
C
    8 FORMAT(1H ,T2,"PANELS PER STACK/25 OP.",T33,I3,T43,I3,T53,I3,
     1T63,I3,T73,I3,T83,I3,T93,I3,T103,I3,//T2,
     2"PANELS PER STACK/10 OP.",T33,I3,T43,I3,T53,I3,T63,I3,T73,I3,
     3T83,I3,T93,I3,T103,I3,//T2,"PANELS PER LOAD",T32,I4,T42,I4,
     4T52,I4,T62,I4,T72,I4,T82,I4,T92,I4,T102,I4,///)
C
      WRITE(6,9) HOTCUR,PATCH,SAWSPD,SAND,GOOD,CERT,SHOP,SREPA,SOKP,
     1SRSND,SDOWN,SSHOP,TSGOOD,TSSHOP,ISCL6,ISCL10,IREORD
C
    9 FORMAT(1H ,T2,"HOTCUR=",T10,F5.1,T22,"PATCH=",T30,F5.1,T42,
     1"SAWSPD=",T50,F5.1,T62,"SAND=",T70,F5.1,//T2,"GOOD=",T10,F4.2,
     2T22,"CERT=",T30,F4.2,T42,"SHOP=",T50,F4.2,//T2,"SREPA=",T10,
     3F4.2,T22,"SOKP=",T30,F4.2,T42,"SRSND=",T50,F4.2,T62,"SDOWN=",
     4T70,F4.2,T82,"SSHOP=",T90,F4.2,//T2,"TSGOOD=",T10,F4.2,T22,
     5"TSSSHOP=",T30,F4.2,//T2,"ISCL6=",T10,I6,T22,"ISCL10=",
     6T30,I6,T42,"IREORD=",T50,I6,////)
C
      WRITE (6,10)
C
   10 FORMAT(1H ,//T2,"INITIAL CONDITIONS",/T2,"------------------",
     1//)
C
      WRITE(6,70)
C
      WRITE (6,11) ISTOKI(11),ISTOKI(12),ISTOKI(13),ISTOKI(14),
     1ISTOKI(15),ISTOKI(18),ISTOKI(23),ISTOKI(24),ISTOKI(25),
     2ISTOKI(27),ISTOKI(28),ISTOKI(36),ISTOKI(37),ISTOKI(43),
     3ISTOKI(44),ISTOKI(45),ISTOKI(66),ISTOKI(67)
C
   11 FORMAT(1H ,T29,"A GRADE",T39,"B GRADE",
     1T49,"C GRADE",T59,"D GRADE",T69,"CENTERS",T79,"CORES C",
     2T89,"CORES D",T99,"B PATCH",//T2,"1/10-54",T30,I6,T40,I6,T50,
     3I6,T60,I6,T70,I6,T100,I6,/T2,"1/10-27",T50,I6,T60,I6,T70,I6,
     4T90,I6,T100,I6,/T2,"1/10-STRIPS",T80,I6,T90,I6,/T2,"1/6-27/54",
     5T50,I6,T60,I6,T70,I6,/T2,"1/6-STRIPS",T80,I6,T90,I6)
C
      WRITE (6,12)
   12 FORMAT(1H ,//T2,"PANEL STOCK",//)
C
      WRITE (6,15)
C
   15 FORMAT(1H ,T2,"PANEL TYPE",T30,"3/8 CD",T40,"5/8 CD",T50,
     1"3/4 CD",T59,"5/16 AC",T68,"15/32 CC",T79,"9/16 AC",T89,
     2"5/16 CD",T100,"1/2 CD",/)
```

```
      WRITE(6,20) (ISTAKI(I),I=1,NPROD),(ISTSAW(I),I=1,NPROD),
     1(ISTOPA(I),I=1,NPROD),(ISTORP(I),I=1,NPROD),(ISTOPP(I),I=1,NPROD)
     2,(ISTOTS(I),I=1,NPROD)
C
   20 FORMAT(1H ,T2,"IN HOT STACK",T30,I6,T40,I6,T50,I6,T60,I6,T70,
     1I6,T80,I6,T90,I6,T100,I6,/T2,"BEFORE SAW",T30,I6,T40,I6,T50,I6,
     2T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,"BEFORE PATCH",T30,I6,
     3T40,I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,
     4"TO REPATCH",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,
     5T100,I6,/T2,"BEFORE SANDER",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,
     6T80,I6,T90,I6,T100,I6,/T2,"BEFORE TSANDER",T30,I6,T40,I6,T50,I6,
     7T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/)
C
      WRITE(6,25)
C
   25 FORMAT(1H ,/T2,"-------------------------------------------------
     1--------------------------------------------------",///T2,
     2"FINAL CONDITIONS",/T2,"----------------",//)
C
      WRITE(6,70)
C
      WRITE (6,11) ISTOCK(11),ISTOCK(12),ISTOCK(13),ISTOCK(14),
     1ISTOCK(15),ISTOCK(18),ISTOCK(23),ISTOCK(24),ISTOCK(25),
     2ISTOCK(27),ISTOCK(28),ISTOCK(36),ISTOCK(37),ISTOCK(43),
     3ISTOCK(44),ISTOCK(45),ISTOCK(66),ISTOCK(67)
C
      WRITE (6,12)
C
      WRITE (6,15)
C
      WRITE (6,20) (ISTACK(I),I=1,NPROD),(INT(ANSAW(I)),I=1,NPROD),
     1(INT(ANPAT(I)),I=1,NPROD),(INT(ANREPA(I)),I=1,NPROD),
     2(INT(ANSAND(I)),I=1,NPROD),(INT(ATSAND(I)),I=1,NPROD)
C
      WRITE (6,30)
C
   30 FORMAT (1H ,//T2,"PRODUCTION",//)
C
      WRITE (6,15)
C
      WRITE (6,35) (IGLUED(I),I=1,NPROD),(IPR(I),I=1,NPROD),
     1(IGOODL(I),I=1,NPROD),(IMCL(I),I=1,NPROD),(ISHOPL(I),I=1,NPROD),
     2(IDELL(I),I=1,NPROD)
C
   35 FORMAT(1H ,T2,"GLUED PANELS",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,
     1T80,I6,T90,I6,T100,I6,/T2,"PRESSED PANELS",T30,I6,T40,I6,T50,I6,
     2T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,"GOOD LOADS",T30,I6,T40,
     3I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,"MILL CERT LDS",
     4T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,
     5"SHOP LOADS",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,
     6T100,I6,/T2,"DELAMIN. LOADS",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,
     7T80,I6,T90,I6,T100,I6)
```

```
      WRITE (6,40) (INT(AGOOD(I)),I=1,NPROD),(INT(ACERT(I)),I=1,NPROD),
     1(INT(ASHOP(I)),I=1,NPROD),(INT(ADELAM(I)),I=1,NPROD)
C
   40 FORMAT (1H ,T2,"UNBANDED GOOD PAN.",T30,I6,T40,I6,T50,I6,T60,
     1I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,"UNBANDED MILL CERT.P.",
     2T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,/T2,
     3"UNBANDED SHOP PANELS",T30,I6,T40,I6,T50,I6,T60,I6,T70,I6,T80,
     4I6,T90,I6,T100,I6,/T2,"UNBANDED DELAMIN.PAN.",T30,I6,T40,I6,
     5T50,I6,T60,I6,T70,I6,T80,I6,T90,I6,T100,I6,///)
C
      WRITE(6,50)
   50 FORMAT(1H ,//T2,"DRY VENEER PURCHASES",//)
C
      WRITE(6,11) IPURCH(11),IPURCH(12),IPURCH(13),IPURCH(14),
     1IPURCH(15),IPURCH(18),IPURCH(23),IPURCH(24),IPURCH(25),
     2IPURCH(27),IPURCH(28),IPURCH(36),IPURCH(37),IPURCH(43),
     3IPURCH(44),IPURCH(45),IPURCH(66),IPURCH(67)
C
      WRITE(6,60)
   60 FORMAT(1H ,//T2,"DRYER GOOD PRODUCTION",//)
C
      WRITE(6,11) IDRY(11),IDRY(12),IDRY(13),IDRY(14),IDRY(15),
     1IDRY(18),IDRY(23),IDRY(24),IDRY(25),IDRY(27),IDRY(28),
     2IDRY(36),IDRY(37),IDRY(43),IDRY(44),IDRY(45),IDRY(66),
     3IDRY(67)
C
   70 FORMAT(1H ,//T2,"DRY VENEER STOCK",//)
C
      RETURN
      END
```

C - MODIFIED SUBROUTINES - RUN # 2

```
      SUBROUTINE ENTJNT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM2/CHLFB,DHLFB,CNHLFB,COHLFB,BPHLFA,CHLFA,DHLFA,
     1CNHLFA,COHLFA,BPFULA,CFULA,DFULA,ISTOJN,ISTOCO,PCTGR6,DRNITE,
     2DRDAY(4),COREC,COKED,ISTOCK(67),BUSPLG,PLUGG,DRYCOR,DRYC,
     3DRYD,DRYCN,DRY(6),PLUGA,PLUGB,PLUGC,PLUGD,PLUGU,AJOINT,
     4BUSJNT,GLSPT(8,2),IVENR(8,67,2),NPROD,NNPLY,IGLUED(8),BUSPPR,
     5WAITOP,PPTIM,AMANUT,IPROD(8),ICOR6,BUSPR(2),PRESS(8,2),TOAT,
     6OPAT,IPR(8),ISTOKI(67),INHSTK(8),ICENT6,IFACE6,IBPATC;NNCOR6
C
      IF(ISTOCK(18).GT.IBPATC) GOTO 1
      I1=INT(AJOINT/2.)
      IF(ISTOCK(23).GE.I1) GOTO 20
      IF(ISTOCK(28).GE.I1) GOTO 10
    1 IF(IBUS(2).EQ.1)IBUS(2)=0
      BUSJNT=0.
      CALL TIMST(BUSJNT,TNOW,2)
      TIME=TNOW
      CALL SHIFT
      IF(IDAY.EQ.0) GOTO 5
      ATRIB(1)=FLOAT(IDAY+1)*1440.
      GOTO 65
    5 ATRIB(1)=4320.
      GOTO 65
C
   10 ISTOCK(28)=ISTOCK(28)-I1
      ATRIB(3)=28.
      GOTO 50
C
   20 ISTOCK(23)=ISTOCK(23)-I1
      ATRIB(3)=23.
C
   50 ATRIB(1)=TNOW+30.
      ATRIB(2)=5.
      CALL FILEM(1)
C
      IF(IBUS(2).NE.0) GOTO 70
      BUSJNT=1.
      CALL TIMST(BUSJNT,TNOW,2)
      IBUS(2)=1
      GOTO 70
C
   65 ATRIB(2)=4.
      CALL FILEM(1)
C
   70 RETURN
      END
```

```
      SUBROUTINE ENTPAT
C
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
C
      COMMON/UCOM1/IBUS(9),TIME,ISHIFT,AMODUL,IDAY,IPANEL(8,2),IFLAG,
     1ISTACK(8),ISCL6,ISCL10,IREORD,IPURCH(67),IDRY(67)
C
      COMMON/UCOM3/HOTCUR,HOTST,ANREPA(8),ANPAT(8),PATCH,BUSPAT,
     1ANSAW(8),ATSAND(8),ANSAND(8),SAWSPD,BUSSAW,AGOOD(8),ACERT(8),
     2ASHOP(8),ADELAM(8),GOOD,CERT,SHOP,LOAD(8),IGOODL(8),IMCL(8),SAND,
     3BUSSND(2),SREPA,SOKP,SRSND,SSHOP,SDOWN,TSGOOD,TSSHOP,ISTOPA(8),
     4ISHOPL(8),IDELL(8),ISTOTS(8),ISTAKI(8),ISTORP(8),ISTSAW(8),
     5ISTOPP(8)
C
      TIME=TNOW
      CALL SHIFT
      IF(IDAY.LE.3.AND.AMODUL.LE.930.) GOTO 10
      IF(AMODUL.LE.450.) GOTO 10
      GOTO 120
C
   10 A1=TNOW-HOTCUR
      I1=4
   15 I2=I1+3
      IF(NNQ(I2).EQ.0) GOTO 40
      CALL COPY(MFE(I2))
      IF(ATRIB(5).GT.A1) GOTO 40
      CALL RMOVE(MFE(I2),I2)
      IF(ATRIB(5).LT.0.0) GOTO 60
      HOTST=TNOW-ATRIB(5)
      CALL COLCT(HOTST,3)
      CALL HISTO(HOTST,3)
      GOTO 60
C
   40 IF(I1.EQ.6) GOTO 50
      I1=6
      GOTO 15
   50 IF(ANREPA(4).GE.PATCH/4.) GOTO 70
      IF(ANREPA(6).GE.PATCH/4.) GOTO 80
      IF(ANPAT(5).GE.PATCH/4.) GOTO 90
      GOTO 120
C
   60 I1=INT(ATRIB(3))
      I2=INT(ATRIB(4))
      ISTACK(I1)=ISTACK(I1)-IPANEL(I1,I2)
      A1=FLOAT(IPANEL(I1,I2))/PATCH*60.
      ATRIB(1)=TNOW+A1
      ATRIB(4)=FLOAT(IPANEL(I1,I2))
      ATRIB(5)=0.
      GOTO 100
```

```
   70 ANREPA(4)=ANREPA(4)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=4.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=3.
      GOTO 100
C
   80 ANREPA(6)=ANREPA(6)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=6.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=3.
      GOTO 100
C
   90 ANPAT(5)=ANPAT(5)-FLOAT(INT(PATCH/4.))
      ATRIB(3)=5.
      ATRIB(4)=FLOAT(INT(PATCH/4.))
      ATRIB(1)=TNOW+ATRIB(4)/PATCH*60.
      ATRIB(5)=0.
C
  100 IF(IBUS(6))110,110,115
  110 IBUS(6)=1
      BUSPAT=1.
      CALL TIMST(BUSPAT,TNOW,6)
C
  115 ATRIB(2)=11.
      CALL FILEM(1)
      GOTO 130
C
  120 IBUS(6)=0
      BUSPAT=0.
      CALL TIMST(BUSPAT,TNOW,6)
      ATRIB(1)=FLOAT(IDAY*1440)+480.
      ATRIB(2)=10.
      ATRIB(5)=0.
      CALL FILEM(1)
C
  130 RETURN
      END
```

```
      SUBROUTINE EVNTS(IX)
      COMMON/GCOM1/ATRIB(25),JEVNT,MFA,MFE(100),MLE(100),MSTOP,
     1NCRDR,NNAPO,NNAPT,NNATR,NNFIL,NNQ(100),NNTRY,NPRNT,PPARM(50,4),
     2TNOW,TTBEG,TTCLR,TTFIN,TTRIB(25),TTSET
      WRITE(6,50) TNOW
   50 FORMAT(F9.4)
C
      GOTO(101,102,103,104,105,106,107,108,109,110,111,112,113,114,
     1115),IX
C
  101 WRITE(6,500)
  500 FORMAT(6H DRYER)
      CALL DRYER
      GOTO 200
  102 WRITE(6,510)
  510 FORMAT(6H INVNT)
      CALL INVNT
      GOTO 200
  103 WRITE(6,520)
  520 FORMAT(6H  PLUG)
      CALL PLUG
      GOTO 200
  104 WRITE(6,530)
  530 FORMAT(6HENTJNT)
      CALL ENTJNT
      GOTO 200
  105 WRITE(6,540)
  540 FORMAT(6HLEAJNT)
      CALL LEAJNT
      GOTO 200
  106 WRITE(6,550)
  550 FORMAT(6HENTGLS)
      CALL ENTGLS
      GOTO 200
  107 WRITE(6,560)
  560 FORMAT(6HLEAGLS)
      CALL LEAGLS
      GOTO 200
  108 WRITE(6,570)
  570 FORMAT(6HLEAPPR)
      CALL LEAPPR
      GOTO 200
  109 WRITE(6,580)
  580 FORMAT(6HLEAHPR)
      CALL LEAHPR
      GOTO 200
  110 WRITE(6,590)
  590 FORMAT(6HENTPAT)
      CALL ENTPAT
      GOTO 200
  111 WRITE(6,600)
  600 FORMAT(6HLEAPAT)
      CALL LEAPAT
      GOTO 200
  112 WRITE(6,610)
  610 FORMAT(6HENTSAW)
      CALL ENTSAW
      GOTO 200
  113 WRITE(6,620)
  620 FORMAT(6HLEASAW)
      CALL LEASAW
      GOTO 200
  114 WRITE(6,630)
  630 FORMAT(6HENTSND)
      CALL ENTSND
      GOTO 200
  115 WRITE(6,640)
  640 FORMAT(6HLEASND)
      CALL LEASND
C
  200 CALL RECRD
      CALL VENPUR
      RETURN
      END
```

D - MODIFIED EVNTS SUBROUTINE

AS A DEBUGGING AID

GASP Echo-check

```
                         SIMULATION PROJECT NUMBER   1  BY  ULRICH

                         DATE  7/  1/  82        RUN NUMBER    1 OF    1
                                    GASP IV VERSION 01JAN76

NNCLT=    3   NNSTA=     9   NNHIS=     3   NNPRM=     0   NNPLT=     5   NNSTR=    1   NNTRY=   500
NNATR=    5   NNFIL=    12   NNSET=  3500   NNEQD=     0   NNEQS=     0   MFLAG=    0
IIPOF=    N   IIPOS=     Y   IISUM=     Y   IIPIR=     Y

COLCT NO.  1  LLABC=OPAT
COLCT NO.  2  LLABC=TOAT
COLCT NO.  3  LLABC=HOTST

TIMST NO.  1  LLABT=BUSPLG   I.C. =   0.
TIMST NO.  2  LLABT=BUSJNT   I.C. =   0.
TIMST NO.  3  LLABT=BUSPPR   I.C. =   0.
TIMST NO.  4  LLABT=BUS25    I.C. =   0.
TIMST NO.  5  LLABT=BUS10    I.C. =   0.
TIMST NO.  6  LLABT=BUSPAT   I.C. =   0.
TIMST NO.  7  LLABT=BUSSAW   I.C. =   0.
TIMST NO.  8  LLABT=BUSSND   I.C. =   0.
TIMST NO.  9  LLABT=BUSTSN   I.C. =   0.


