PARVCOST:
A PARTICLEBOARD VARIABLE COST PROGRAM

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FOREST SERVICE
FOREST PRODUCTS LABORATORY
MADISON, WIS.

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ABSTRACT

PARVCOST, a FORTRAN program, was designed to develop economic and financial analyses of systems for manufacturing particleboard. In the program, costs and requirements of wood are calculated as are chemicals and energy per unit of finished board products. Estimates are made of sensitivity of the finished product costs to changes in unit costs of energy and raw materials. Weight statistics are computed for the finished product and for the profit contribution ratio for values of given products. An appendix is included with a sample program output, two versions of data decks and modifications, notes on use of the two versions, and a listing of the program and documentation cards.
PARVCOST: A PARTICLEBOARD VARIABLE COST PROGRAM

By
Peter J. Ince, Statistical Assistant
George B. Harpole, Economist
Forest Products Laboratory, Forest Service
U.S. Department of Agriculture

INTRODUCTION

A computer program for the variable cost manufacturing systems. PARVCOST, was developed by the Marketing and Economics Analysis Research Work Unit of the Forest Products Laboratory (FPL). The objective was to automate the computations of raw material and energy unit cost, board statistics, and energy requirements for particleboard manufacture from estimates of material costs and energy requirements. Many of the basic concepts used in PARVCOST were adapted from a computer program developed by G. A. Koenigshof, USDA, Forest Service, Athens, Ga., to evaluate veneered particleboard products Laboratory, and a DATAcraft 6024/3 (FPL).

Appended to this report are the following: A sample program output; a listing of a long (documented) version data deck; a sample of a short version data deck; two program cards needed for modification of the two versions; notes on use of the two versions; and a listing of the PARVCOST program and documentation cards.

COMPUTATIONS

PARVCOST calculates costs and requirements of wood, chemicals, and energy per unit of finished board product. It estimates sensitivity of costs of finished products to changes in costs of units of energy and raw materials. It also computes weight statistics for the finished product and the profit contribution ratio for given product values.

Raw Materials, Energy, and Costs

PARVCOST computes input requirements for raw material and energy and variable costs of particleboard manufacture in standard units of finished product output (Mft\(^2\)·3/8 in., Mft\(^2\)·1/2-in., m\(^3\)). Computational outputs of PARVCOST (appendix A) are derived from estimates of process and supply requirements.

Gross input requirements per unit of output for particleboard manufacture are always greater than the final amount of raw materials that physically appear in a unit of the finished product. This is caused by fines, trims, and other processing material and energy losses. The phrase "per unit of output" in this program refers to the gross input requirements per unit of finished board product. Variable costs of production are calculated as gross input requirements per unit of product multiplied by estimated price for given raw material and energy input.

1/ The Laboratory is maintained in cooperation with the University of Wisconsin-Madison.

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If an external fuel, in addition to residues fuels, is needed, PARVCOST selects the least expensive alternative fuel—wood, oil, gas, or coal—on the basis of cost per effective heating value. Energy requirements and costs are computed in terms of the least expensive fuel available.

**Sensitivity of Unit Variable Costs**

Another objective of PARVCOST is to gage the sensitivity of total gross variable cost to possible changes in individual market costs of raw material (wood, resin, and wax) and energy (electricity and fuel). Sensitivity of total gross variable cost to the cost for each of these is given in the PARVCOST printed output in terms of total gross variable cost per cubic foot of finished product. Sensitivity is expressed as simple linear equations of the form,

\[ Y = AX + B \]

where

- \( Y \) is total gross variable cost per cubic foot of panel product;
- \( A \), a “slope” coefficient calculated by the program;
- \( X \), an individual item cost on an input basis (wood cost in $/ft^3, price of oil in $/barrel); and
- \( B \), a constant term calculated by the program.

Sensitivity equations provide for determining the effect that changes in input prices for raw materials will have on total gross variable cost per cubic foot of finished product. If there is a change in the cost of one raw material, the new total gross variable cost can be calculated by simply applying a sensitivity equation to the new cost of that raw material.

The effect of any magnitude of change in cost of wood raw material, resin, wax, or electricity can be evaluated using the appropriate sensitivity equation. Gross variable cost is a strictly linear function of cost of wood, resin, wax, and electricity for any value of these individual costs. However, only the effect of marginal changes in fuel costs can be evaluated by the sensitivity to the fuel-cost formula. PARVCOST always selects the least expensive fuel on the basis of cost per effective British thermal unit. Large changes in fuel cost may result in substituting one fuel for another.

**Profit Contribution Ratio**

PARVCOST calculates a profit contribution ratio. Profit contribution is the net sales value plus any benefits from the sale of surplus residues minus variable costs of production. The profit contribution ratio is the ratio of the profit contribution to the net sales value, which expresses the percent of revenues available to cover other operating costs and yield profits. The PARVCOST profit contribution ratio can be used to gage the relative feasibility of manufacturing particleboard between sites where raw materials, energy, and product outputs have different values, but other operating costs may be assumed equal.

**DATA REQUIREMENTS OF PARVCOST PROGRAM**

Data required by PARVCOST consist of estimates of the following factors: (1) Specific gravity and moisture content of wood, bark, and pressed panel, (2) cost of procuring wood, chemicals, residues, fuel, electricity, (3) costs of finished board product, (4) ratio of bark to wood in roundwood, (5) percents of process residues loss and the width of edging trims, (6) finished panel size, (7) percent face and core furnish, (8) weight percentages of chemicals needed in face and core furnish, (9) British thermal unit value of fines, trims, bark, and fuel, and (10) requirements of heat energy (Btu) and electricity (kWh) per cubic foot of output.