HISTO NO.  1  LLABH=OPAT                     NNCEL=  10   HHLOW=   .5000E+01   HHWID=   .5000E+01
HISTO NO.  2  LLABH=TOAT                     NNCEL=  15   HHLOW=   .1000E+02   HHWID=   .5000E+01
HISTO NO.  3  LLABH=HOTST                    NNCEL=  20   HHLOW=   .1200E+03   HHWID=   .6000E+02

GPLOT NO.  1  LLABP=TIME     IITAP=   1   NNVAR=   6   LLPLT=   0         DTPLT=   .3000E+02
  VAR NO.  1     1=A54       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  2     2=B54       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  3     3=C54       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2400E+05
  VAR NO.  4     4=D54       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2400E+05
  VAR NO.  5     5=CN54      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2400E+05
  VAR NO.  6     6=BP54      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
GPLOT NO.  2  LLABP=TIME     IITAP=   2   NNVAR=   7   LLPLT=   0         DTPLT=   .3000E+02
  VAR NO.  1     1=C27       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  2     2=D27       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  3     3=CENT27    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  4     4=CORD27    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  5     5=BP27      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  6     6=CORCST    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3000E+05
  VAR NO.  7     7=CORDST    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3000E+05
GPLOT NO.  3  LLABP=TIME     IITAP=   3   NNVAR=   5   LLPLT=   0         DTPLT=   .3000E+02
  VAR NO.  1     1=C1/6      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  2     2=D1/6      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  3     3=CNT1/6    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1200E+05
  VAR NO.  4     4=CORC1/6   LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2000E+05
  VAR NO.  5     5=CORD1/6   LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2000E+05
GPLOT NO.  4  LLABP=TIME     IITAP=   4   NNVAR=   8   LLPLT=   0         DTPLT=   .3000E+02
  VAR NO.  1     1=3/8CD     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2350E+04
  VAR NO.  2     2=5/8CD     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .4200E+04
  VAR NO.  3     3=3/4CD     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .6000E+04
  VAR NO.  4     4=5/16AC    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3550E+04
  VAR NO.  5     5=15/32CC   LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3150E+04
  VAR NO.  6     6=9/16AC    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .6200E+04
  VAR NO.  7     7=5/16CD    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1150E+04
  VAR NO.  8     8=1/2CD     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2000E+05
GPLOT NO.  5  LLABP=TIME     IITAP=   8   NNVAR=   9   LLPLT=   0         DTPLT=   .3000E+02
  VAR NO.  1     1=PLUG      LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .1000E+02
  VAR NO.  2     2=JOINT     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .9000E+01
  VAR NO.  3     3=PPRESS    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3000E+01
  VAR NO.  4     4=25HPR     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .7000E+01
  VAR NO.  5     5=10HPR     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .6000E+01
  VAR NO.  6     6=PATCH     LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .5000E+01
  VAR NO.  7     7=SAW       LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .4000E+01
  VAR NO.  8     8=SANDER    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .3000E+01
  VAR NO.  9     9=TSNDER    LLPLO=   1   LLPHI=   1   PPLO =   0.        PPHI =   .2000E+01

PRIORITY FILE   1=FIFO
PRIORITY FILE   2=FIFO
PRIORITY FILE   3=FIFO
PRIORITY FILE   4=FIFO
PRIORITY FILE   5=FIFO
PRIORITY FILE   6=FIFO
PRIORITY FILE   7=FIFO
PRIORITY FILE   8=FIFO
PRIORITY FILE   9=FIFO
PRIORITY FILE  10=FIFO
PRIORITY FILE  11=FIFO
PRIORITY FILE  12=FIFO

MSTOP=    1   JJCLR=   Y   JJBEG=   Y   TTBEG=   0.        TTFIN=   .9600E+04
JJFIL=    Y
IISED=    0
```

CONSTANTS FOR THE SIMULATION

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
WEEKLY OBJECTIVE	2350	4200	0	3550	3150	6200	1150	20000

BPFULA=	.167	CFULA=	.667	DFULA=	.166						
BPHLFA=	.163	CHLFA=	.543	DHLFA=	.163	CNHLFA=	.109	COHLFA=	.022		
CHLFB=	.650	DHLFB=	.200	CNHLFB=	.130	COHLFB=	.020				
COREC=	.650	CORED=	.350								
ISTOCO=	40000	ISTOJN=	5000								
DRNITE=	880.6	DRDAY(1)	727.3	DRDAY(2)	779.5	DRDAY(3)	753.4	DRDAY(4)	349.7		
DRYC=	.500	DRYD=	.350	DRYCN=	.150						
DRY(1)=	30850.0	DRY(2)=	13250.0	DRY(3)=	0.0	DRY(4)=	0.0	DRY(5)=	0.0	DRY(6)=	0.0
PCTGR6=	1.0	DRYCOR=	8820.0								
PLUGG=	306.0										
PLUGA=	.250	PLUGB=	.450	PLUGC=	.250	PLUGD=	.030	PLUGU=	.020		
AJOINT=	300.0	IBPATC=	9999								
ICOR6=	10750	ICENT6=	6200	IFACE6=	0						

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
GLUESPR.TIME TO 25 OP.HPR.	7.28	7.28	7.28	6.41	6.41	6.41	6.41	6.41
GLUESPR.TIME TO 10 OP.HPR.	2.91	2.91	2.91	2.56	5.13	2.56	2.56	5.13
25 OP. PRESS TIME	6.75	6.35	7.70	5.60	5.60	6.10	5.60	5.60
10 OP. PRESS TIME	7.35	6.85	8.10	6.10	12.20	6.60	6.10	12.20
PANELS PER STACK/25 OP.	50	25	25	50	25	25	50	25
PANELS PER STACK/10 OP.	20	10	10	20	20	10	20	20
PANELS PER LOAD	88	53	44	132	66	66	105	66

HOTCUR= 120.0 PATCH= 188.0 SAWSPD= 360.0 SAND= 313.0

GOOD= .93 CEKT= .03 SHOP= .03

SREPA= .20 SOKP= .35 SRSND= .40 SDOWN= .03 SSHOP= .02

TSGOOD= .90 TSSSHOP= .03

ISCL6= 3123 ISCL10= 4905 IREORD= 500

INITIAL CONDITIONS

DRY VENEER STOCK

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	2344	2344	1172	1172	21093			6445
1/10-27			0	0	0		0	6445
1/10-STRIPS						5859	23437	
1/6-27/54			0	0	7031			
1/6-STRIPS						0	7031	

PANEL STOCK

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
IN HOT STACK	1050	0	0	1250	850	0	0	0
BEFORE SAW	0	0	0	0	0	0	0	0
BEFORE PATCH	0	0	0	0	0	0	0	0
TO REPATCH	0	0	0	0	0	0	0	0
BEFORE SANDER	0	0	0	0	0	2083	0	0
BEFORE TSANDER	0	0	0	0	0	0	0	0

INTERMEDIATE RESULTS

PURCHASED 4414 GOOD DRY VENEERS - CODE 36 AT TIME 1416.6

PURCHASED 4424 GOOD DRY VENEERS - CODE 36 AT TIME 2467.8

PURCHASED 2662 GOOD DRY VENEERS - CODE 67 AT TIME 8692.3

PURCHASED 4422 GOOD DRY VENEERS - CODE 37 AT TIME 8942.9

DRY VENEER PURCHASES

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	0	0	15425	10795	4625			0
1/10-27			6625	4635	1985		0	0
1/10-STRIPS						14570	7508	
1/6-27/54			0	0	0			
1/6-STRIPS						0	2662	

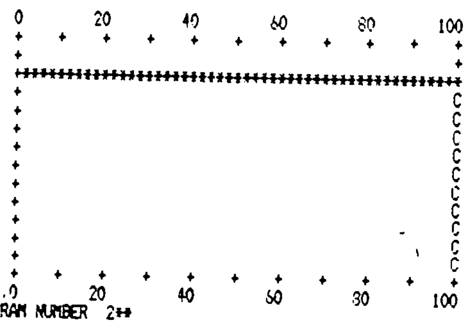
DRYER GOOD PRODUCTION

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	0	0	46746	11607	0			11607
1/10-27			0	0	0		0	0
1/10-STRIPS						18880	10160	
1/6-27/54			4640	1360	830			
1/6-STRIPS						4560	2480	

HISTOGRAM NUMBER 1

OPAT

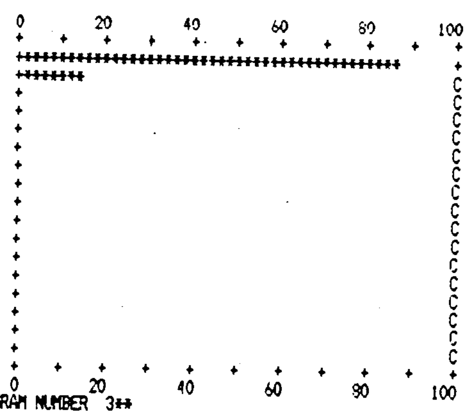
OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
0	0.000	0.000	.5000E+01
1468	1.000	1.000	.1000E+02
0	0.000	1.000	.1500E+02
0	0.000	1.000	.2000E+02
0	0.000	1.000	.2500E+02
0	0.000	1.000	.3000E+02
0	0.000	1.000	.3500E+02
0	0.000	1.000	.4000E+02
0	0.000	1.000	.4500E+02
0	0.000	1.000	.5000E+02
0	0.000	1.000	.5500E+02
0	0.000	1.000	INF
1468			



HISTOGRAM NUMBER 2

TOAT

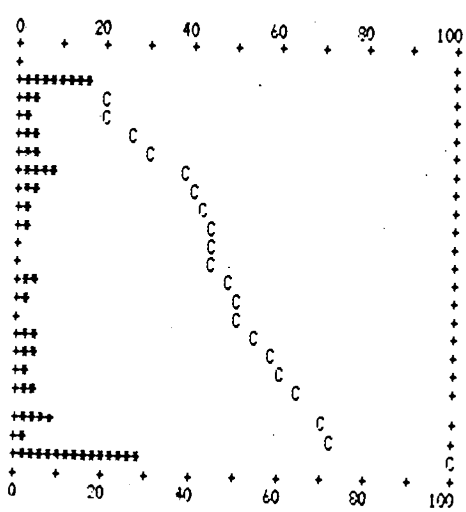
OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
1251	.852	.852	.1000E+02
217	.148	1.000	.1500E+02
0	0.000	1.000	.2000E+02
0	0.000	1.000	.2500E+02
0	0.000	1.000	.3000E+02
0	0.000	1.000	.3500E+02
0	0.000	1.000	.4000E+02
0	0.000	1.000	.4500E+02
0	0.000	1.000	.5000E+02
0	0.000	1.000	.5500E+02
0	0.000	1.000	.6000E+02
0	0.000	1.000	.6500E+02
0	0.000	1.000	.7000E+02
0	0.000	1.000	.7500E+02
0	0.000	1.000	.8000E+02
0	0.000	1.000	.8500E+02
0	0.000	1.000	INF
1468			



HISTOGRAM NUMBER 3

HOTST

OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
0	0.000	0.000	.1200E+03
189	.162	.162	.1800E+03
39	.033	.196	.2400E+03
13	.011	.207	.3000E+03
58	.050	.257	.3600E+03
53	.045	.302	.4200E+03
83	.071	.373	.4800E+03
36	.031	.404	.5400E+03
12	.010	.415	.6000E+03
25	.021	.436	.6600E+03
5	.004	.440	.7200E+03
0	0.000	.440	.7800E+03
42	.036	.476	.8400E+03
25	.021	.498	.9000E+03
0	0.000	.498	.9600E+03
51	.044	.542	.1020E+04
50	.043	.585	.1080E+04
22	.019	.603	.1140E+04
39	.033	.637	.1200E+04
82	.070	.707	.1260E+04
19	.016	.724	.1320E+04
322	.276	1.000	INF
1165			



```
MAXIMUM NUMBER OF ENTRIES IN FILE STORAGE AREA =371

PRINTOUT OF FILE NUMBER   1
TNOW =   .9600E+04
QQTIM=   .9600E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       8.8438
STANDARD DEVIATION            .9463
MAXIMUM NUMBER IN FILE      10

                                  FILE CONTENTS
ENTRY  1  =   .9600E+04   .1000E+01   0.          0.          0.
ENTRY  2  =   .9603E+04   .1300E+02   .8000E+01   .2500E+02   0.
ENTRY  3  =   .9603E+04   .7000E+01   .8000E+01   .1000E+01   .9597E+04
ENTRY  4  =   .9606E+04   .9000E+01   .8000E+01   .1000E+01   .9591E+04
ENTRY  5  =   .1008E+05   .4000E+01   .2800E+02   0.          0.
ENTRY  6  =   .1056E+05   .1400E+02   .6000E+01   .6750E+03   .2000E+01
ENTRY  7  =   .1056E+05   .3000E+01   0.          0.          0.
```

```
PRINTOUT OF FILE NUMBER   2
TNOW =   .9600E+04
QQTIM=  0.

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       0.0000
STANDARD DEVIATION           0.0000
MAXIMUM NUMBER IN FILE       0

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   3
TNOW =   .9600E+04
QQTIM=   .3489E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE        .0002
STANDARD DEVIATION            .0146
MAXIMUM NUMBER IN FILE       1

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   4
TNOW =   .9600E+04
QQTIM=   .4075E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       2.1245
STANDARD DEVIATION           5.4707
MAXIMUM NUMBER IN FILE      21

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   5
TNOW =   .9600E+04
QQTIM=   .9362E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       4.2216
STANDARD DEVIATION           6.0829
MAXIMUM NUMBER IN FILE      16

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   6
TNOW =   .9600E+04
QQTIM=  0.

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       0.0000
STANDARD DEVIATION           0.0000
MAXIMUM NUMBER IN FILE       0

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   7
TNOW =   .9600E+04
QQTIM=   .4928E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE      22.2142
STANDARD DEVIATION          28.4268
MAXIMUM NUMBER IN FILE      96

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   8
TNOW =   .9600E+04
QQTIM=   .1557E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       8.9277
STANDARD DEVIATION          22.6116
MAXIMUM NUMBER IN FILE      95

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER   9
TNOW =   .9600E+04
QQTIM=   .6687E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE     157.6030
STANDARD DEVIATION          81.1559
MAXIMUM NUMBER IN FILE     248
```

```
PRINTOUT OF FILE NUMBER  10
TNOW =   .9600E+04
QQTIM=   .5112E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE        .4439
STANDARD DEVIATION           2.0235
MAXIMUM NUMBER IN FILE      17

THE FILE IS EMPTY
```

```
PRINTOUT OF FILE NUMBER  11
TNOW =   .9600E+04
QQTIM=   .9599E+04

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE      74.6120
STANDARD DEVIATION          66.6146
MAXIMUM NUMBER IN FILE     169
```

```
PRINTOUT OF FILE NUMBER  12
TNOW =   .9600E+04
QQTIM=  0.