Of a total of 48 input variables, each must be assigned a value. Forty-two are estimates of various particleboard manufacturing factors; five are simple integer option variables that control the format of the printed program output; and one is the title of the printed output. Following is a listing of the 48 input variables required by PARVCOST. The variables are in the order in which they occur in the data deck. The four-letter program name of each variable precedes each definition.
INPUT VARIABLES

1. CCUF, cost of wood raw material in dollars per cubic foot (solid volume).
2. SGRW, ovendry specific gravity of wood raw material (average value, green volume, and dry weight).
3. GRMC, moisture content on an ovendry basis of wood raw material (as a decimal).
4. PCTB, ratio of bark to wood in wood raw material (this ratio is on a weight basis and refers only to the bark that is removed and used as fuel).
5. WBMC, moisture content on an ovendry basis of bark (as a decimal).
6. SGBK, ovendry specific gravity of bark (average value, green volume, and dry weight).
7. CRES, cost of resin in dollars per pound of resin.
8. PRRF, weight percent of face blend required to be resin (as a decimal).
9. PRRC, weight percent of core blend required to be resin (as a decimal).
10. CWAX, cost of wax in dollars per pound of wax.
11. PWRF, weight percent of face blend required to be wax (as a decimal).
12. PWRC, weight percent of core blend required to be wax (as a decimal).
13. ODWP, weight in pounds per solid cubic foot of finished product.
14. FPMC, ovendry basis moisture content of wood in finished product (as a decimal).
15. PTLG, width in inches of panel trims cut away along length of product.
16. PTWD, width in inches of panel trims cut away along width of product.
17. PWSR, weight percent of wood raw material that becomes green (wet screened) wood residue.
18. CORM, f.o.b.—mill value of any surplus residues (residue mix) in dollars per pound.
19. CKWH, cost of electricity in dollars per kilowatt-hour.
20. BTUF, average higher heating value of nonbark wood fuel residues in million British thermal units per pound.
21. BTUB, average higher heating value of bark residues in million British thermal units per pound.
22. BTRD, million British thermal units required at boiler or other heat recovery device per pound of water evaporated by wood dryer.
23. BTRP, million British thermal units required at boiler for press steam per cubic foot cut panel product.
24. BTRT, million British thermal units required at boiler for thaw pond per cubic foot cut panel product.
25. BTRH, million British thermal units required at boiler for heating per cubic foot cut panel product.
26. BTRM, million British thermal units required at boiler for miscellaneous purposes per cubic foot cut panel product.
27. RKWH, kilowatt-hours of electricity required per cubic foot of cut panel product.
28. PPWD, width of pressed panel in inches (trimmed dimension).
29. PPLG, length of pressed panel in inches (trimmed dimension).
30. SALE, net sales value f.o.b. mill of product in dollars per solid cubic foot.
31. PGAS, price of natural gas in dollars per thousand cubic foot.
32. POIL, price of fuel oil in dollars per barrel.
33. PWOD, price of external (nonprocess residue) wood fuel in dollars per ton.
34. PCOL, price of coal in dollars per ton.
35. BTUG, million British thermal units per thousand cubic foot of natural gas.
36. BTUO, million British thermal units per barrel of oil.
37. BTUW, million British thermal units per ton of wood fuel.
38. BTUC, million British thermal units per ton of coal.
39. IOP1, coded specification of size of panel for which data should be printed in second data column of data printout (0 (or blank) for 3/8 in., 1 for 1/4 in., 2 for 3/4 in., 3 for 5/8 in., and 4 for 1/2 in.).
45. IOP2, coded specification of size of panel for which data should be printed in third data column of data printout (0 or blank) for 1/2 in., 1 for 1/4 in., 2 for 3/4 in., 3 for 5/8 in., and 4 for cubic meter).  
46. NOPT, coded specification of number of data columns to be printed on printed output (3 for 3 columns, 0 or blank) for 5 columns).  
47. NCOP, specification of number of copies of output to be printed (01 to 10).  
48. TITL, an alphanumeric array for input of title of printed output.  

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STRUCTURE OF DATA DECK  

The PARVCOST data deck has two versions: A long, documented version (DV) (appendix B) and a short, not documented version (SV) for which a sample is given in appendix C. Either version may be used for entering data into the PARVCOST program. The two versions enter exactly the same data in the same order. The only difference between the two versions is that only the long version contains documentation of each input variable.  

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LONG VERSION DATA DECK  

The DV data deck (appendix B) has 104 lines. Most of the DV data deck is documentation that explains the data-coding sequence; it does not influence the function of the program. The documentation in the DV data deck is essential if the deck is stored in a computing facility, communication is established via a teletype terminal or similar device, and stored data is to be edited line-by-line. A list of the DV data deck can also be used as a coding guide reference if using the SV data deck.  

In using the DV data deck, data to be entered is shown in appendix B and follows "WOOD RAW MATERIAL COST PER CUBIC FOOT." The numerical information is given that should be entered in columns 6 through 18; each datum must include a decimal point.  

Program controls are entered as integer data without decimal points in columns 1 and 2 (as indicated) on the five data cards preceding the program title cards (last cards in data deck). Alphanumeric (title of output) data are entered on the last two cards of the data deck. All of the other data columns and documentation comments of the DV data deck are nonfunctional.  

Use of the DV data deck requires that program card 6 be replaced by card 6B (appendix D). Thus, if using the DV data deck, remove main program card number 6 and insert card number 6B in the same place in the main program. The program will not run with the DV data deck unless this modification has been made.  

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SHORT VERSION DATA DECK FORMAT  

The SV data deck consists of 10 data cards. Forty-eight input variables are entered on 10 cards in the same order listed in the long version section on data requirements. If using the SV deck, all of the required statistics of particleboard manufacture (the first 42 input variables) are entered on cards 1 to 6 (table 1). Program control specifications (input variables 43-47) are entered on card 7. The title of the output is entered on cards 8 through 10.  

Cards 1 through 6, instructions: The estimates for the first 42 input variables are
entered on the first six cards of the SV data deck. Seven estimates are entered on each card. One estimate is punched in every 10 spaces starting in columns 1 through 10 of each card. Each estimate that is punched must include a decimal point. An estimate may be punched anywhere in the 10-space field allotted to each variable. Input variables for cards 1 through 6 and the columns for their entry are listed in Table 1.

<table>
<thead>
<tr>
<th>Card No.</th>
<th>Columns 1-10</th>
<th>11-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>61-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CCUF</td>
<td>SGRW</td>
<td>GRMC</td>
<td>PCTB</td>
<td>WBMC</td>
<td>SGBK</td>
<td>CRES</td>
</tr>
<tr>
<td>2</td>
<td>PRRF</td>
<td>PRRC</td>
<td>CWAX</td>
<td>PWRF</td>
<td>PWRC</td>
<td>ODMC</td>
<td>PCTF</td>
</tr>
<tr>
<td>3</td>
<td>PCFF</td>
<td>PCCF</td>
<td>ODWP</td>
<td>FPMC</td>
<td>PTLG</td>
<td>PTWD</td>
<td>PWSR</td>
</tr>
<tr>
<td>4</td>
<td>CORM</td>
<td>CKWH</td>
<td>BTUF</td>
<td>BTUB</td>
<td>BTRD</td>
<td>BTRP</td>
<td>BTRT</td>
</tr>
<tr>
<td>5</td>
<td>BTRH</td>
<td>BTRM</td>
<td>RKWH</td>
<td>PPWD</td>
<td>PPLG</td>
<td>SALE</td>
<td>PGAS</td>
</tr>
<tr>
<td>6</td>
<td>POIL</td>
<td>PWOD</td>
<td>PCOL</td>
<td>BTUG</td>
<td>BTUO</td>
<td>BTUC</td>
<td></td>
</tr>
</tbody>
</table>

Card 7, instructions: Input variables 43 through 47 are specified on card 7. The single integer specifications for ITOP, IOP1, IOP2, and NOPT are punched in columns 1 through 4, respectively. The two integer specifications for NCOP are punched in columns 5 and 6. The appropriate integers to punch in these columns are discussed in the listing of input variables in the various section on data requirements for the PARVCOST program.

Cards 8 through 10, instructions: The title desired to be printed at the top of the program output is punched on cards 8 through 10 of the SV data deck. The title should be typed on the center of these cards.

Appendix B is a listing of a sample SV data deck. Note that it contains the same data as the sample listing of the DV version in appendix A. If the SV version of the data deck is used, program card 6 (not 6B, see appendix D) must be in the program deck. The program will not run with the SV data deck unless program card 6 is in the program deck and card 6B has been removed.
APPENDIX A.—Sample Program Output Obtained by Running PARVCOST with Sample Data from Appendixes B or C

MATERIAL AND RESOURCE REQUIREMENTS, BOARD STATS, AND VARIABLE COSTS FOR MANUFACTURE OF STRUCTURAL PARTICLEBOARD PER UNIT OF OUTPUT (HYPOTHETICAL TEST)

<table>
<thead>
<tr>
<th>NET SALES VALUE</th>
<th>$/CU.FT.</th>
<th>$/MSF 3/8 IN. BASIS</th>
<th>1/2 IN. BASIS</th>
<th>5/8 IN. BASIS</th>
<th>$/CU.METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2,929.00</td>
<td>$2,929.00</td>
<td>$2,929.00</td>
<td>$2,929.00</td>
<td>$2,929.00</td>
<td></td>
</tr>
</tbody>
</table>

VARIABLE COSTS OF PRODUCTION

- **WOOD (50,000/CU.FT.):** $2.2859
- **RESIN (6,500/LB.):** $0.4000
- **MAX (1,000, 1.27/LH.):** $0.0458
- **ELECTRIC POWER (5,820/KWH):** $1.1200
- **DIESEL FUEL (2,000/MM BTU):** $0.0172
- **PROC. STEAM (FUELS = 2,000/MM BTU):** $0.0005
- **LESS RESIDUE VALUES (38,00/MM ADU):** $0.0000

GROSS VARIABLE COST

- $1,871.00

PROFIT CONTRIBUTION

- $1,047.00

P. C. RATIO: 95.9%

SENSITIVITY OF GROSS VARIABLE COST PER CU. FT. OF FINISHED PRODUCT OUTPUT

- **VAR. COST/CU. FT. = 1.0212 * (WOOD COST/CU. FT.) + 1.0853**
- **VAR. COST/CU. FT. = 2.3705 * (RESIN COST/LB.) + 0.4095**
- **VAR. COST/CU. FT. = 1.0467 * (MAX COST/LH.) + 1.3275**
- **VAR. COST/CU. FT. = 6.7000 * (ELECTRICITY COST/KWH) + 1.2513**
- **VAR. COST/CU. FT. = 0.0005 * (PRICE OF COAL/TON) + 1.5024**
- **VAR. COST/CU. FT. = 0.0413 * (PRICE OF NAT. GAS/MCF) + 1.3590**

BOARD STATISTICS

- **LBS./CU.FT.:** 38.155
- **LBS./MSF 3/8 IN. BASIS 1/2 IN. BASIS 5/8 IN. BASIS LBS./CU.METER**
  - 1192.187
  - 1589.585
  - 1986.979
  - 1347.076
  - 114.283

- **HEIGHT OF WATER (9.0% M.C.):** 3.150
- **DIESEL DRY WEIGHT (G/T. OF BOARD):** 35.000
- **GROSS WEIGHT OF RESINS (90.5% SOLIDS):** 2.275
- **GROSS WEIGHT OF MAX (1.0% SOLIDS):** 0.350
- **HEIGHT OF DOGWOOD:** 32.375

MATERIAL REQUIREMENTS

- **WOOD (NO. 2 SPEC, GRAV.: 0.59):** 37.457
- **POUNDS OF O.D. DOGWOOD:** 67.963
- **CU. FT. OF ROUNDWOOD:** 1.021
- **RESIN (LBS. SOLIDS/LIQUID):** 2.731
- **MAX (LBS. SOLIDS):** 0.365