TIME PERIOD FOR STATISTICS  .9600E+04
AVERAGE NUMBER IN FILE       0.0000
STANDARD DEVIATION           0.0000
MAXIMUM NUMBER IN FILE       0

THE FILE IS EMPTY
```

Statistics on GASP files contents

FINAL CONDITIONS

DRY VENEER STOCK

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	3078	7304	25377	1671	1122			2473
1/10-27			4650	1735	10		0	145
1/10-STRIPS						17059	655	
1/6-27/54			4640	1360	1711			
1/6-STRIPS						3960	2023	

PANEL STOCK

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
IN HOT STACK	0	0	0	0	0	3800	0	3750
BEFORE SAW	0	0	0	30	0	60	0	0
BEFORE PATCH	0	0	0	0	791	0	0	0
TO REPATCH	0	0	0	944	0	879	0	0
BEFORE SANDER	0	0	0	0	0	0	0	0
BEFORE TSANDER	0	0	0	0	0	0	0	0

PRODUCTION

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
GLUED PANELS	2350	4200	0	3550	3150	6200	1150	19625
PRESSED PANELS	2350	4200	0	3550	3150	6200	1150	19600
GOOD LOADS	35	73	0	25	43	47	12	230
MILL CERT LDS	1	2	0	0	0	0	0	7
SHOP LOADS	1	2	0	1	1	2	0	7
DELAMIN. LOADS	0	0	0	0	0	0	0	2
UNBANDED GOOD PAN.	81	36	0	51	12	20	83	14
UNBANDED MILL CERT.P.	14	20	0	0	0	0	34	12
UNBANDED SHOP PANELS	14	20	0	19	29	8	34	12
UNBANDED DELAMIN.PAN.	34	42	0	47	40	23	11	26

GASP SUMMARY REPORT

SIMULATION PROJECT NUMBER 1 BY ULRICH

DATE 7/ 1/ 82 RUN NUMBER 1 OF 1

CURRENT TIME = .9600E+04

STATISTICS FOR VARIABLES BASED ON OBSERVATION

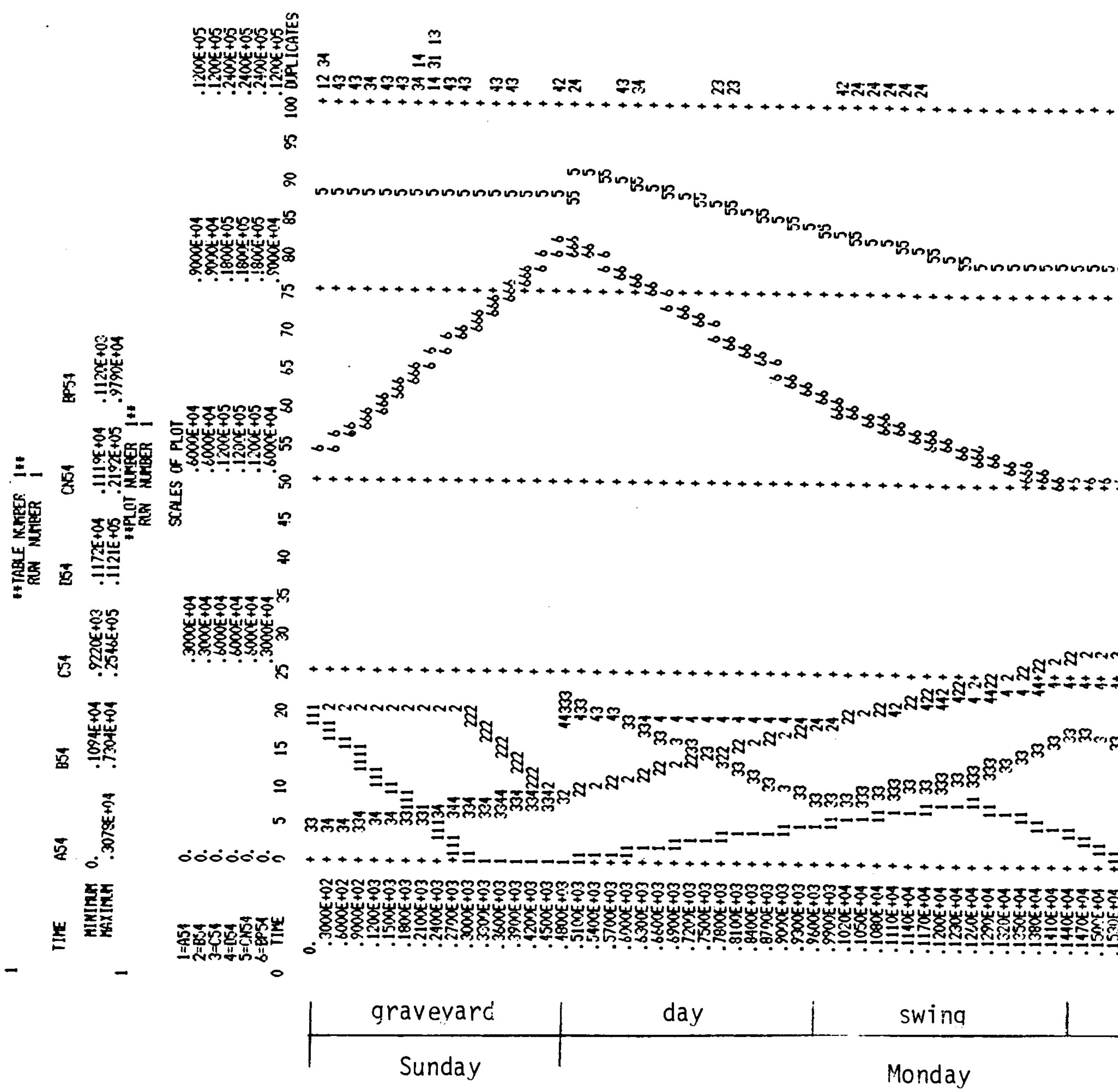
	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS
OPAT	.6537E+01	.3077E+00	.8031E-02	.4707E-01	.6410E+01	.7280E+01	1468
TOAT	.9539E+01	.3084E+00	.8049E-02	.3233E-01	.9410E+01	.1028E+02	1468
HOTST	.1157E+04	.1187E+04	.3477E+02	.1026E+01	.1202E+03	.4800E+04	1165