- **1333.200**
- **3599.766**
- **56.000**
- **12.877**
<table>
<thead>
<tr>
<th>FUEL AND POWER STATISTICS IN MILLION B.T.U.S</th>
<th>BTUS/CU.FT</th>
<th>BTUS/MSF 3/8 IN. BASIS</th>
<th>1/2 IN. BASIS</th>
<th>5/8 IN. BASIS</th>
<th>BTUS/CU.METER</th>
</tr>
</thead>
<tbody>
<tr>
<td>FUEL REQUIREMENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DRYER HEAT</strong></td>
<td>.047498</td>
<td>1.486323</td>
<td>1.479048</td>
<td>2.473671</td>
<td>1.477166</td>
</tr>
<tr>
<td><strong>PROCESS STEAM</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRESS</strong></td>
<td>.019200</td>
<td>.600000</td>
<td>.600001</td>
<td>1.000000</td>
<td>.677652</td>
</tr>
<tr>
<td><strong>TANK POND</strong></td>
<td>.002000</td>
<td>.062500</td>
<td>.063333</td>
<td>.104167</td>
<td>.070620</td>
</tr>
<tr>
<td><strong>HEATING</strong></td>
<td>.010000</td>
<td>.500000</td>
<td>.686667</td>
<td>.833333</td>
<td>.564960</td>
</tr>
<tr>
<td><strong>MISCELLANEOUS</strong></td>
<td>.003200</td>
<td>.100000</td>
<td>.133333</td>
<td>.166667</td>
<td>.112992</td>
</tr>
<tr>
<td><strong>TOTAL FUEL REQUIRED</strong></td>
<td>.057896</td>
<td>2.746823</td>
<td>3.662433</td>
<td>4.578037</td>
<td>3.103640</td>
</tr>
<tr>
<td><strong>WOOD FUEL GENERATED</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>DRIED FINE WOOD (8.0%/2.0%)</strong></td>
<td>.033277</td>
<td>.727416</td>
<td>.969809</td>
<td>1.212360</td>
<td>.621922</td>
</tr>
<tr>
<td><strong>NET RAPID (12.1:1 RATIO OF D.W./C)</strong></td>
<td>.031190</td>
<td>.708865</td>
<td>1.289821</td>
<td>1.624775</td>
<td>1.101519</td>
</tr>
<tr>
<td><strong>SCREENED WOOD RESIDUES</strong></td>
<td>.010846</td>
<td>.360184</td>
<td>.453570</td>
<td>.566974</td>
<td>.384381</td>
</tr>
<tr>
<td><strong>TOTAL FUEL GENERATED</strong></td>
<td>.065509</td>
<td>2.042565</td>
<td>2.723289</td>
<td>3.404199</td>
<td>2.507922</td>
</tr>
<tr>
<td><strong>AUXILIARY FUEL BTU</strong></td>
<td>.011364</td>
<td>.300435</td>
<td>.480580</td>
<td>.600725</td>
<td>.407263</td>
</tr>
<tr>
<td><strong>NET FUEL REQUIREMENT</strong></td>
<td>.011000</td>
<td>.303922</td>
<td>.458563</td>
<td>.573204</td>
<td>.383805</td>
</tr>
<tr>
<td><strong>FUEL AND POWER REQUIRED</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>KWH, ELECT. POWER ($ .020/KWH)</strong></td>
<td>.000000</td>
<td>187,500</td>
<td>250,000</td>
<td>312,500</td>
<td>211,860</td>
</tr>
<tr>
<td><strong>TONS COAL ($ 18.00/TON)</strong></td>
<td>.004091</td>
<td>.015354</td>
<td>.020472</td>
<td>.025589</td>
<td>.017348</td>
</tr>
<tr>
<td><strong>MCF, AUX. GAS ($ .90/MCF.)</strong></td>
<td>.013297</td>
<td>.014243</td>
<td>.052391</td>
<td>.090409</td>
<td>.040118</td>
</tr>
</tbody>
</table>
APPENDIX B.—Listing of Long, or Documented, Version Data Deck