STATISTICS FOR TIME-PERSISTENT VARIABLES

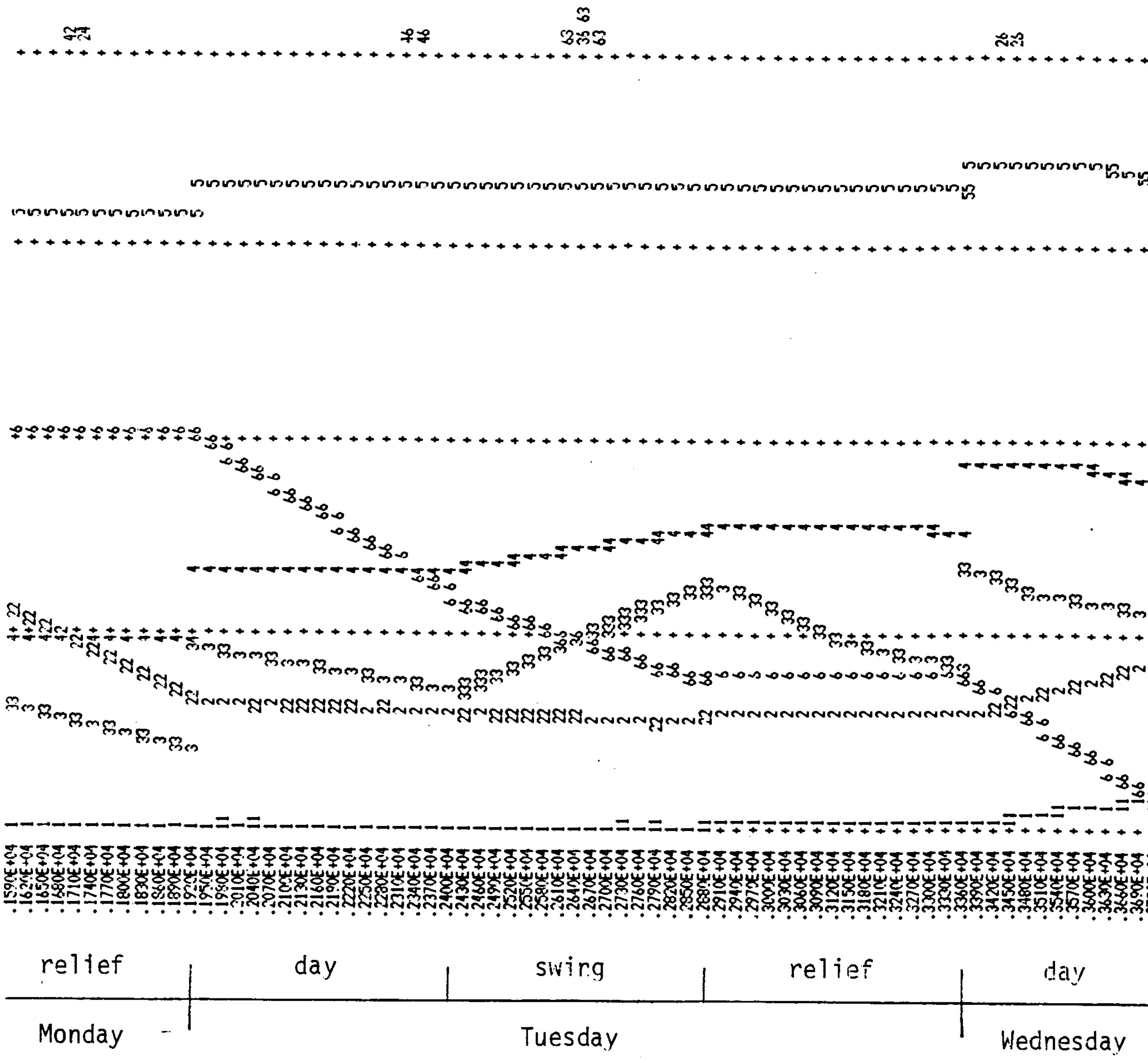
	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
BUSPLG	.4469E+00	.4972E+00	0.	.1000E+01	.9600E+04	0.
BUSJNT	.1313E+00	.3377E+00	0.	.1000E+01	.9600E+04	0.
BUSPPR	.4587E+00	.4983E+00	0.	.1000E+01	.9600E+04	0.
BUS25	.8877E+00	.3158E+00	0.	.1000E+01	.9600E+04	.1000E+01
BUS10			NO VALUES RECORDED			
BUSPAT	.2394E+00	.4267E+00	0.	.1000E+01	.9600E+04	0.
BUSSAW	.6196E+00	.4855E+00	0.	.1000E+01	.9600E+04	.1000E+01
BUSSND	.1821E+00	.3860E+00	0.	.1000E+01	.9600E+04	0.
BUSTSN	.1361E+00	.3429E+00	0.	.1000E+01	.9600E+04	0.

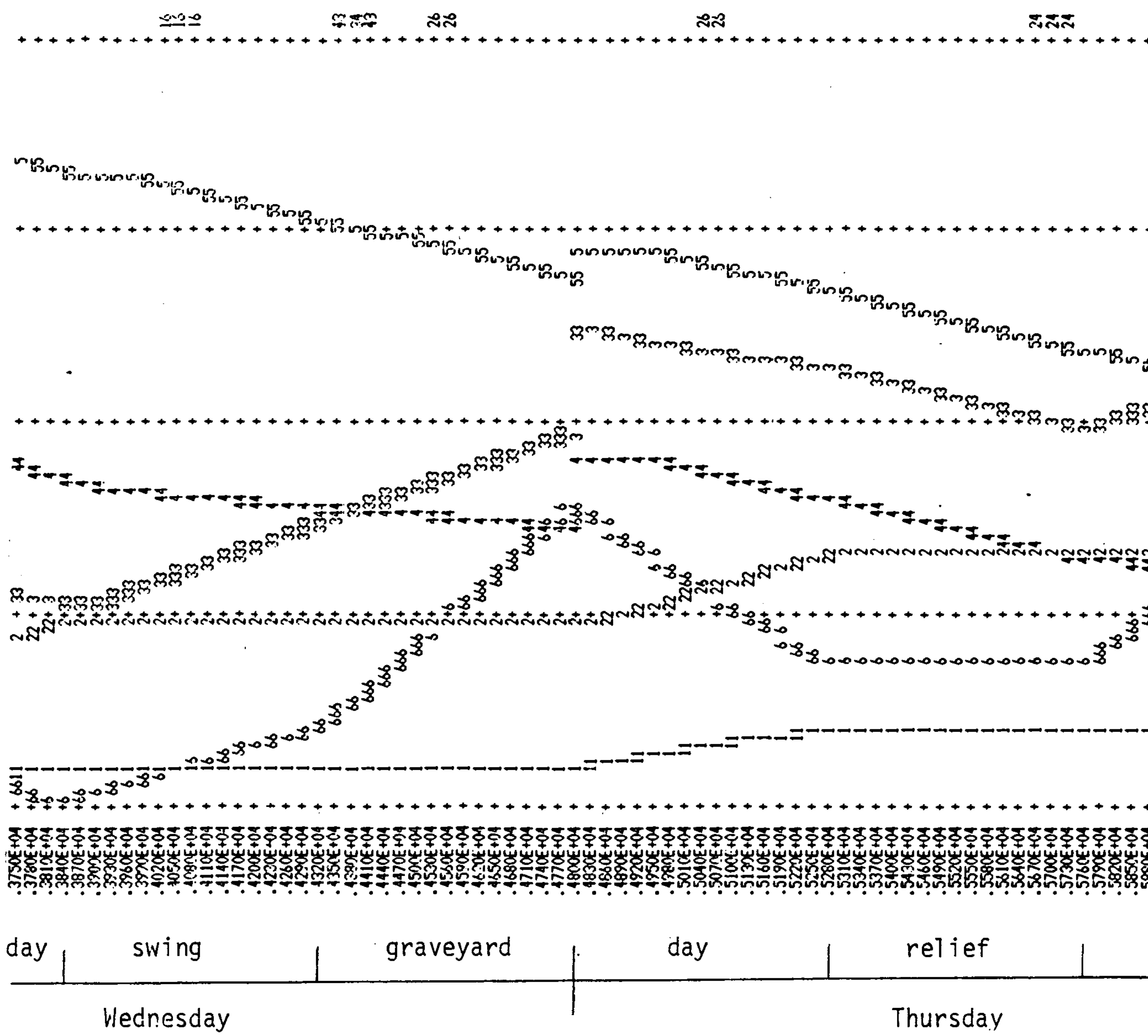
Plot # 1 - Run # 1

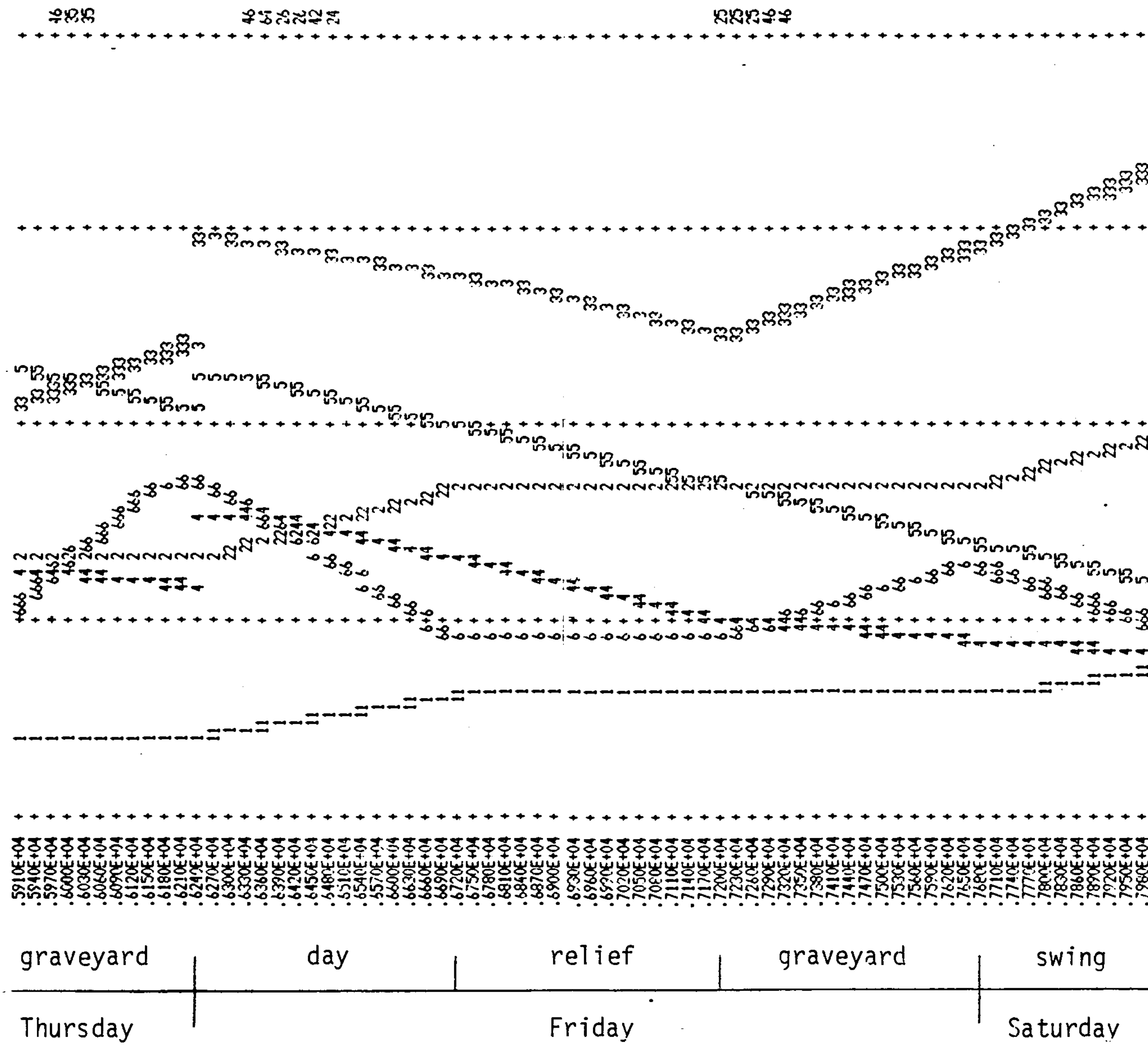
Veneer stock

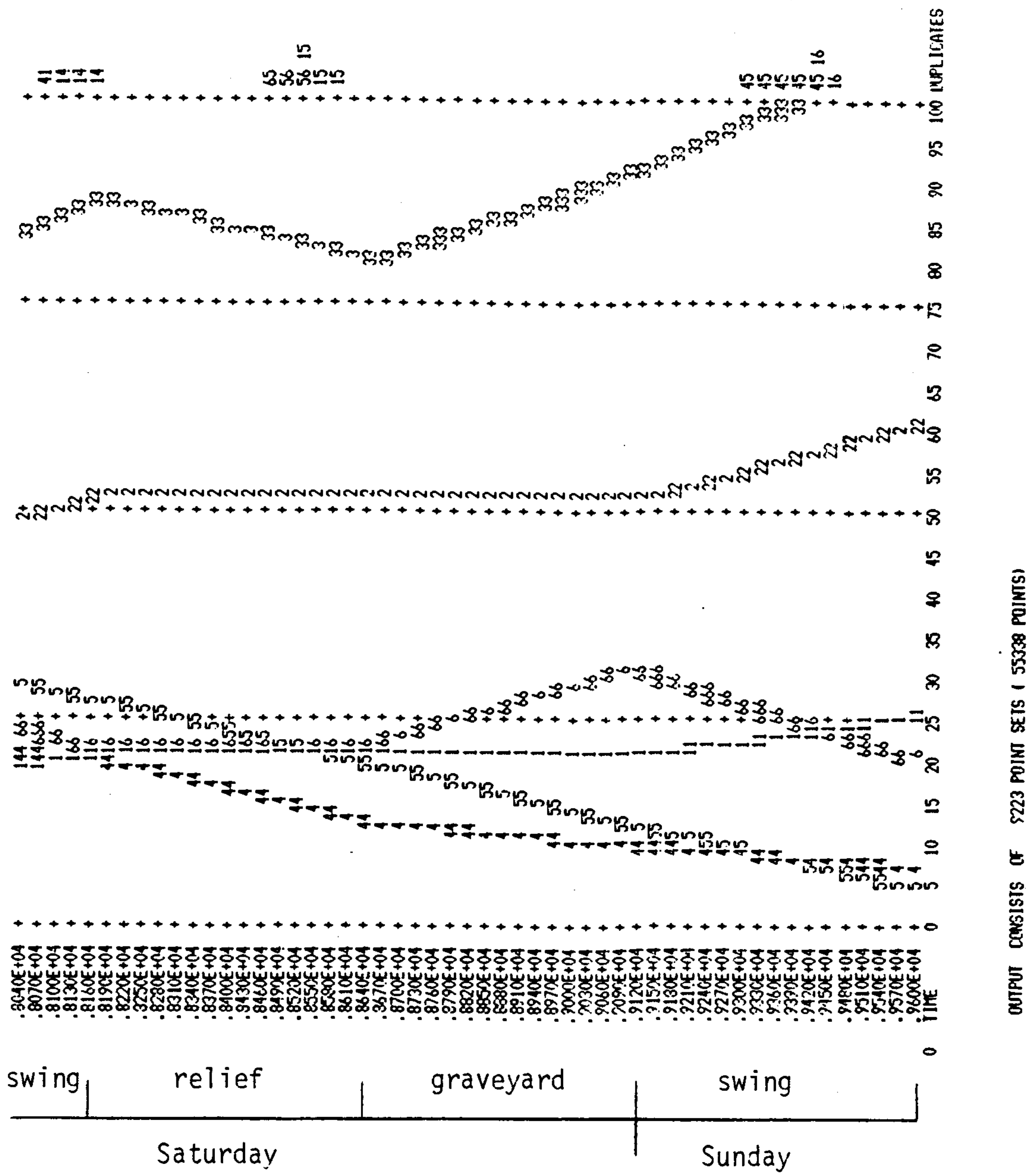


codes : 1 - 1/10" 54" A
2 - 1/10" 54" B
3 - 1/10" 54" C
4 - 1/10" 54" D
5 - 1/10" 54" Centers
6 - 1/10" 54" Bpatch


relief
day
swing
relief
day
Monday
Tuesday
Wednesday

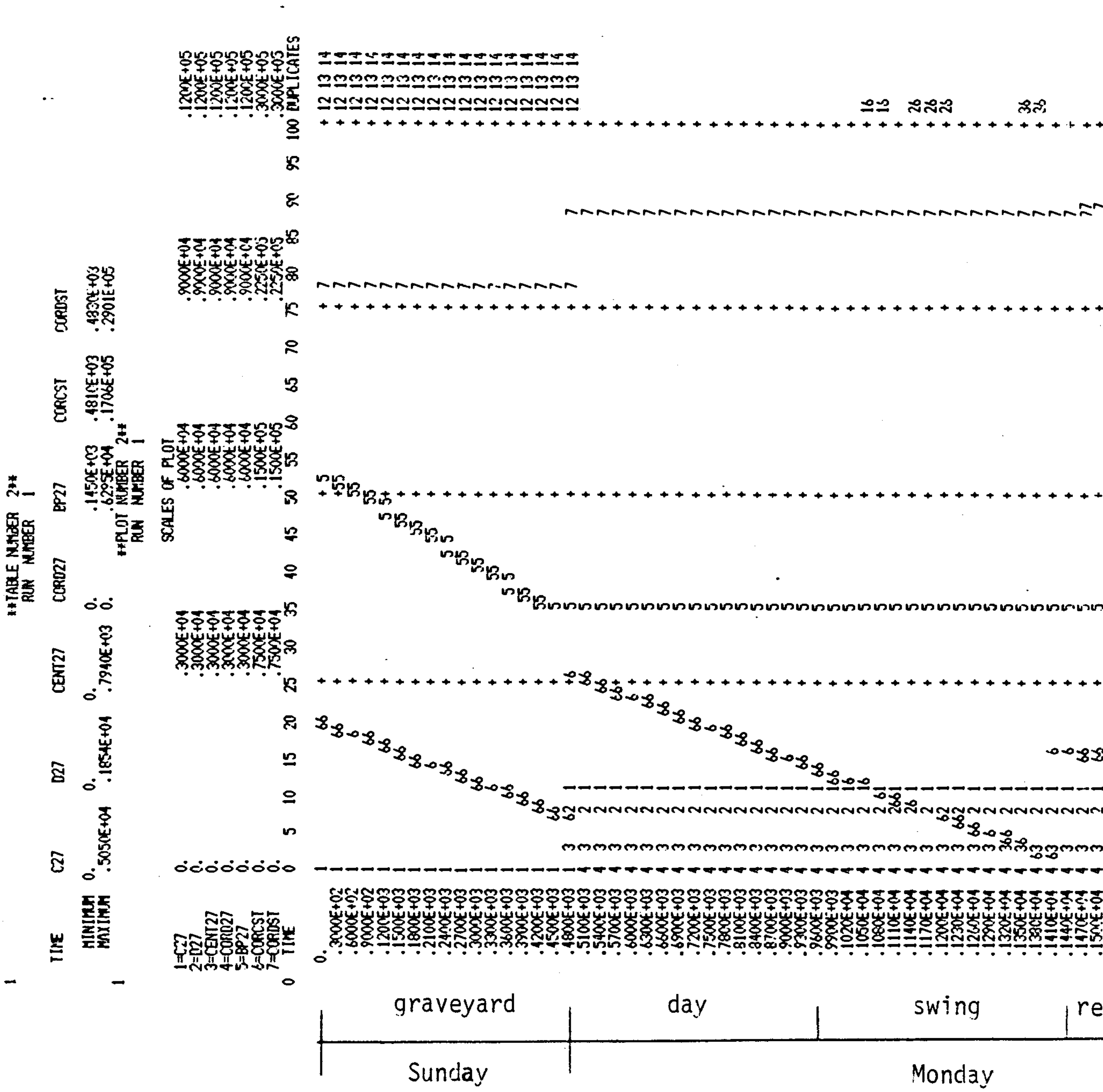

day
swing
graveyard
day
relief
Wednesday
Thursday


graveyard
day
relief
graveyard
swing
Thursday
Friday
Saturday


OUTPUT CONSISTS OF 5223 POINT SETS (55338 POINTS)
swing
relief
graveyard
swing
Saturday
Sunday

Plot # 2 - Run # 1

Veneer stock



codes : 1 - 1/10" 27" C

2 - 1/10" 27" D

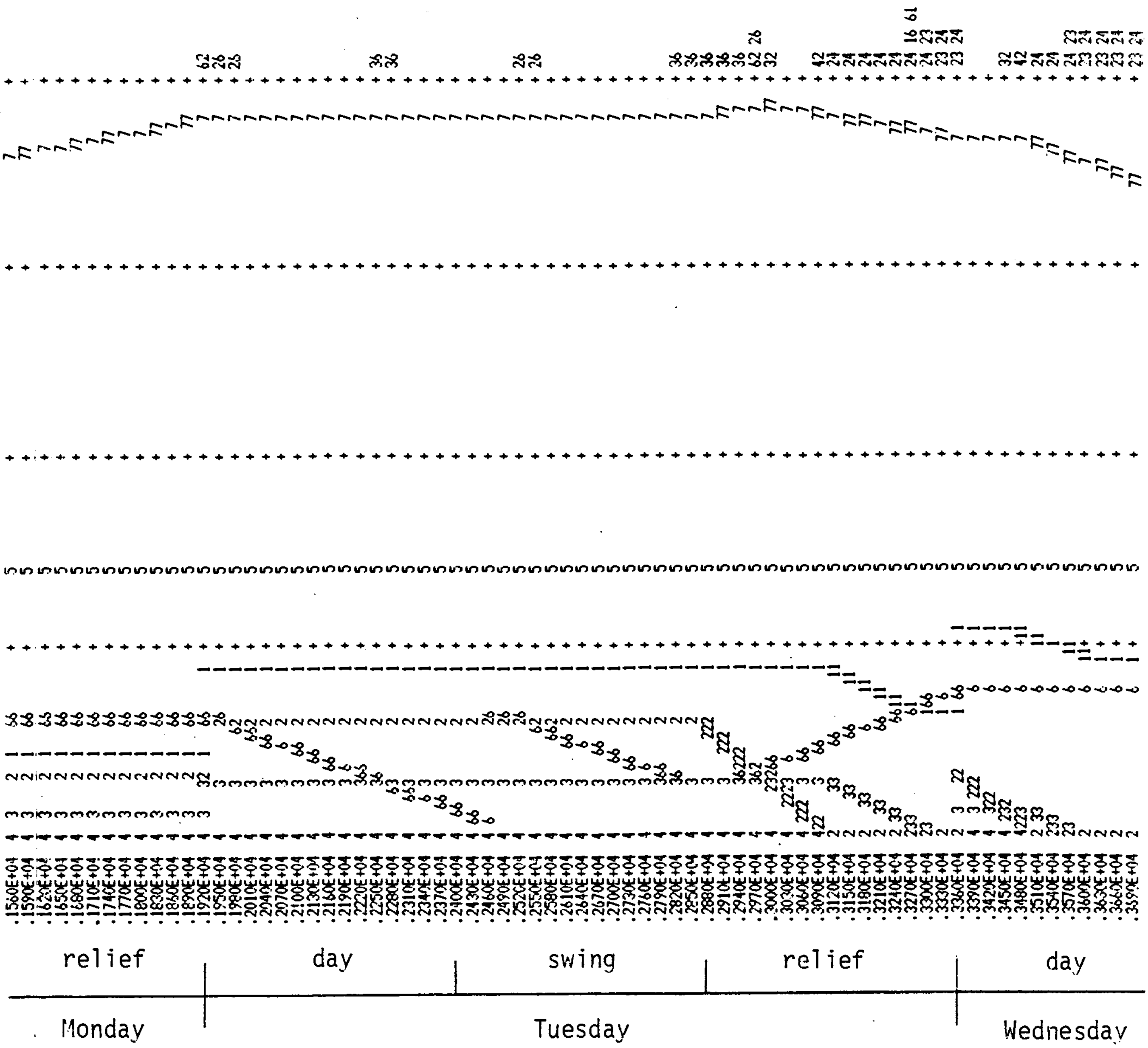
3 - 1/10" 27" Centers

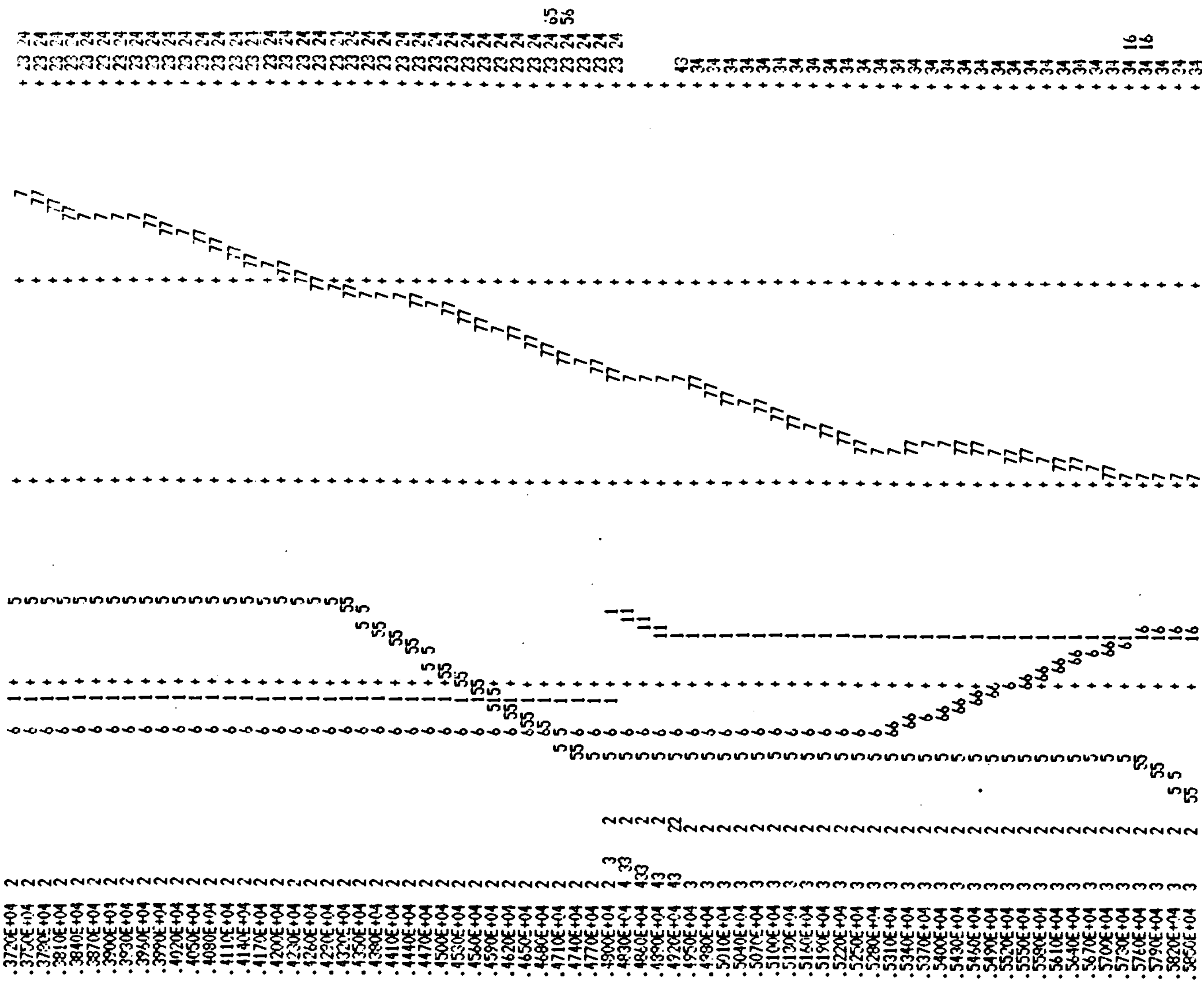
4 - 1/10" 27" Cores D

5 - 1/10" 27" Bpatch

6 - 1/10" Strips Cores C

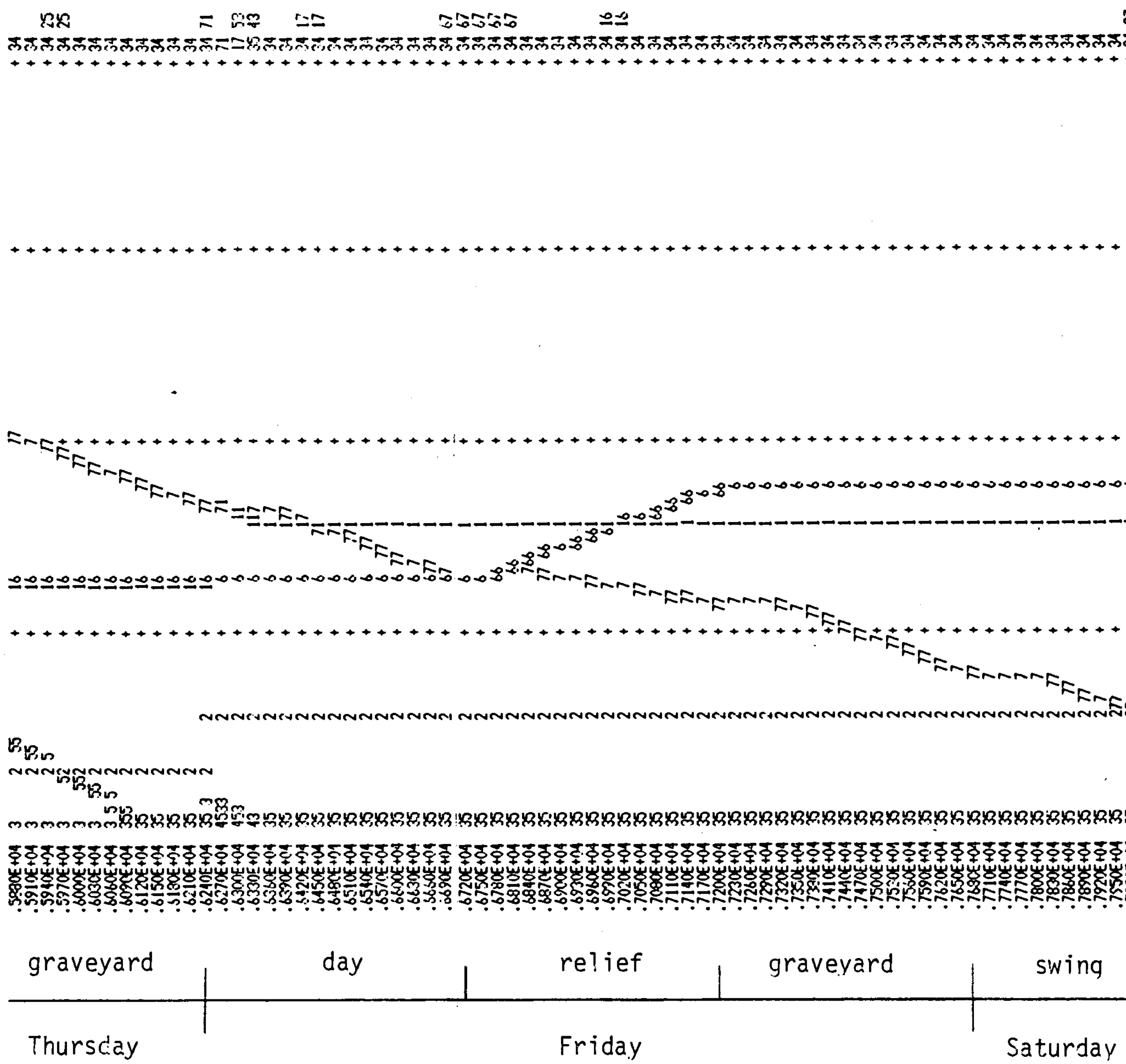
7 - 1/10 Strips Cores D

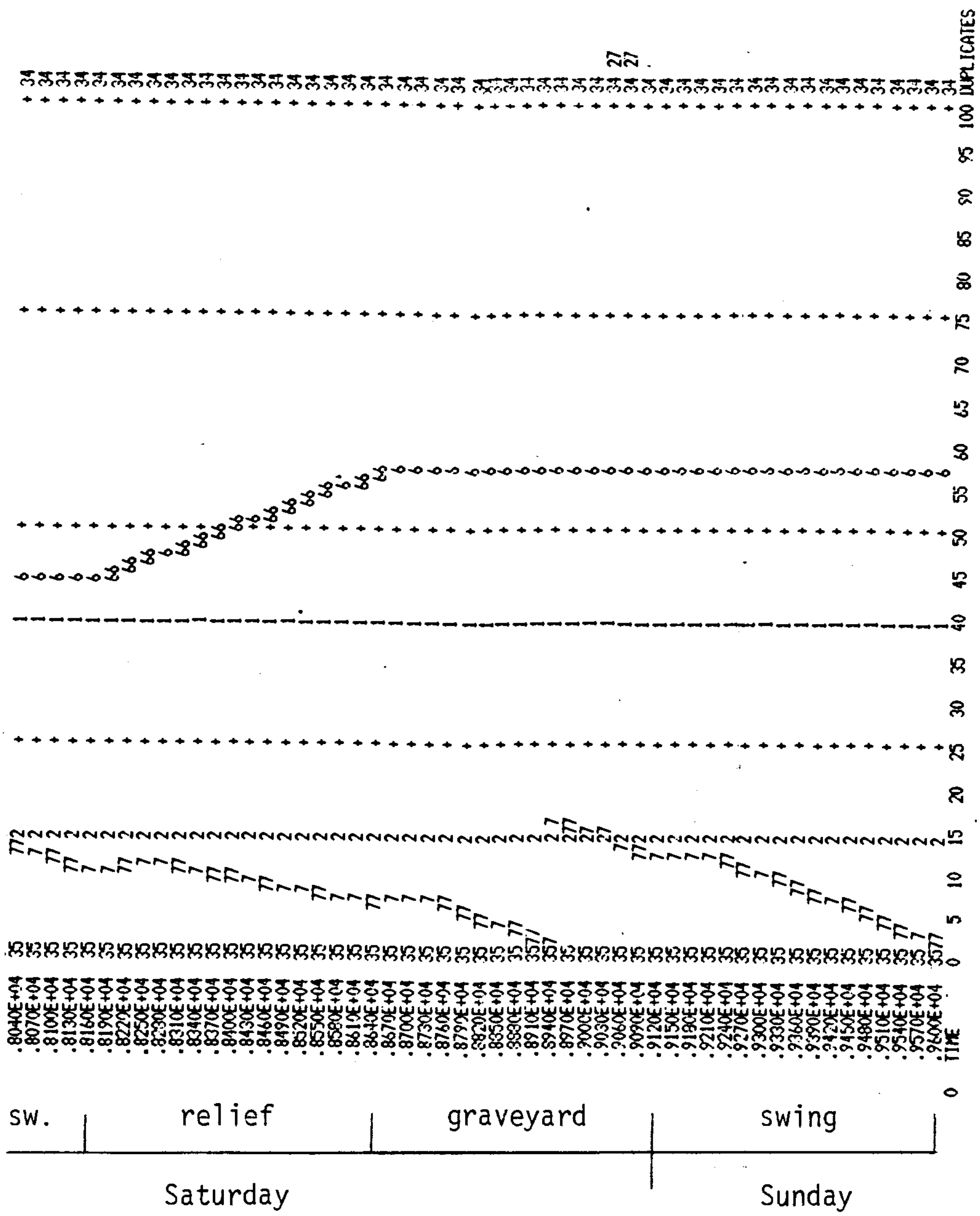

relief
day
swing
relief
day
Monday
Tuesday
Wednesday



day	swing	graveyard	day	relief	gr.

Wednesday	Thursday

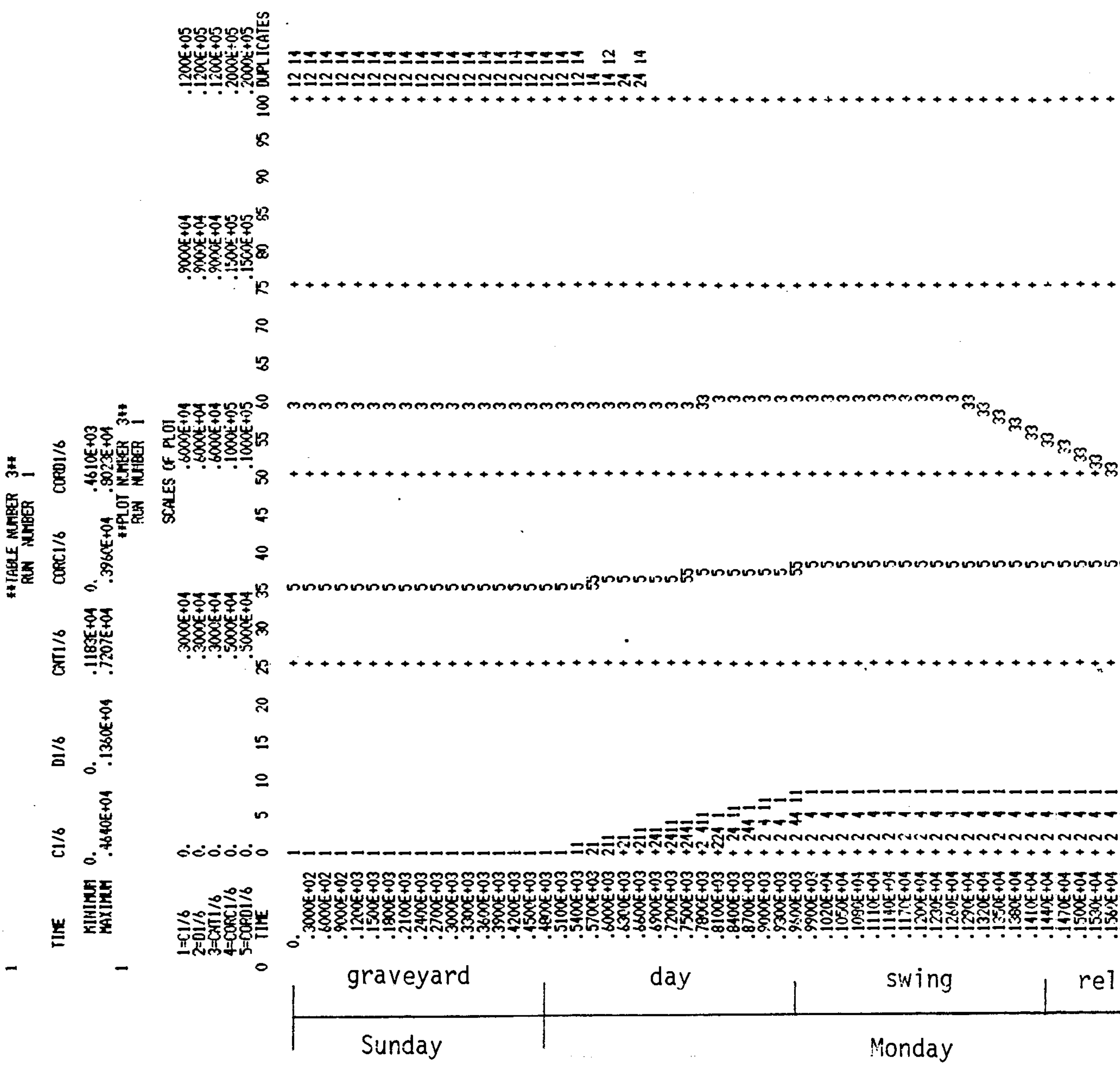

graveyard
day
relief
graveyard
swing
Thursday
Friday
Saturday



OUTPUT CONSISTS OF 9223 POINT SETS (64561 POINTS)

Plot # 3 - Run # 1

Veneer stock



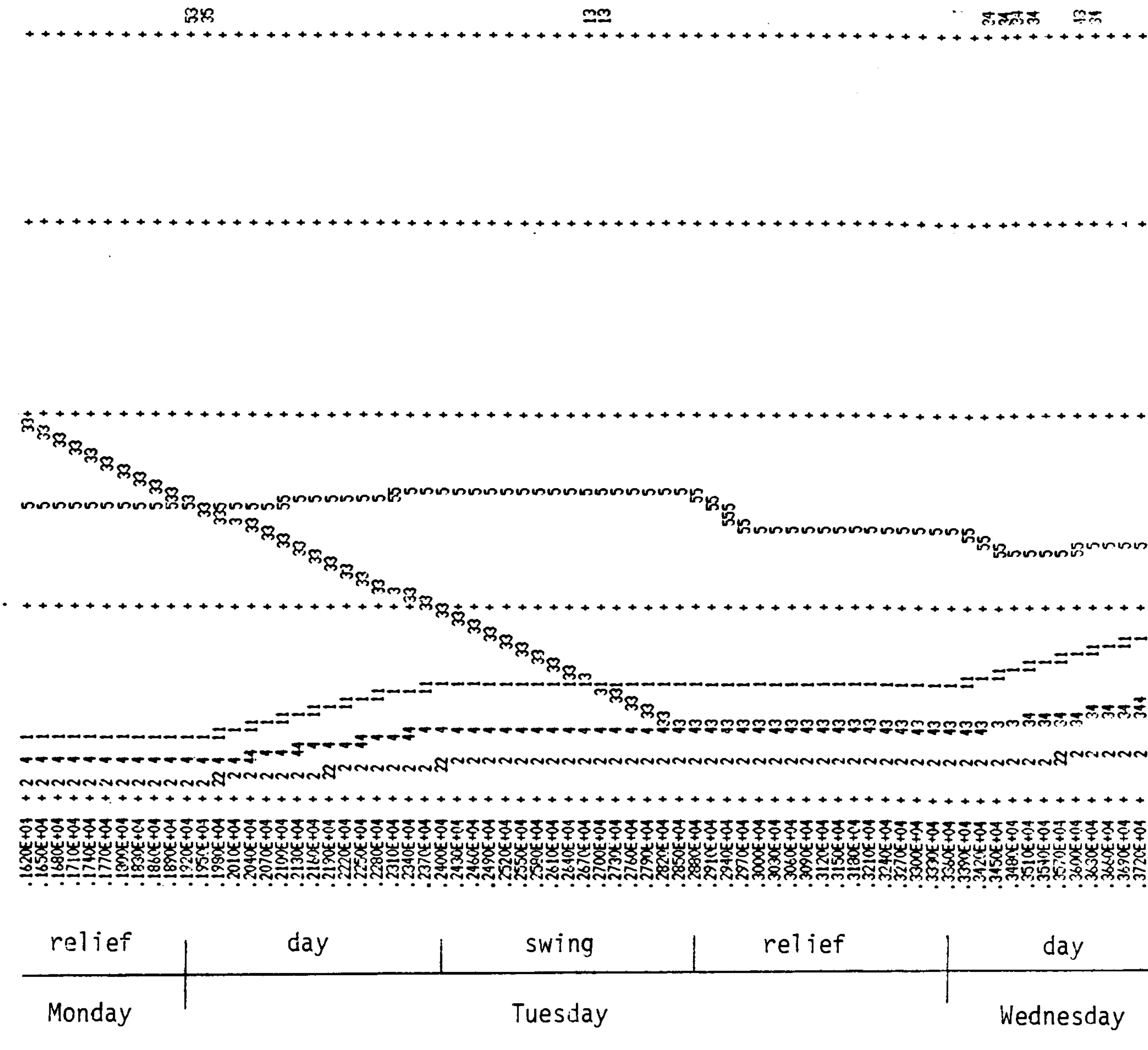
codes : 1 - 1/6" 27-54" C

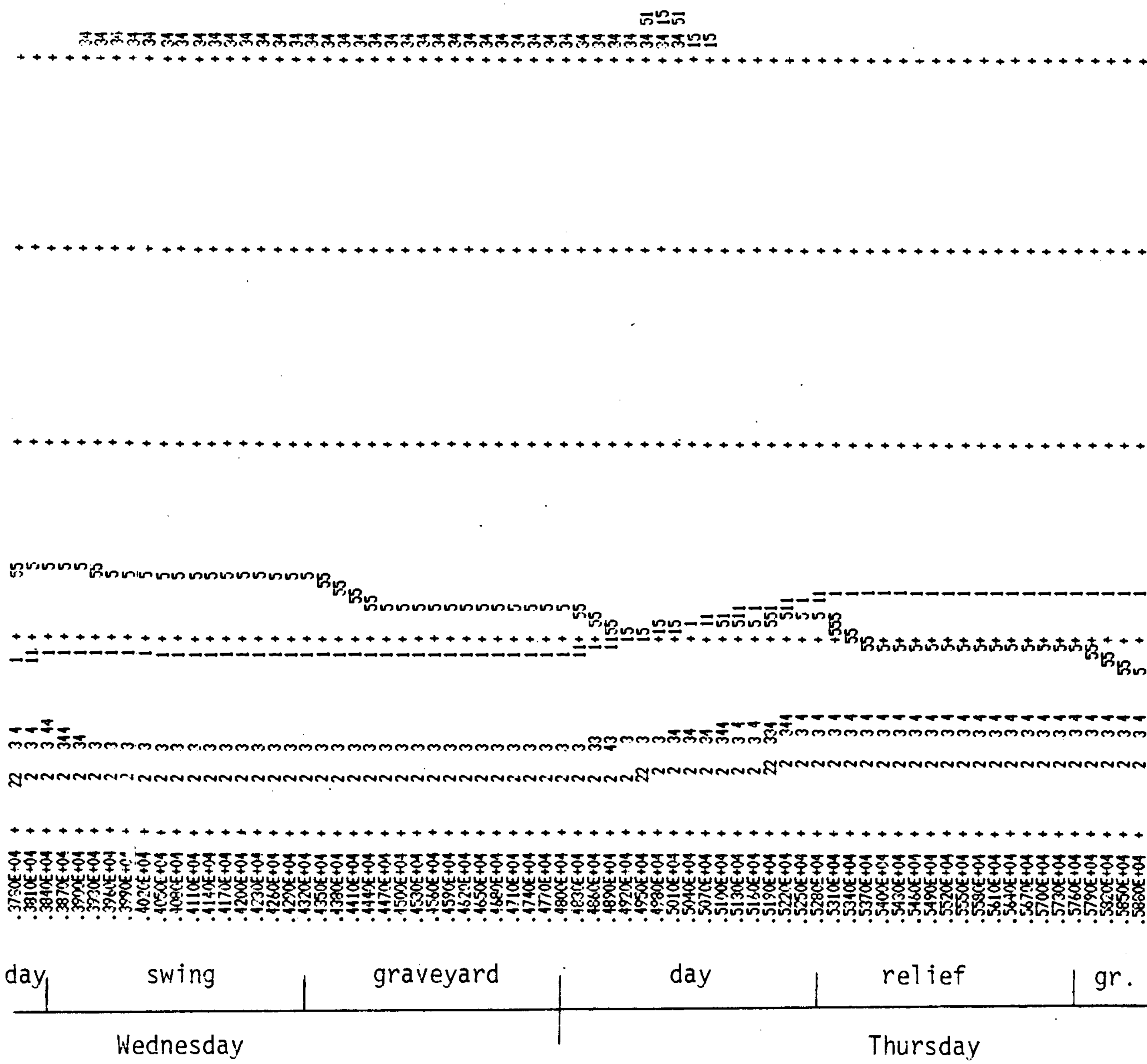
2 - 1/6" 27-54" D

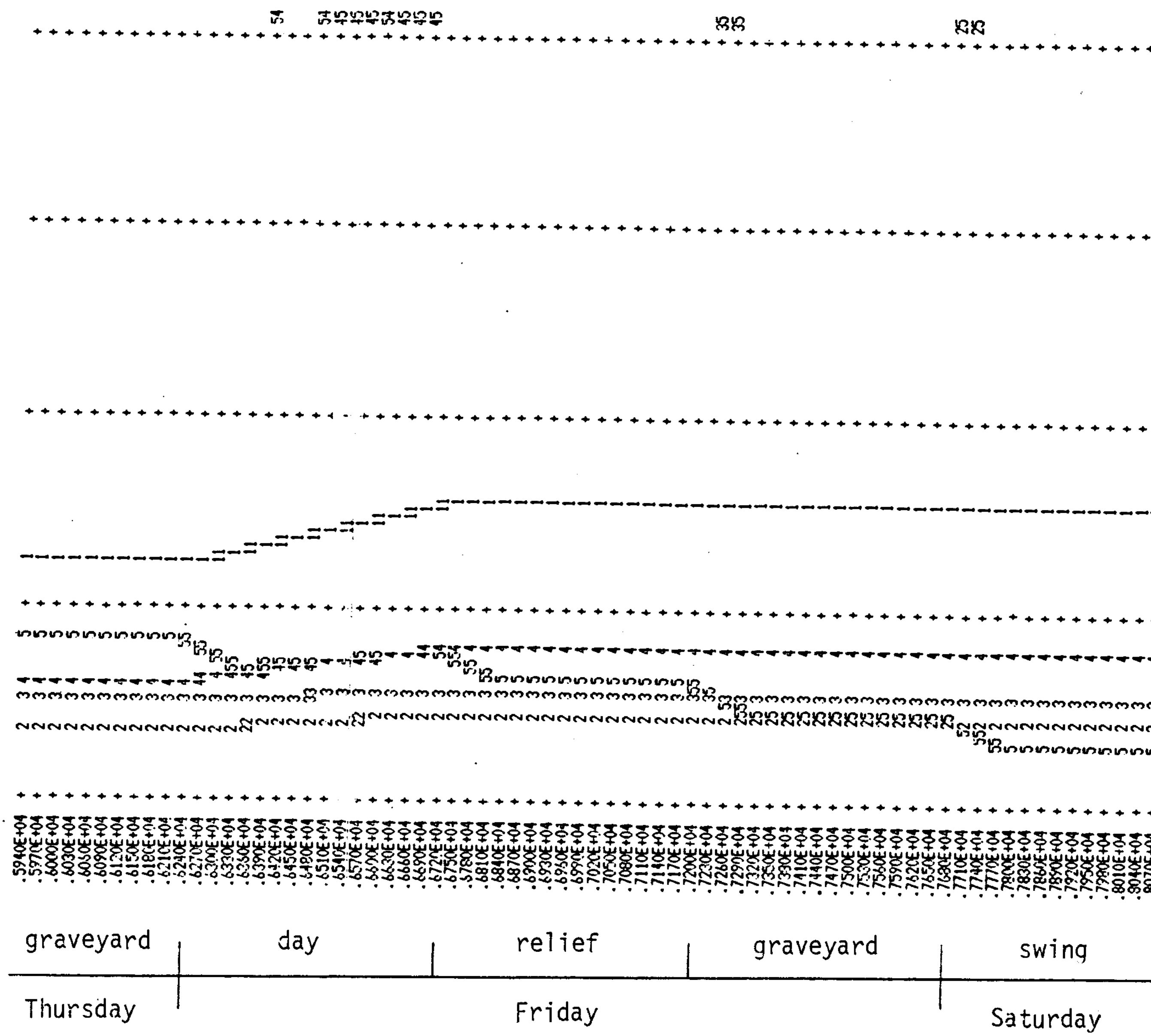
3 - 1/6" 27-54" Centers

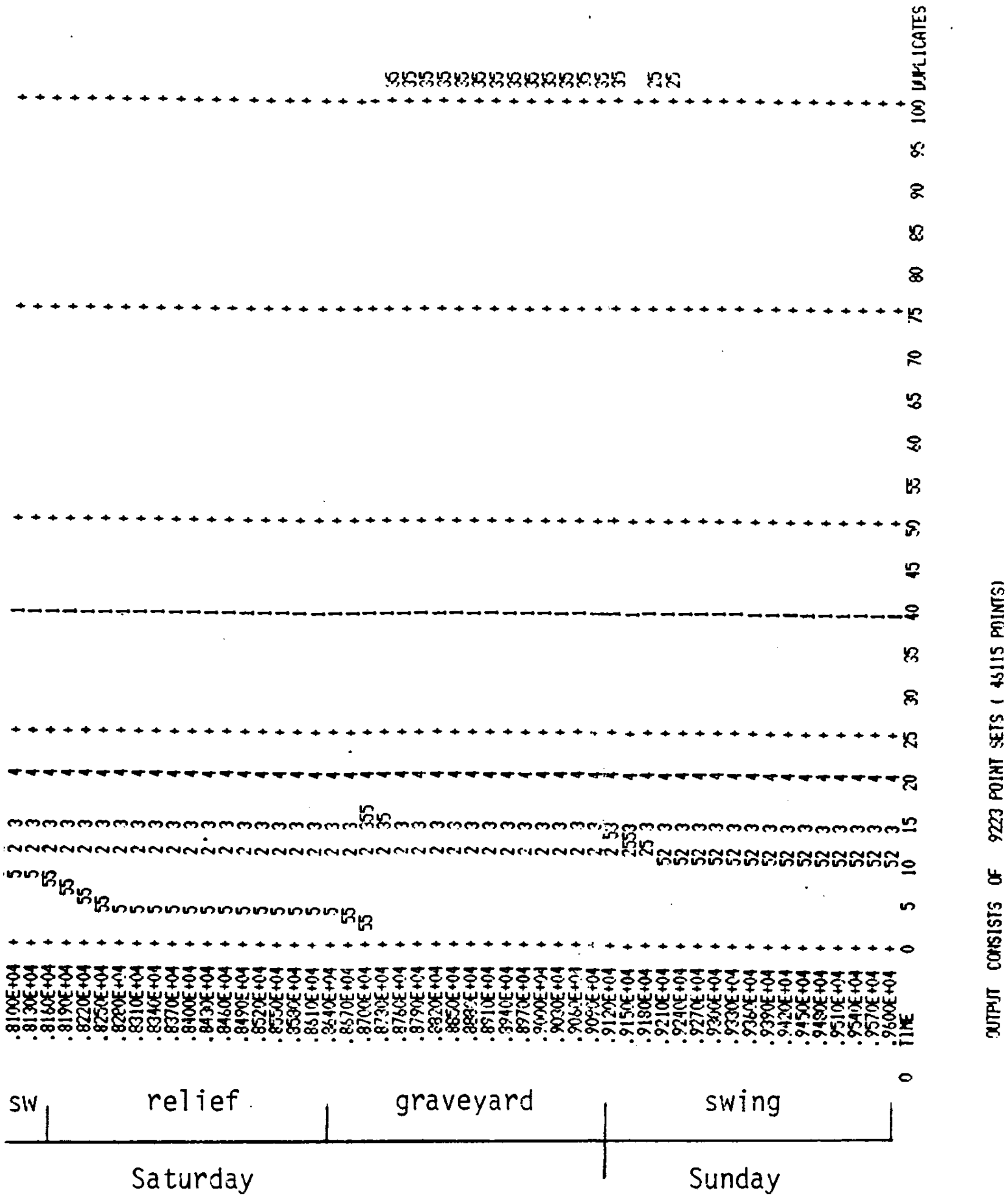
4 - 1/6" strips Cores C

5 - 1/6" strips Cores D


relief
day
swing
relief
day
Monday
Tuesday
Wednesday

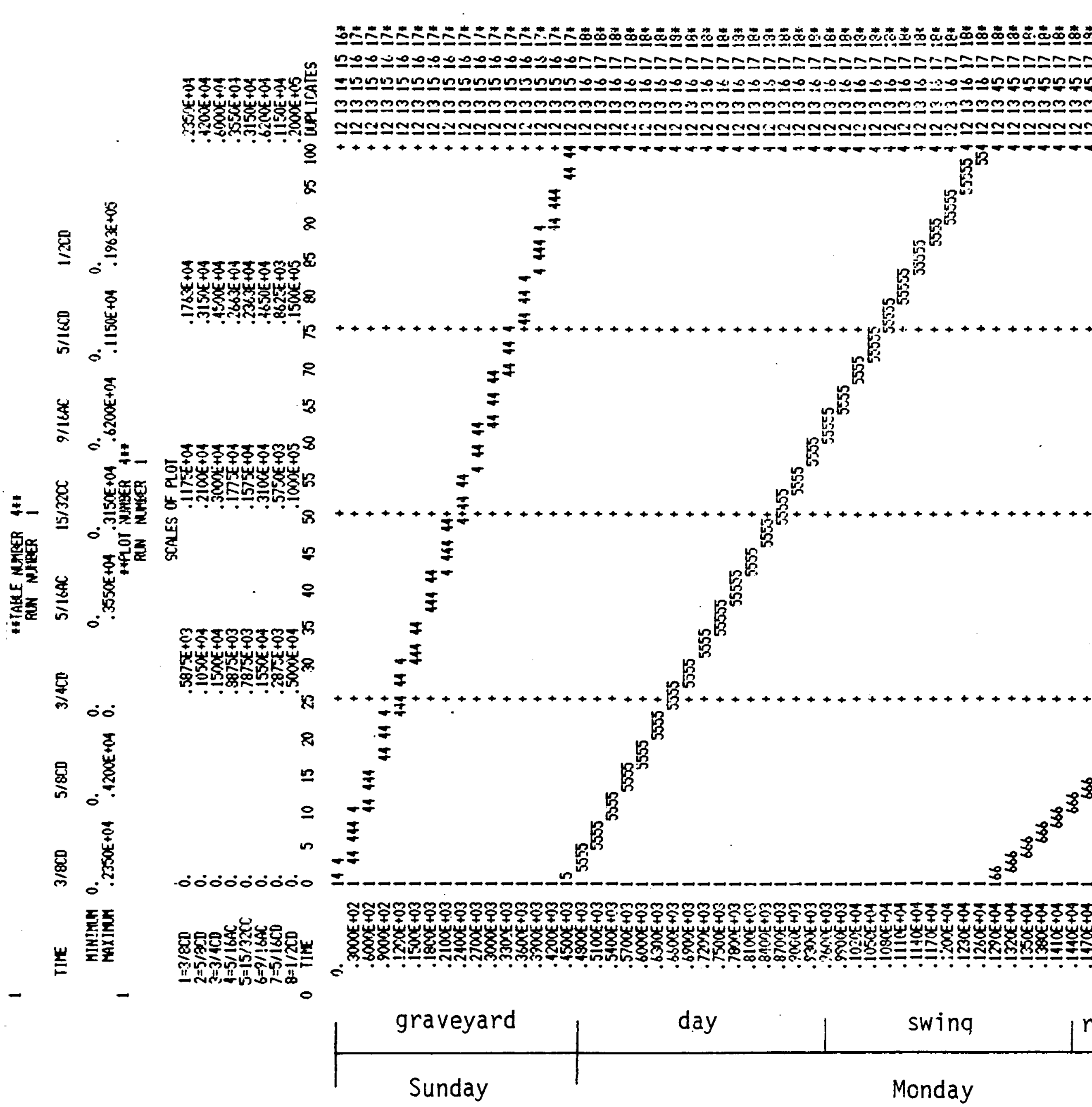

day
swing
graveyard
day
relief
gr.
Wednesday
Thursday


graveyard
day
relief
graveyard
swing
Thursday
Friday
Saturday

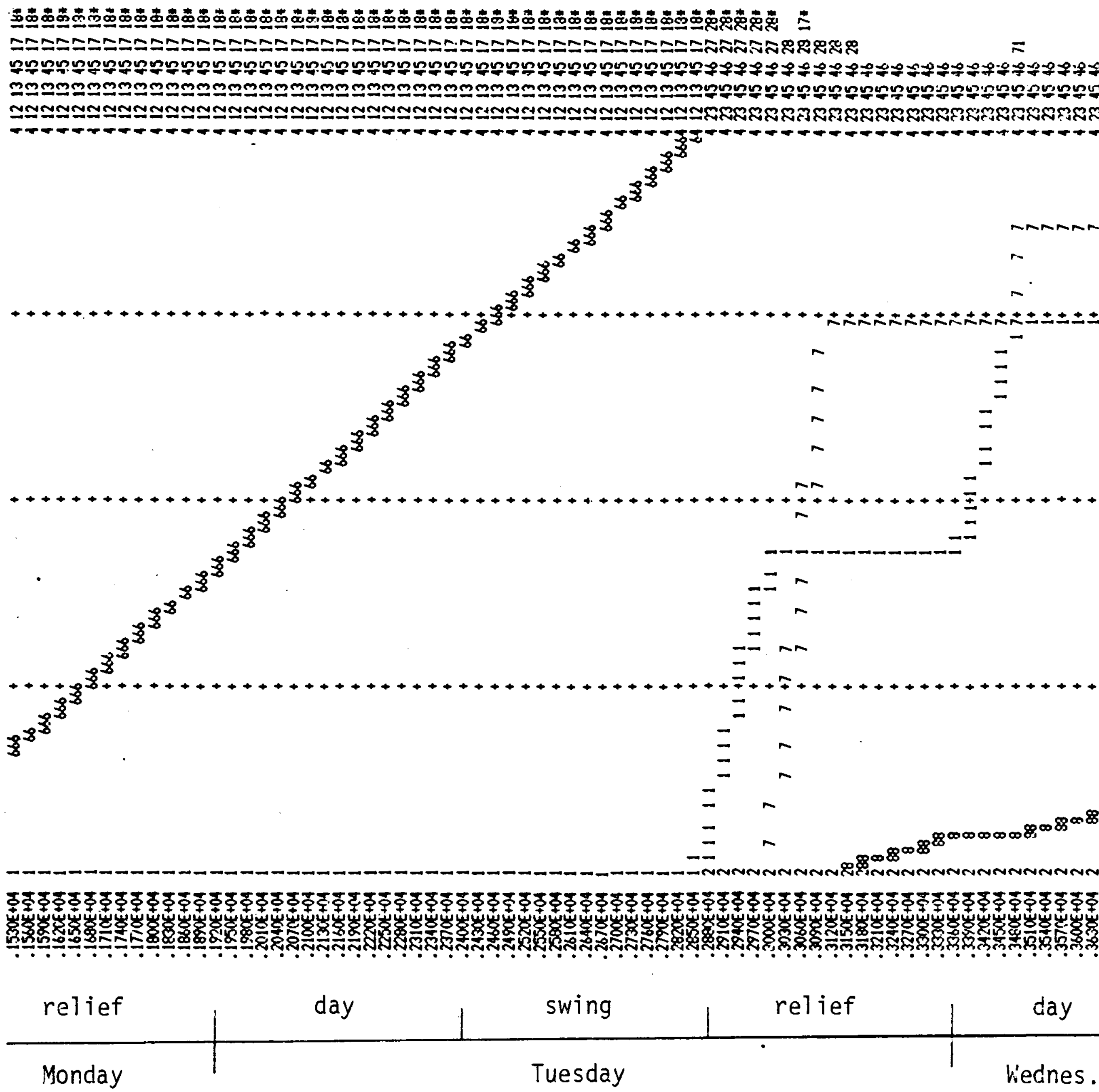

DUPLICATES
TIME
OUTPUT CONSISTS OF 9223 POINT SETS (46115 POINTS)
sw
relief
graveyard
swing
Saturday
Sunday

Plot # 4 - Run # 1

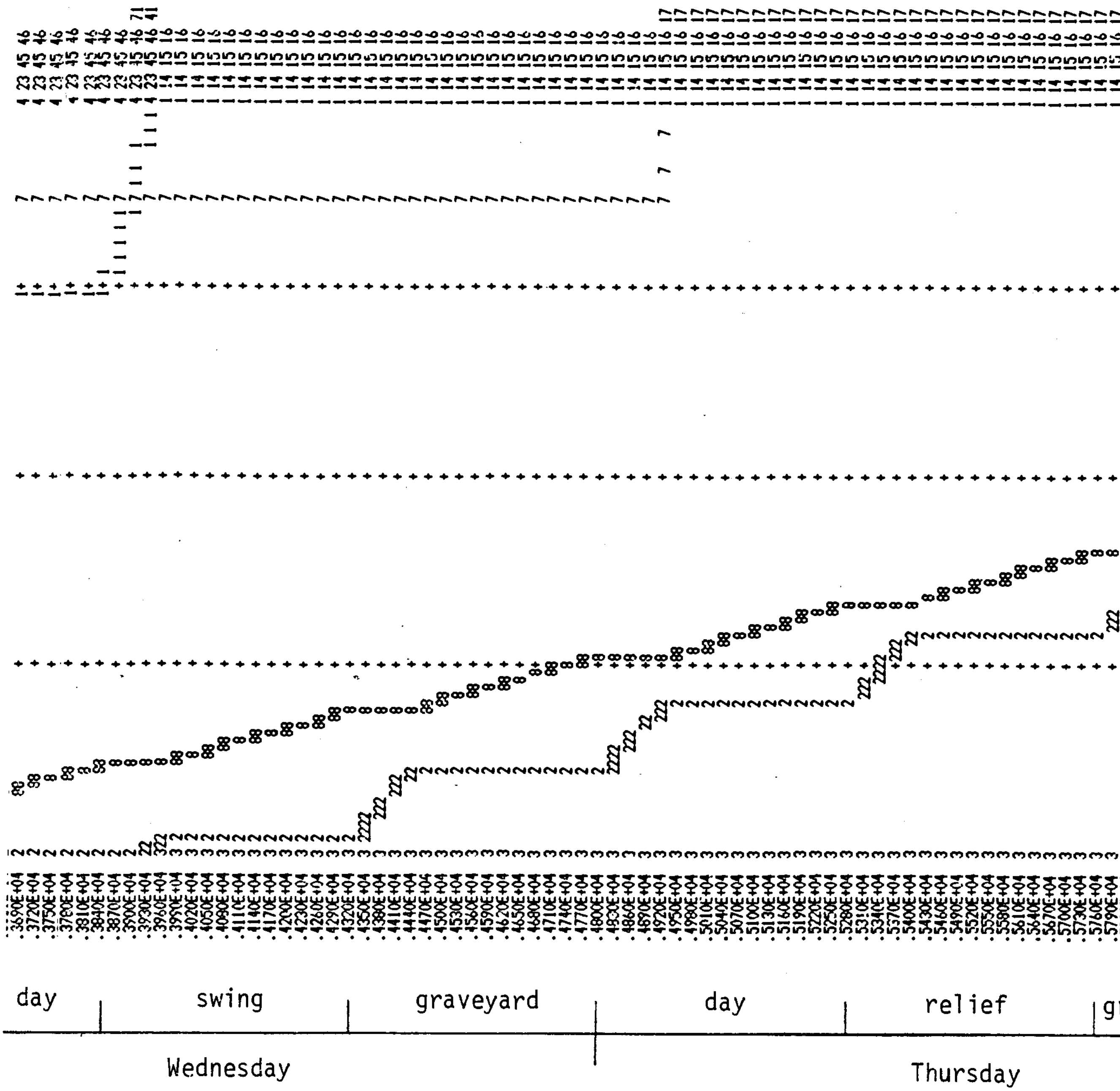
Assembled production

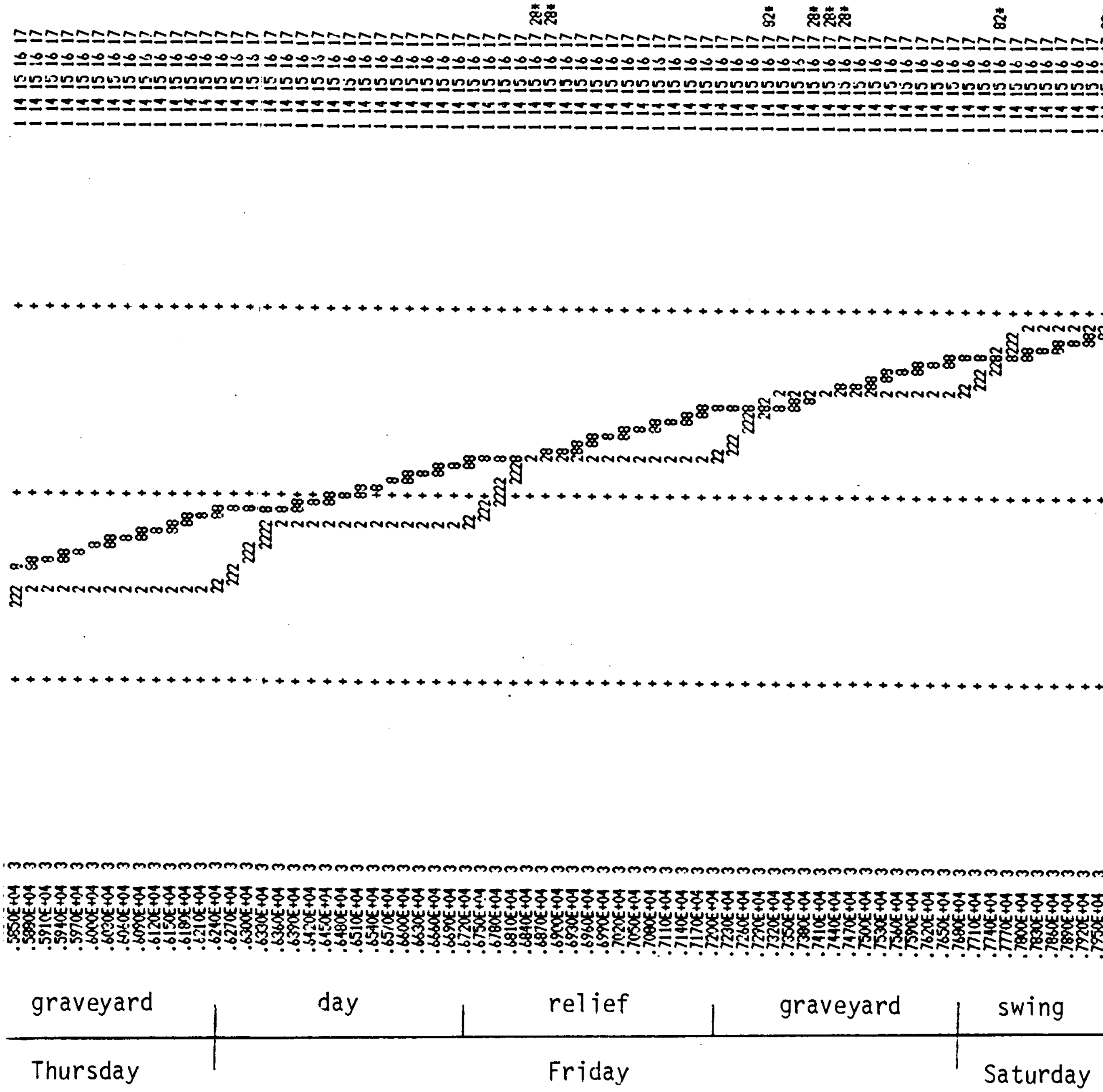


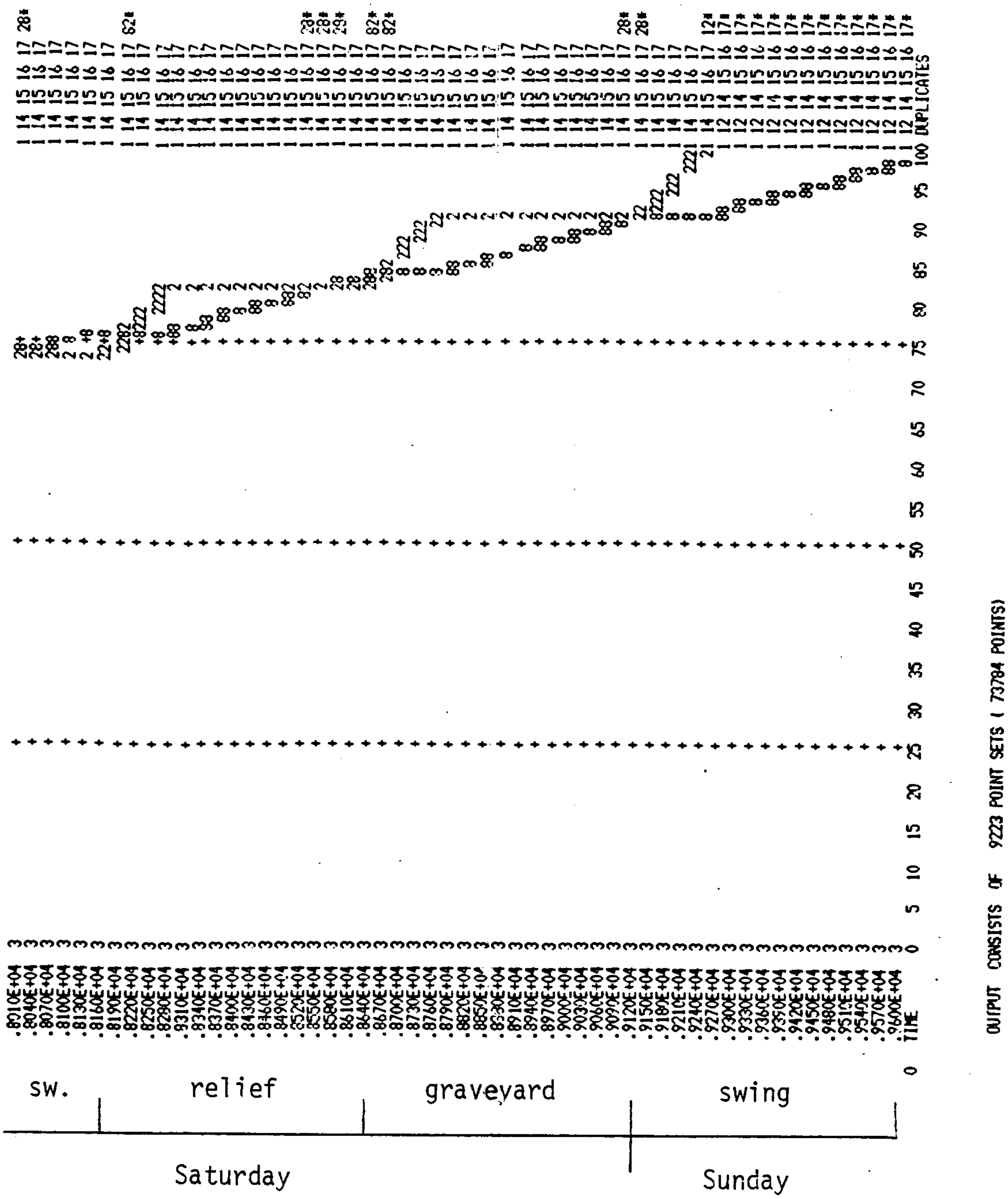
index codes same as panel codes



relief
day
swing
relief
day
Monday
Tuesday
Wednes.


day
swing
graveyard
day
relief
Wednesday
Thursday

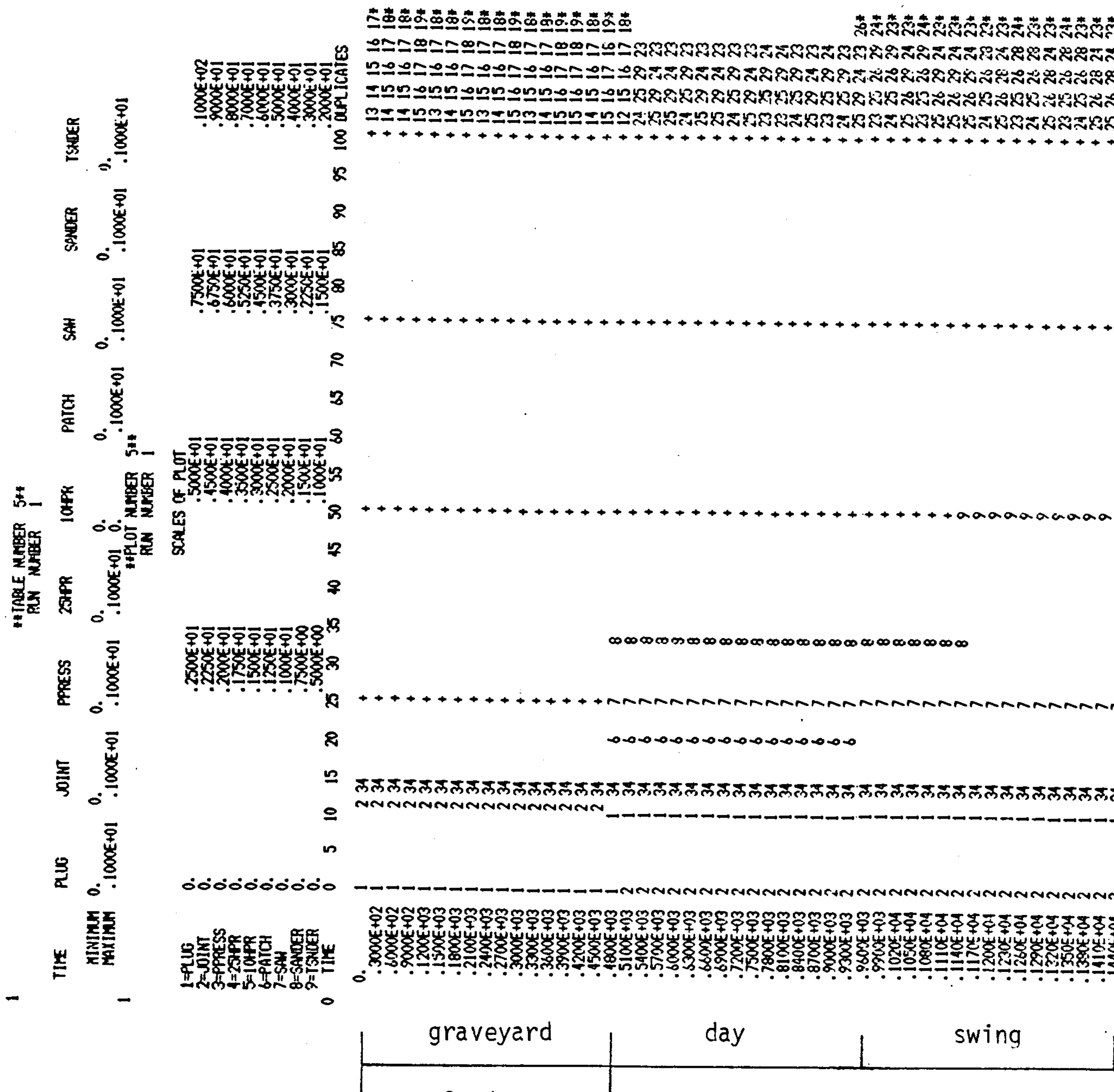

graveyard
day
relief
graveyard
swing
Thursday
Friday
Saturday



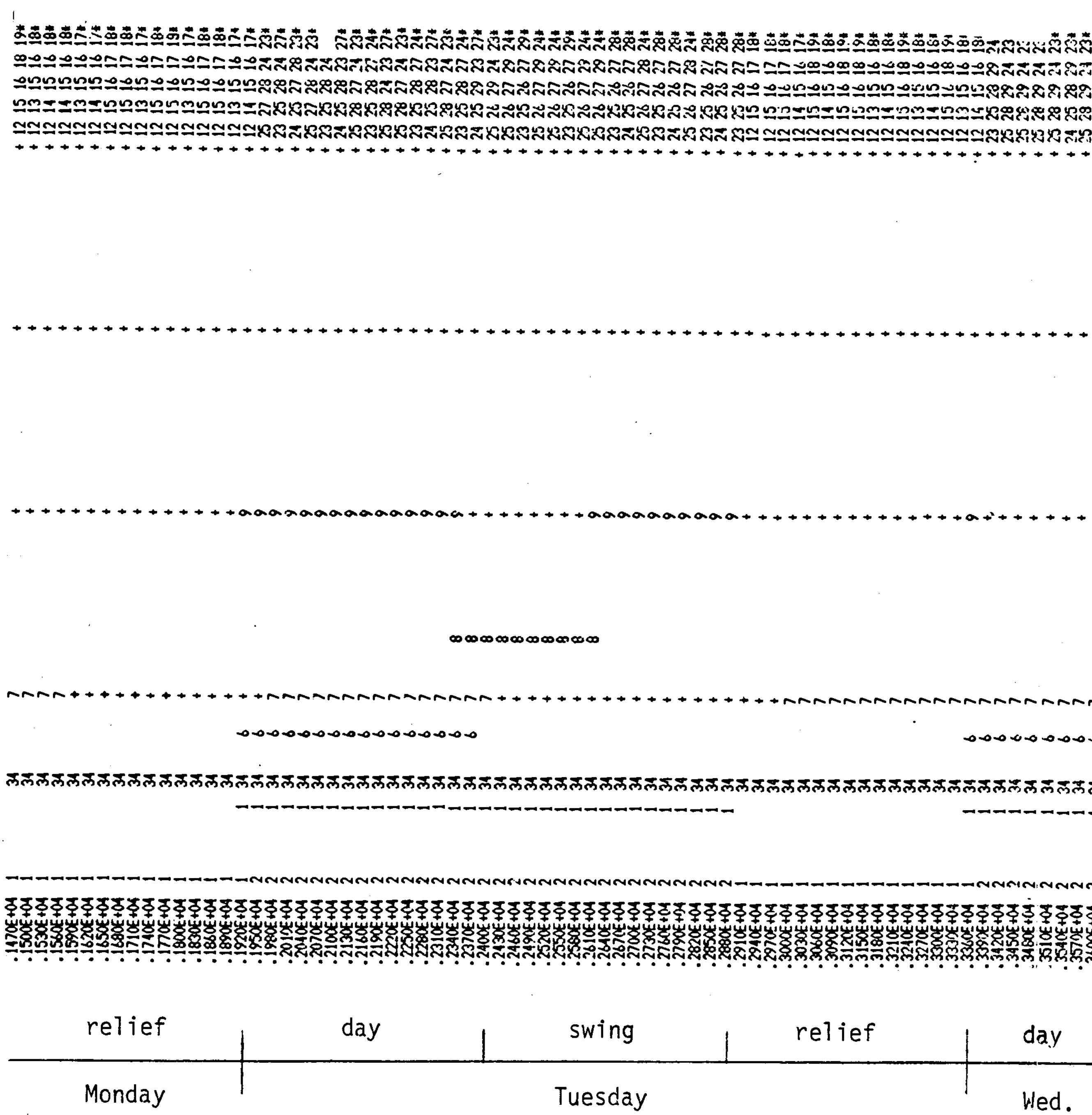
TIME
DUPLICATES
OUTPUT CONSISTS OF 9223 POINT SETS (73784 POINTS)
sw.
relief
graveyard
swing
Saturday
Sunday

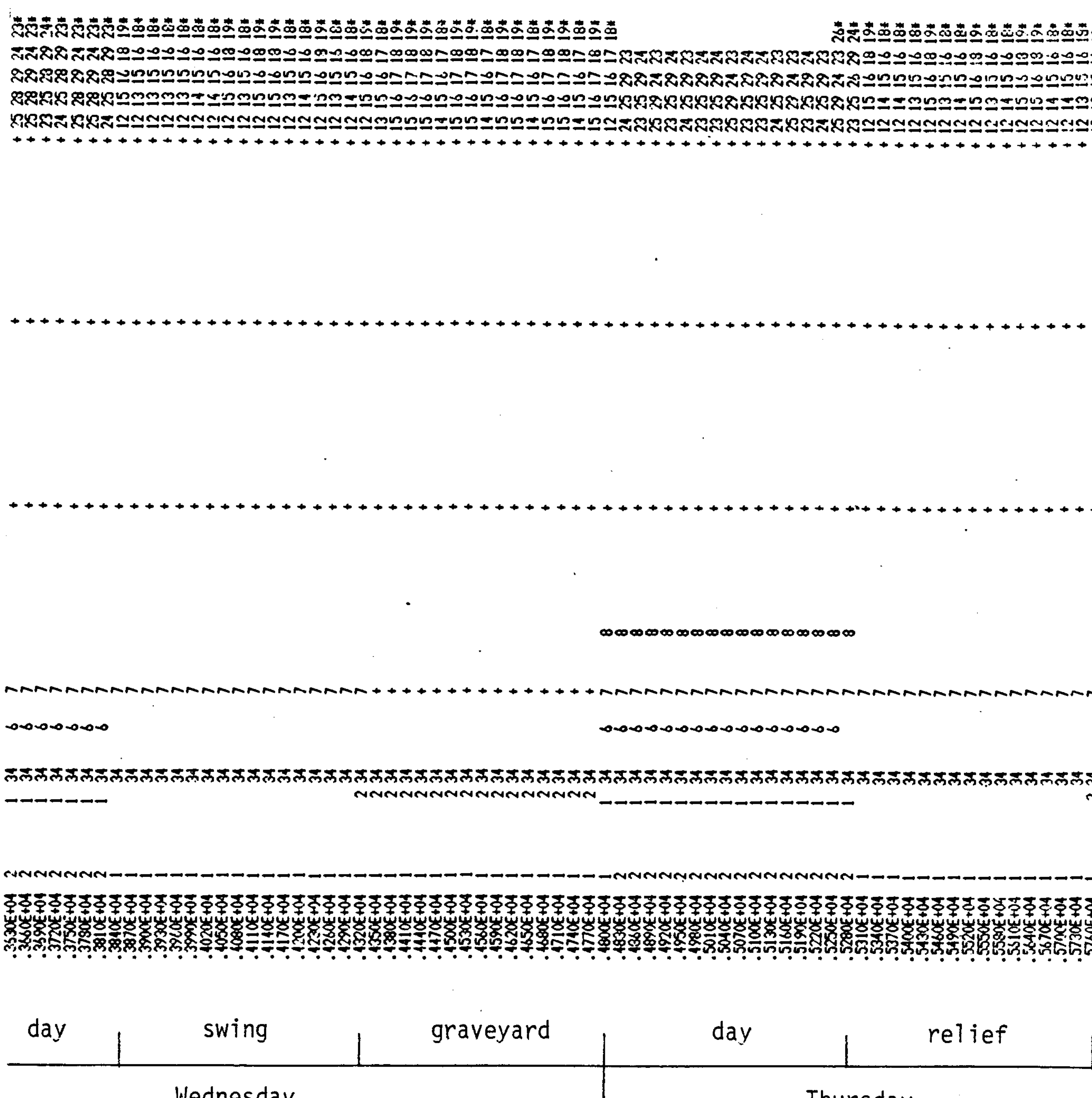
Plot # 5 - Run # 1

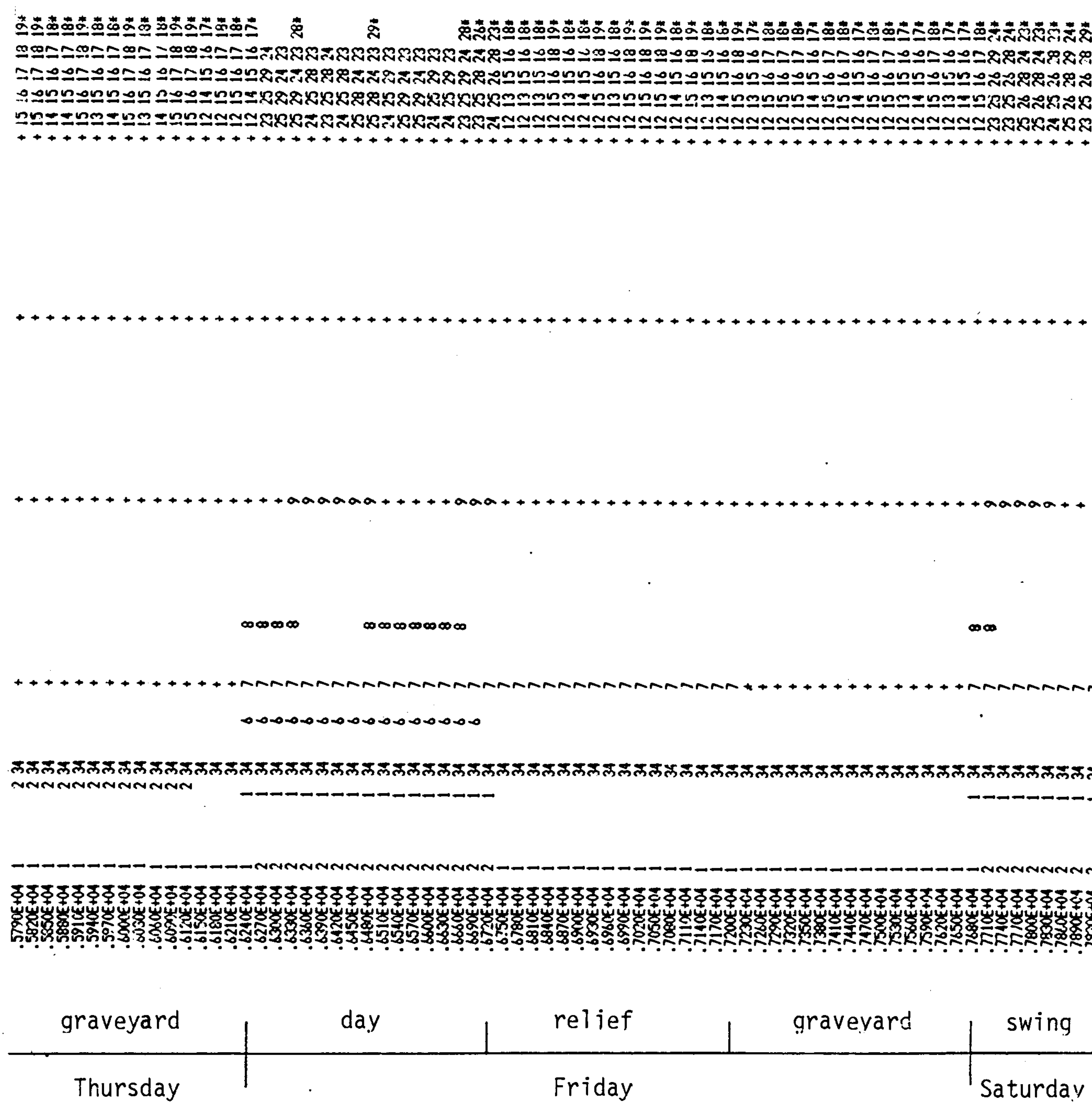