THIS THE DOCUMENTED VERSION OF THE PAVVCOST DATA DECK

COLUMN WIDTHS

18Y 30X

WOOD RAW MATERIAL COST PER CUBIC FOOT
CCUF = 0.28

D. D. SPECIFIC GRAVITY OF THE WOOD RAW MATERIAL
SGRM = 0.5420

MOISTURE CONTENT O. D. BASIS OF THE GREEN WOOD RAW MATERIAL
GWCNCH = 0.80

RATIO OF BARK TO WOOD IN WOOD RAW MATERIAL
RCTBN = 0.12

MOISTURE CONTENT O. D. BASIS OF GREEN BARK MATERIAL
BHMCNCH = 1.10

O. D. SPECIFIC GRAVITY OF THE BARK
SBGRM = 0.70

COST OF RESIN PER POUND IS
CRES = 0.30

PERCENT RESIN REQUIRED IN FACE IS
PRRF = 0.07

PERCENT RESIN REQUIRED IN CORE IS
PRRC = 0.05

COST OF WAX PER POUND OF WAX IS
CWX = 0.12

PERCENT OF WAX REQUIRED IN FACE IS
PWRF = 0.01

PERCENT OF WAX REQUIRED IN CORE IS
PWRC = 0.01

MOIST. CONTENT WOOD OUT OF DRYER
OMC = 0.06

THE RECOVERABLE PERCENT OF FINES LOSS (WEIGHT PERCENT OF WOOD RAW MATERIAL)
PCTCF = 0.08

PERCENT OF PRODUCT IN FACE FURNISH
PCFF = 0.75

PERCENT OF PRODUCT IN CORE FURNISH
PCCF = 0.25

O.D. WT. OF PRESSED PANEL/CU. FT.
ODWP = 0.00

MOIST. CONTENT OF WOOD IN PRODUCT
FMCH = 0.09

PANEL TRIMS ALONG LENGTH (INCHES)
PTLG = 1.5

PANEL TRIMS ALONG WIDTH (INCHES)
PTWD = 1.5

PERCENT OF WOOD RAW MATERIAL LOST AS GREEN RESIDUE, (RECOVERED AS FUEL)
PWSRS = 0.05

THE VALUE F.O.B. MILL PROCESS GENERATED WOOD AND BARK RESIDUES (AVERAGES/POUND)
CODWP = 0.00

COST OF ELECTRICITY PER KWH.
CKWH = 0.20

BTU IN WOOD FINES AND RESIDUES (MILLION BTU/LB. O.D. HIGHER HEATING VALUE)
BTUF = 0.00530

BTU IN BARK (MILLION BTU/LB. O.D. HIGHER HEATING VALUE)
BTUB = 0.09500

DRYER BTU DEMAND AT BOILER—MILLION BTU/LB. WATER EVAPORATED
BTDM = 0.01700

PROC. STEAM PRESS BTU DEMAND AT BOILER—MILL. BTU/CU. FT. PANELS
BTPR = 0.019200

THAW FROZEN STEAM BTU DEMAND AT BOILER—MILL. BTU/CU. FT. PANELS
BTTH = 0.020200

HEATING STEAM BTU DEMAND AT BOILER—MILL. BTU/CU. FT. PANELS
BTHTM = 0.010000

MISCELLANEOUS STEAM BTU DEMAND AT BOILER—MILL. BTU/CU. FT. PANELS
BTTRM = 0.003200

ELECTRIC USAGE—KWH./CU. FT. PANELS
EKWH = 0.00

PRESSED PANEL WIDTH (INCHES)
PPWD = 48.0

PRESSED PANEL LENGTH (INCHES)
PPLD = 96.0

THE NET SALES VALUE ($/CU. FT.)
SALE = 2.974

AVERAGE ANTICIPATED PRICE OF NATURAL GAS PER MCF
PGAS = 0.40

-8-
AVERAGE ANTICIPATED PRICE OF OIL PER BARREL
P0IL = 9.00
AVERAGE ANTICIPATED PRICE OF WOOD TO BE USED AS FUEL PER TON
PW0D = 17.00
AVERAGE ANTICIPATED PRICE OF COAL PER TON
P0CL = 18.00
MILLION BTUS AVAILABLE PER MCF OF NATURAL GAS
BTUG = 1.00
MILLION BTUS AVAILABLE PER BARREL OF OIL
BTUO = 5.00
MILLION BTUS AVAILABLE PER TON OF WOOD
BTUW = 18.00
MILLION BTUS AVAILABLE PER TON OF COAL
BTUC = 26.00
LEAVE NEXT LINE BLANK IF TRIMS ARE RECYCLED AS FURNISH, 1 IN COL. 1 IF AS FUEL
ON THE FOLLOWING LINE SPECIFY IOPl, THE TYPE OF OUTPUT IN COLUMN 2, SPECIFY
1 FOR 1/4 IN., 2 FOR 3/4 IN., 3 FOR 5/8 IN., 4 FOR 1/2 IN., DEFAULT (0) IS 3/8 IN.
0
ON THE FOLLOWING LINE SPECIFY IOPl, THE TYPE OF OUTPUT IN COLUMN 3, SPECIFY
1 FOR 1/4 IN., 2 FOR 3/4 IN., 3 FOR 5/8 IN., 4 FOR CU. METER, DEFAULT (0) IS 1/2 IN.
0
ON THE NEXT LINE SPECIFY THE NUMBER OF COLUMNS OF DATA OUTPUT TO BE PRINTED
SPECIFY 3 FOR 3 COLUMN WIDTH, DEFAULT (0) IS 5 COLUMN WIDTH
0
ON THE FOLLOWING LINE SPECIFY NCP, THE NUMBER OF COPIES (01 TO 10)
01
CENTER THE TITLE ON THE NEXT THREE LINES
MATERIAL AND RESOURCE REQUIREMENTS, BOARD STATS, AND VARIABLE COSTS FOR MANUFACTURE OF STRUCTURAL PARTICLEBOARD PER UNIT OF OUTPUT (HYPOTHETICAL TEST)
APPENDIX C.—Sample of Short Version Data Deck

Data and cards of the short version data deck: The same sample data presented for the documented version sample in appendix A are presented here as they would be entered in the data deck for the short version.

<table>
<thead>
<tr>
<th>FACTURE OF STRUCTURAL PARTICLEBOARD PER UNIT OF OUTPUT (HYPOTHETICAL TEST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL AND RESOURCE REQUIREMENTS, BOARD STATS. AND VARIABLE COSTS FOR MV</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9.00</th>
<th>27.0</th>
<th>18.0</th>
<th>1.00</th>
<th>5.00</th>
<th>16.0</th>
<th>28.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.016</td>
<td>0.0032</td>
<td>6.00</td>
<td>96.0</td>
<td>288.0</td>
<td>2.978</td>
<td>0.90</td>
</tr>
<tr>
<td>0.02</td>
<td>0.02</td>
<td>0.0035</td>
<td>0.0095</td>
<td>0.0017</td>
<td>0.0192</td>
<td>0.0020</td>
</tr>
<tr>
<td>0.75</td>
<td>0.25</td>
<td>0.09</td>
<td>1.5</td>
<td>1.0</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>0.07</td>
<td>0.05</td>
<td>0.12</td>
<td>0.01</td>
<td>0.01</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>0.28</td>
<td>0.0045</td>
<td>0.80</td>
<td>0.12</td>
<td>1.00</td>
<td>0.70</td>
<td>0.35</td>
</tr>
</tbody>
</table>
APPENDIX D.—Program Cards 6 and 6B

Program card 6, to be used with the short version data deck:

Program card 6B, for the long, documented version data deck:
APPENDIX E.—Notes on Use of Program

Calculation of Fuel Statistics

PARVCOST uses the data input prices and heating values of the four types of external fuel—wood, coal, oil, and natural gas—to select the most economical fuel. It may become desirable to exclude one or more of these fuels from consideration (for example, natural gas may be excluded as a potential fuel if supplies are interruptible). Any one of the four fuels can be excluded as a fuel by inputting an imaginary high price for that fuel, because PARVCOST considers only the least expensive fuel. However, an accurate cost for procuring either oil or natural gas should always be entered in the data deck. The reason is oil or natural gas will be needed as an auxiliary fuel for wood residues, bark, and external wood fuel. The program calculates the cost of auxiliary fuel on the basis of the cost of oil or natural gas, whichever is cheapest per effective British thermal unit.

The price of fuel as given in the output (in dollars per million effective Btu’s) is a weighted average that includes the cost of auxiliary fuel and the reduction in costs attributable to using process residue fuel. If process residues are sufficient to supply the energy requirement, fuel price is simply the price of auxiliary fuel per million effective British thermal units from residues and auxiliary fuel.

PARVCOST includes subroutines that calculate the effective heating value of fuels. All data for heating value entered in the data deck should be the “higher heating” value, which is the maximum heat released by combustion of dry fuel determined in a bomb calorimeter. This is the most common method of reporting the heating value of fuels.

Internal Program Assumptions

Several process variables are assigned fixed values within the PARVCOST program. These variables include the following:

PERM, the percent of nonrenewable fines loss, which is assigned a value of 3 percent in statement number 78;

FACT, the weight in pounds of a bone-dry unit of process residues mix, which is assigned a value of 2,400 in statement number 182;

AUXF, the percent of process requirement of British thermal units that must be supplied by auxiliary fuel for wood or residues fuel, which is assigned a value of 5 percent in statement number 109;

T1, the ambient temperature of fuel and air for combustion of residue fuels in degrees Fahrenheit, which is assigned a value of 68 in statement number 8 of subroutine SUB 1;

T2, the stack gas temperature for combustion of residue fuels in degrees Fahrenheit, which is assigned a value of 400 in statement number 9 of subroutine SUB1; and

PCTR, the percent excess air in combustion of residue fuels, which is assigned a value of 40 percent in statement number 7 of subroutine SUB 1.

If it is necessary to change any of these fixed assumptions, the program statements must be changed.
APPENDIX F.—Listing of PARVCOST
Program and Documentation Cards

PARTICLEBOARD VARIABLE COST PROGRAM: PARVCOST

BY
PETER J. INCE

AND
GEORGE B. HARPOLE

U. S. FOREST PRODUCTS LAB., USDA

MADISON, WISCONSIN 53705

MARCH, 1977

PARVCOST IS A FORTRAN PROGRAM DESIGNED TO ASSIST
DEVELOPMENT OF ECONOMIC AND FINANCIAL ANALYSIS OF PARTICLEBOARD
MANUFACTURING SYSTEMS. PARVCOST CALCULATES COSTS AND
REQUIREMENTS OF WOOD, CHEMICALS AND ENERGY PER UNIT OF
FINISHED BOARD PRODUCT. IT ESTIMATES SENSITIVITY OF FINISHED
PRODUCT COSTS TO CHANGES IN UNIT COSTS OF ENERGY AND RAW
MATERIALS. IT ALSO COMPUTES WEIGHT STATISTICS FOR THE
FINISHED PRODUCT AND THE PROFIT CONTRIBUTION RATIO FOR
GIVEN PRODUCT VALUES.