Utilizations of production centers

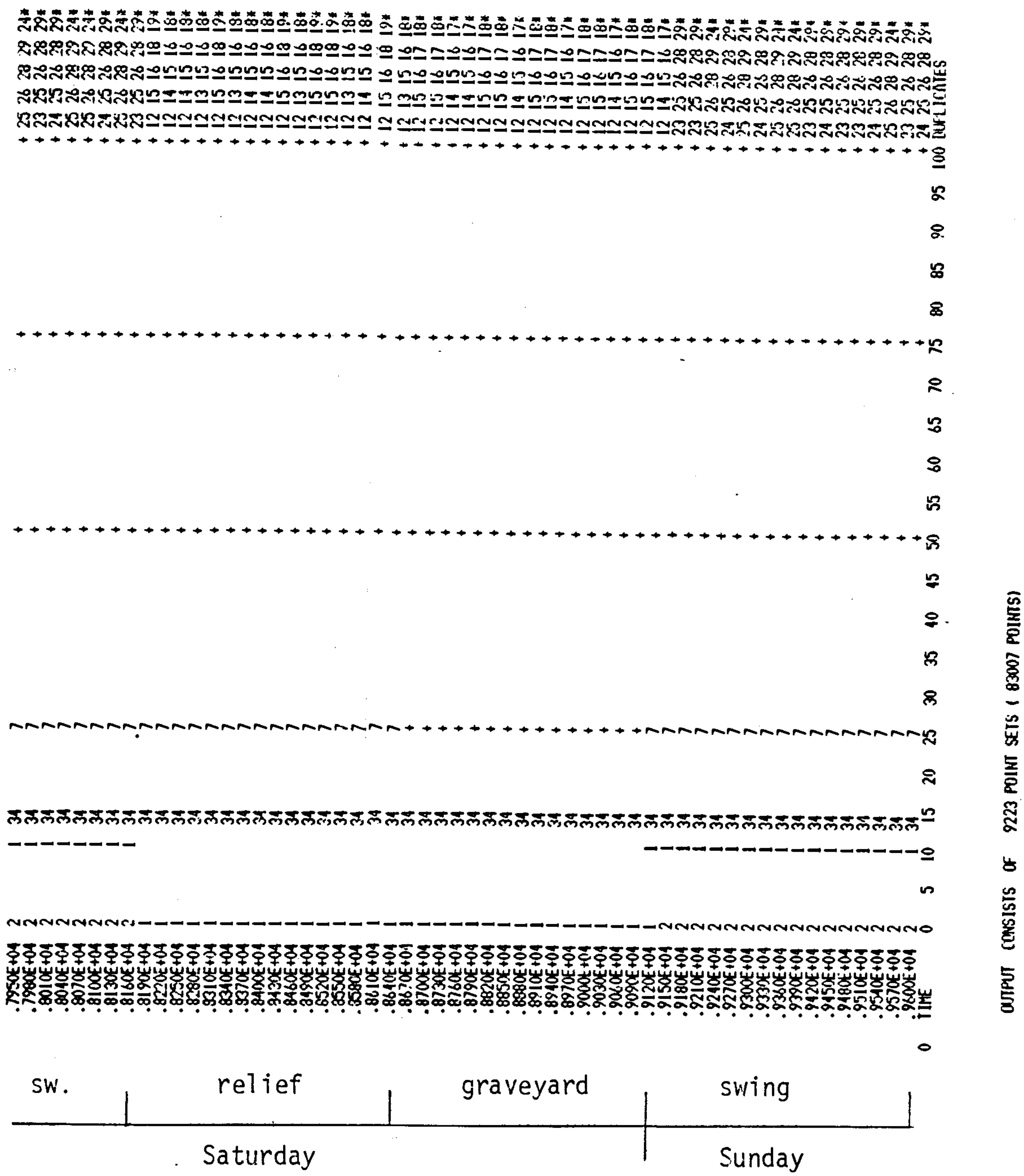


codes : 1 - Pluggers
2 - Jointer
3 - Pre-press
4 - 25 op. hot press
5 - 10 op. hot press
6 - Patch line
7 - Saw
8 - Sander
9 - Speed sander


relief
day
swing
relief
day
Monday
Tuesday
Wed.


day
swing
graveyard
day
relief
Wednesday
Thursday


graveyard
day
relief
graveyard
swing
Thursday
Friday
Saturday


OUTPUT CONSISTS OF 9223 POINT SETS (83007 POINTS)
TIME
DUPLICATES
sw.
relief
graveyard
swing
Saturday
Sunday

INTERMEDIATE RESULTS (RUN # 2)

PURCHASED 4414 GOOD DRY VENEERS - CODE 36 AT TIME 1416.6

PURCHASED 4424 GOOD DRY VENEERS - CODE 36 AT TIME 2467.8

PURCHASED 2662 GOOD DRY VENEERS - CODE 67 AT TIME 8692.3

PURCHASED 4422 GOOD DRY VENEERS - CODE 37 AT TIME 8942.9

PURCHASED 4421 GOOD DRY VENEERS - CODE 14 AT TIME 8962.1

DRY VENEER PURCHASES

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	0	0	15425	15216	4625			0
1/10-27			6625	4635	1985		0	0
1/10-STRIPS						14570	7508	
1/6-27/54			0	0	0			
1/6-STRIPS						0	2662	

DRYER GOOD PRODUCTION

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	0	0	46746	11607	0			11607
1/10-27			0	0	0		0	0
1/10-STRIPS						18880	10160	
1/6-27/54			4640	1360	880			
1/6-STRIPS						4560	2480	

FINAL CONDITIONS

(RUN # 2)

DRY VENEER STOCK

	A GRADE	B GRADE	C GRADE	D GRADE	CENTERS	CORES C	CORES D	B PATCH
1/10-54	2698	6604	31597	4077	1092			2353
1/10-27			25	1735	10		0	1795
1/10-STRIPS						17059	655	
1/6-27/54			4640	1360	1711			
1/6-STRIPS						3960	2023	

PANEL STOCK

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
IN HOT STACK	0	0	0	0	0	0	0	4625