PARVCOST PROGRAM INPUT REQUIRES ESTIMATES OF (1) SPECIFIC
GRAVITY AND MOISTURE CONTENT OF WOOD, PAPER AND PRESSED PANEL,
(2) MARKET PRICES OF WOOD, CHEMICALS, RESIDUES, PAPER,
(3) ELECTRICITY AND THE FINISHED BOARD PRODUCT, (3) RATIO
OF BARK TO WOOD IN ROUNDWOOD, (4) PROCESS FINES LOSS PERCENT
AND LOST OF EDGING TRIMS, (5) FINISHED PANEL SIZE, PERCENT
FACE AND CORE FURNISH, AND PERCENTAGES OF CHEMICALS NEEDED
IN FURNISH, (6) N.T.U. VALUE OF RESIDUES, BARK AND FUEL,
(7) N.T.U. REQUIREMENTS PER CURIC FOOT OF OUTPUT FOR PROCESS
STEAM AND ALSO ELECTRICITY REQUIREMENTS.

KEY TERMS

PAR UNIT OF OUTPUT $$$ (PER UNIT OF PRODUCT, PER CUBIC FOOT
OF PANELS, OR PER CUBIC FOOT OF CUT PANEL PRODUCT)
EXCEPT FOR BOARD WEIGHT STATISTICS, PER UNIT OF OUTPUT
ALWAYS REFERS TO THE GROSS MATERIAL REQUIREMENTS OR
COSTS OF INPUTS PER UNIT OF FINISHED BOARD PRODUCT
OUTPUT AND INCLUDES THE QUANTITIES OR COSTS OF ALL
MATERIALS LOST FROM THE FINISHED PRODUCT OUTPUT AS
TRIMS OR RESIDUE. BOARD WEIGHT STATISTICS ARE ABSOLUTE
STATISTICS WHICH DO NOT INVOLVE PROCESSING WEIGHT LOSSES.

SENSITIVITY OF UNIT VARIABLE COST $$$ THE SENSITIVITY OF THE
UNIT VARIABLE COST (COST PER CUBIC FOOT OF OUTPUT) TO THE
COSTS OF WOOD, RESIN, MAX, ELECTRICITY, AND FUEL ARE
EXPRESSED IN THE FORM OF LINEAR EQUATIONS, THESE
EQUATIONS APPLY ONLY TO THE SENSITIVITY OF GROSS VARIABLE
COST PER CUBIC FOOT OF FINISHED PRODUCT OUTPUT.

ALPHABETICAL LISTING AND DEFINITIONS OF PROGRAM VARIABLES

"INPUT" MEANS THE VARIABLE IS AN INPUT VARIABLE
AND HENCE OCCURS ALSO IN THE DATA DECK
'INTERNAL' MEANS THE VARIABLE IS USED STRICTLY WITHIN THE PROGRAM AND APPEARS ONLY FOR THE PURPOSES OF CALCULATION OR CLARIFICATION

'OUTPUT' MEANS THE VARIABLE WILL APPEAR AS PART OF THE PRINTED OUTPUT (A FEW VARIABLES ARE BOTH 'INPUT' AND 'OUTPUT')

'SUB1' MEANS THE VARIABLE IS USED WITHIN SUBROUTINE 'SUB1'

'SUB2' MEANS THE VARIABLE IS USED WITHIN SUBROUTINE 'SUB2'

'SUP' MEANS THE VARIABLE IS USED WITHIN SUBROUTINE 'SUP'

'SPA' MEANS THE VARIABLE IS USED WITHIN SUBROUTINE 'SPA'

'*' MEANS THE VARIABLE IS USED WITHIN SUBROUTINE 'S*'

1-AS...(OUTPUT) SENSITIVITY ANALYSIS FIRST ORDER COEFFICIENTS OR 'SLOPE' TERMS IN THE LINEAR EQUATIONS RELATING NET VARIABLE COST TO THE COST, ON AN INPUT BASIS OF ROUNDWOOD, RESIN, MAX, ELECTRIC POWER, AND FUEL

2TRR....(INTERNAL) AVERAGE EFFECTIVE B.T.U. PER POUND OF RESIDUES

2UX....(INTERNAL) THE PERCENT OF TOTAL WOOD AND AUXILIARY FUEL ON A B.T.U. BASIS WHICH MUST BE AUXILIARY FUEL REQUIRED TO RUN WOOD ON BARK FUEL (2UX IS ASSIGNED A VALUE BY THE PROGRAM)

4UX....(OUTPUT) UNITS OF AUXILIARY FUEL REQUIRED (BARRELS OF OIL OR MCF OF NATURAL GAS) PER CUBIC FOOT OF CUT PANEL PRODUCT

4VM....(SUB1) AVAILABLE HEAT OF WOOD FUEL (BTU'S PER POUND)

4I-BS....(OUTPUT) SENSITIVITY ANALYSIS CONSTANTS IN THE LINEAR EQUATIONS RELATING NET VARIABLE COST TO THE COST, ON AN INPUT BASIS OF ROUNDWOOD, RESIN, MAX, ELECTRIC POWER, AND FUEL

5UX....(OUTPUT) B.T.U.'S SUPPLIED BY AUXILIARY FUEL PER CU. FT. OF CUT PANEL PRODUCT

5TRK....(OUTPUT) B.T.U. VALUE OF THE BARK FUEL GENERATED PER CUBIC FOOT OF CUT PANEL PRODUCT

5TFR....(SUB2) MILLION EFFECTIVE B.T.U. PER UNIT OF FUEL FOR NON-RESIDUE FUELS

5TFN....(INTERNAL) MILLION EFFECTIVE B.T.U.'S IN PROCESS WOOD RESIDUE FUEL PER CUBIC FOOT CUT PANELS

5TFU....(SUB2) B.T.U. VALUE OF FUEL PER UNIT OF FUEL IN MILLION B.T.U. PER FUEL UNIT

5T<CCCCONN=OTT+OTP0T MILLIONS OF BTU'S TO evaporate ONE POUND OF MOISTURE

5TRH....(INPUT+OUTPUT) MILLIONS OF B.T.U. REQUIRED AT THE BOILER FOR HEATING STEAM PER CUBIC FOOT OF CUT PANEL PRODUCT

5TRM....(INPUT+OUTPUT) MILLIONS OF B.T.U. REQUIRED AT THE BOILER FOR MISCELLANEOUS PURPOSES PER CUBIC FOOT OF CUT PANEL PRODUCT