BEFORE SAW	0	0	0	30	0	80	0	0
BEFORE PATCH	0	0	0	0	39	0	0	0
TO REPATCH	0	0	0	4	0	30	0	0
BEFORE SANDER	0	0	0	0	0	0	0	0
BEFORE TSANDER	0	0	0	0	235	0	0	0

PRODUCTION

PANEL TYPE	3/8 CD	5/8 CD	3/4 CD	5/16 AC	15/32 CC	9/16 AC	5/16 CD	1/2 CD
GLUED PANELS	2350	4200	0	3550	3150	6200	1150	19625
PRESSED PANELS	2350	4200	0	3550	3150	6200	1150	19600
GOOD LOADS	35	73	0	31	50	109	12	223
MILL CERT LDS	1	2	0	0	0	0	0	6
SHOP LOADS	1	2	0	1	1	4	0	6
DELAMIN. LOADS	0	0	0	0	0	0	0	2
UNBANDED GOOD PAN.	81	36	0	105	15	23	149	27
UNBANDED MILL CERT.P.	14	20	0	0	0	0	34	52
UNBANDED SHOP PANELS	14	20	0	47	44	44	34	52
UNBANDED DELAMIN.PAN.	34	42	0	47	40	61	11	17

GASP SUMMARY REPORT (RUN # 2)

SIMULATION PROJECT NUMBER 1 BY ULRICH

DATE 7/ 1/ 82 RUN NUMBER 1 OF 1

CURRENT TIME = .9600E+04

STATISTICS FOR VARIABLES BASED ON OBSERVATION

	MEAN	STD DEV	SD OF MEAN	CV	MINIMUM	MAXIMUM	OBS
OPAT	.6537E+01	.3077E+00	.8031E-02	.4707E-01	.6410E+01	.7280E+01	1468
TOAT	.9532E+01	.3084E+00	.8049E-02	.3233E-01	.9410E+01	.1028E+02	1468
HOTST	.1262E+04	.7599E+03	.2122E+02	.6022E+00	.1202E+03	.3618E+04	1282

STATISTICS FOR TIME-PERSISTENT VARIABLES

	MEAN	STD DEV	MINIMUM	MAXIMUM	TIME INTERVAL	CUR. VALUE
BUSPLG	.4156E+00	.4928E+00	0.	.1000E+01	.9600E+04	0.
BUSJNT	.2344E+00	.4236E+00	0.	.1000E+01	.9600E+04	0.
BUSPPR	.4587E+00	.4983E+00	0.	.1000E+01	.9600E+04	0.
BUS25	.8877E+00	.3158E+00	0.	.1000E+01	.9600E+04	.1000E+01
BUS10			NO VALUES RECORDED			
BUSPAT	.4751E+00	.4994E+00	0.	.1000E+01	.9600E+04	0.
BUSSAW	.6701E+00	.4702E+00	0.	.1000E+01	.9600E+04	.1000E+01
BUSSND	.2568E+00	.4369E+00	0.	.1000E+01	.9600E+04	0.
BUSTSN	.2270E+00	.4189E+00	0.	.1000E+01	.9600E+04	0.