5TRP....(INPUT+OUTPUT) MILLIONS OF B.T.U. REQUIRED AT THE BOILER FOR THE PRESS PER CUBIC FOOT OF CUT PANEL PRODUCT

5TRT....(INPUT+OUTPUT) MILLIONS OF B.T.U. REQUIRED AT THE BOILER FOR THE THAW POND PER CUBIC FOOT OF CUT PANEL PRODUCT

5TUB....(INPUT) HIGHER HEATING VALUE IN MILLIONS OF B.T.U. PER POUND OF OVEN DRY BARK FUEL

5TUC....(INPUT) HIGHER HEATING VALUE OF COAL IN MILLION B.T.U. PER TON OF COAL

5TUE....(SUB1) EFFECTIVE B.T.U.'S PER POUND OF WOOD OR BARK RESIDUES FUEL
<table>
<thead>
<tr>
<th><strong>FRMC</strong></th>
<th>(INPUT+OUTPUT) MOISTURE CONTENT OF THE WOOD IN THE FINISHED PRODUCT (PERCENT 0%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRPS</strong></td>
<td>(INTERNAL) FINISHED PANEL SIZE IN SQUARE INCHES</td>
</tr>
<tr>
<td><strong>FRUN</strong></td>
<td>(OUTPUT) NET FUEL VALUE REQUIRED IN MILLION EFFECTIVE B.T.U. PER CU. FT. OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>FUEL</strong></td>
<td>THE UNITS OF EXTERNAL NON-RESIDUE FUEL (BARRELS, TONS, OR MCF) REQUIRED PER CURIC FOOT OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>GBO</strong></td>
<td>(OUTPUT) GROSS BOARD WEIGHT OF PANELS PER CURIC FOOT OF PANEL (IN POUNDS)</td>
</tr>
<tr>
<td><strong>GMCT</strong></td>
<td>(SUB) GREEN BASIS MOISTURE CONTENT OF WOOD OR BARK FUEL</td>
</tr>
<tr>
<td><strong>GRFF</strong></td>
<td>(INTERNAL) POUNDS OF PROCESS WOOD FUEL FINES AND TRIMS GENERATED PER CU. FT. OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>GRMC</strong></td>
<td>(INPUT) MOISTURE CONTENT OF WOOD FURNISH RAW MATERIAL BEFORE ENTERING PROCESS ( % O.D.)</td>
</tr>
<tr>
<td><strong>GRHD</strong></td>
<td>(OUTPUT) POUNDS OF GREEN WOOD RAW MATERIAL REQUIRED PER CU. FT. OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>GRFW</strong></td>
<td>(INTERNAL) POUNDS OF PROCESS WOOD FUEL FINES AND TRIMS AVAILABLE (AFTER DEDUCTION OF THE NON-RENEWABLE LOSS) PER CURIC FOOT OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>GWCO</strong></td>
<td>(OUTPUT) POUNDS OF OVEN DRY WOOD REQUIRED PER CURIC FOOT OF CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>GWDO</strong></td>
<td>(INTERNAL) GROSS OVEN DRY WEIGHT OF PARTICLEBOARD OUTPUT PER CURIC FOOT OF CUT PANEL PRODUCT (IN POUNDS)</td>
</tr>
<tr>
<td><strong>GWF</strong></td>
<td>(INTERNAL) GROSS POUNDS OF FURNISH (WOOD PLUS ANY RECycled TRIMS) PER CURIC FOOT CUT PANEL PRODUCT</td>
</tr>
<tr>
<td><strong>MHL</strong></td>
<td>(SUB) HYDROGEN HEAT LOSS PERCENT OF AVAILABLE HEAT</td>
</tr>
<tr>
<td><strong>MHTV</strong></td>
<td>(SUB) THE HIGHER HEATING VALUE OF A WOOD OR BARK FUEL IN M.T.U.S PER POUND</td>
</tr>
<tr>
<td><strong>IOP</strong></td>
<td>(INTERNAL) INTEGER OPTION VARIABLE SPECIFYING THE TYPE OF FUEL BEING USED (OIL, COAL, NAT, GAS OR WOOD)</td>
</tr>
<tr>
<td><strong>IUP1</strong></td>
<td>(INPUT) AN OPTION VARIABLE TO SPECIFY THE KIND OF OUTPUT TO BE DELIVERED IN COLUMN TWO OF THE PRINTOUT</td>
</tr>
<tr>
<td><strong>IOP2</strong></td>
<td>(INPUT) AN OPTION VARIABLE TO SPECIFY THE KIND OF OUTPUT TO BE DELIVERED IN COLUMN THREE OF THE PRINTOUT</td>
</tr>
<tr>
<td><strong>IOP</strong></td>
<td>(INPUT) AN OPTION VARIABLE TO SPECIFY WHETHER OR NOT TRIMS WILL BE RECYCLED AS FURNISH (RECYCLED, UNTRIMS USED AS FUEL)</td>
</tr>
<tr>
<td><strong>NAF</strong></td>
<td>(INTERNAL) AN OPTION VARIABLE TO CONTROL THE TYPE OF AUXILIARY FUEL BEING USED (1 FOR OIL, 2 FOR NATURAL GAS)</td>
</tr>
<tr>
<td><strong>NCOP</strong></td>
<td>(INPUT) AN OPTION VARIABLE TO CONTROL THE NUMBER OF COPIES OF PRINTED OUTPUT (1 TO 10)</td>
</tr>
<tr>
<td><strong>NOPT</strong></td>
<td>(INPUT) AN OPTION VARIABLE TO CONTROL THE WIDTH OF THE PRINTED OUTPUT (3 OR 5 COLUMNS OF DATA)</td>
</tr>
<tr>
<td><strong>POMC</strong></td>
<td>(INPUT) MOISTURE CONTENT OF THE WOOD COMING OUT OF THE DRYER ( % O.D.)</td>
</tr>
<tr>
<td><strong>POF</strong></td>
<td>(INPUT+OUTPUT) THE OVEN DRY WEIGHT OF THE PRESSED PANELS PER CURIC FOOT OF PANEL (IN POUNDS)</td>
</tr>
<tr>
<td><strong>POF2</strong></td>
<td>(INPUT) THE OVEN DRY WEIGHT OF WOOD AFTER PRESSING IN A CURIC FOOT OF PRESSED PANEL (IN POUNDS)</td>
</tr>
<tr>
<td><strong>P</strong></td>
<td>(INTERNAL) PRICE OF FUEL PER EFFECTIVE R.T.U.</td>
</tr>
<tr>
<td><strong>PCCP</strong></td>
<td>(INPUT) PERCENT OF THE PRODUCT THAT IS CORE FURNISH</td>
</tr>
<tr>
<td><strong>PCFF</strong></td>
<td>(INPUT) PERCENT OF THE PRODUCT THAT IS FACE FURNISH</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td>PCOL</td>
<td>Input: Price of coal in dollars per ton</td>
</tr>
<tr>
<td>PCUN</td>
<td>Output: The profit contribution as the net sales value minus the variable costs of production per cubic foot of cut panel product</td>
</tr>
<tr>
<td>PCWA</td>
<td>Output: The profit contribution ratio (ratio of the profit contribution to net sales value)</td>
</tr>
<tr>
<td>PCRTB</td>
<td>Input/output: Volume ratio of bark to wood in the raw material expressed as a decimal</td>
</tr>
<tr>
<td>PCTF</td>
<td>Input/output: The recoverable percent fines-loss in cutting and chipping of raw wood (percent of raw wood)</td>
</tr>
<tr>
<td>PCTR</td>
<td>Sub: Percent excess air in residue fuel combustion (assigned a value of 40% by the program)</td>
</tr>
<tr>
<td>PCTT</td>
<td>Output: Percent of particleboard output that is cut away as trims</td>
</tr>
<tr>
<td>PERM</td>
<td>Internal: A percent of the fines generated that is permanently lost (non-recoverable loss—not to be confused with 'PCTF')</td>
</tr>
<tr>
<td>PR</td>
<td>Internal: Cost of external purchased fuel, excluding auxiliary fuel per cu. ft. cut panels</td>
</tr>
<tr>
<td>PPGAS</td>
<td>Input: Price of natural gas in dollars per Mcf</td>
</tr>
<tr>
<td>POIL</td>
<td>Input: Price of oil in dollars per barrel</td>
</tr>
<tr>
<td>PBLG</td>
<td>Input: The length of the cut panel product in inches</td>
</tr>
<tr>
<td>PPHD</td>
<td>Input: The width of the cut panel product in inches</td>
</tr>
<tr>
<td>PR</td>
<td>Output: The percent of the oven dry panel product that is resin by weight</td>
</tr>
<tr>
<td>PPRC</td>
<td>Input: The required resin height percent of core furnish</td>
</tr>
<tr>
<td>PNHF</td>
<td>Input: The required resin height percent of face furnish</td>
</tr>
<tr>
<td>PSLG</td>
<td>Input: The height in inches of the strip of trims cut away along the panel length (average figure)</td>
</tr>
<tr>
<td>PTHD</td>
<td>Input: The width in inches of the strip of trims cut away along the panel width (average figure)</td>
</tr>
<tr>
<td>PW</td>
<td>Output: The percent of the oven dry panel product that is max. by height</td>
</tr>
<tr>
<td>PPWD</td>
<td>Input: Price of external wood fuel in dollars per ton</td>
</tr>
<tr>
<td>PPRC</td>
<td>Input: The required warp percent of core furnish</td>
</tr>
<tr>
<td>PNHF</td>
<td>Input: The required warp percent of face furnish</td>
</tr>
<tr>
<td>PPSR</td>
<td>Input: The percent of green wood raw material which is lost as screened wet residues in the process from the debarker to the dryer but which may be recovered as 'net screened' wood fuel</td>
</tr>
<tr>
<td>RDWC</td>
<td>Output: The cost of wood raw material per cubic foot of cut panel product</td>
</tr>
<tr>
<td>RESR</td>
<td>Output: Market value of realization for excess residues (assumes excess residues are marketed in a mix with amounts of each residue type proportional to amounts produced) per cu. ft. cut panel product</td>
</tr>
<tr>
<td>RESV</td>
<td>Output: Market value of residue mix per bone-dry-unit (4000 pounds)</td>
</tr>
<tr>
<td>RWH</td>
<td>Input/output: The required kilowatt-hours of electricity per cubic foot of cut panel product</td>
</tr>
<tr>
<td>SALE</td>
<td>Input/output: The net sales value of the cut panel product per cubic foot</td>
</tr>
</tbody>
</table>
SGWR....(INPUT) THE OVEN DRY SPECIFIC GRAVITY OF THE BARK