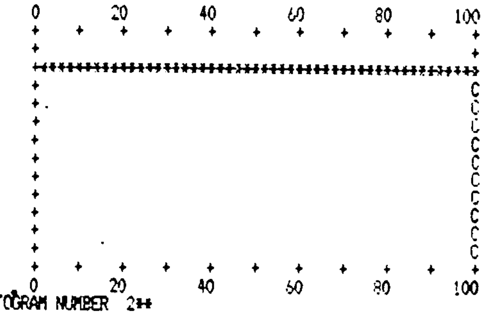
GASP FILE STORAGE AREA DUMP AT TIME .9600E+04

(RUN # 2)

HISTOGRAM NUMBER 1

OPAT

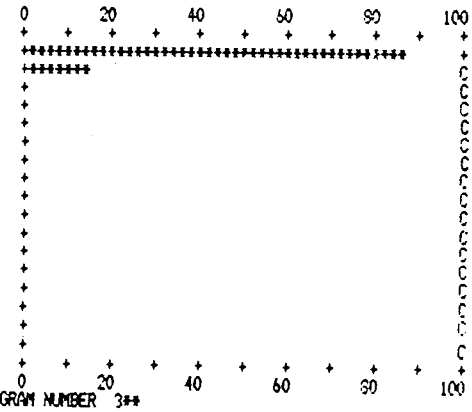
OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
0	0.000	0.000	.5000E+01
1468	1.000	1.000	.1000E+02
0	0.000	1.000	.1500E+02
0	0.000	1.000	.2000E+02
0	0.000	1.000	.2500E+02
0	0.000	1.000	.3000E+02
0	0.000	1.000	.3500E+02
0	0.000	1.000	.4000E+02
0	0.000	1.000	.4500E+02
0	0.000	1.000	.5000E+02
0	0.000	1.000	.5500E+02
0	0.000	1.000	INF
1468			



HISTOGRAM NUMBER 2

TOAT

OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
1251	.852	.852	.1000E+02
217	.148	1.000	.1500E+02
0	0.000	1.000	.2000E+02
0	0.000	1.000	.2500E+02
0	0.000	1.000	.3000E+02
0	0.000	1.000	.3500E+02
0	0.000	1.000	.4000E+02
0	0.000	1.000	.4500E+02
0	0.000	1.000	.5000E+02
0	0.000	1.000	.5500E+02
0	0.000	1.000	.6000E+02
0	0.000	1.000	.6500E+02
0	0.000	1.000	.7000E+02
0	0.000	1.000	.7500E+02
0	0.000	1.000	.8000E+02
0	0.000	1.000	.8500E+02
0	0.000	1.000	INF
1468			



HISTOGRAM NUMBER 3

HOTST

OBSV FREQ	RELA FREQ	CUML FREQ	UPPER CELL LIMIT
0	0.000	0.000	.1200E+03
174	.136	.136	.1800E+03
27	.021	.157	.2400E+03
5	.004	.161	.3000E+03
0	0.000	.161	.3600E+03
7	.005	.166	.4200E+03
59	.046	.212	.4800E+03
19	.015	.227	.5400E+03
26	.020	.247	.6000E+03
39	.030	.278	.6600E+03
61	.048	.325	.7200E+03
5	.004	.329	.7800E+03
0	0.000	.329	.8400E+03
4	.003	.332	.9000E+03
7	.005	.338	.9600E+03
6	.005	.342	.1020E+04
6	.005	.347	.1080E+04
6	.005	.352	.1140E+04
31	.024	.376	.1200E+04
35	.027	.403	.1260E+04
39	.030	.434	.1320E+04
726	.566	1.000	INF
1282