SGW..(INPUT-OUTPUT) THE OVEN DRY SPECIFIC GRAVITY OF THE WOOD MATERIAL

SM..(SUB1) SENSIBLE HEAT LOSS (HEAT LOSS DUE TO MOISTURE) PERCENT OF AVAILABLE HEAT

T1....(SUB1) TEMPERATURE OF RESIDUE FUELS AND FURNACE AIR BEFORE COMBUSTION IN DEGREES FAHRENHEIT

T2....(SUB1) STACK GAS TEMPERATURE FOR COMBUSTION OF RESIDUE FUELS IN DEGREES FAHRENHEIT

TFG....(OUTPUT) TOTAL FUEL VALUE GENERATED, MILLION EFFECTIVE B.T.U. PER CUBIC FOOT OF CUT PANEL PRODUCT

TFV....(OUTPUT) TOTAL FUEL VALUE REQUIRED BY DRYER AND PROCESS STEAM, MILLION B.T.U. PER CUBIC FOOT OF CUT PANEL PRODUCT

TCM....(OUTPUT) THE DRYER HEAT PORTION OF HEAT ENERGY COST PER CUBIC FOOT OF CUT PANEL PRODUCT

TCFR....(INTERNAL) THE TOTAL COST OF FUEL PER CUBIC FOOT OF CUT PANEL PRODUCT (INCLUDES COST OF AUXILIARY FUEL)

TCM....(OUTPUT) THE TOTAL COST FOR ELECTRIC POWER PER CUBIC FOOT OF CUT PANEL PRODUCT

TCPS....(OUTPUT) THE PROCESS STEAM SHARE OF TOTAL HEAT ENERGY COST PER CUBIC FOOT OF CUT PANEL PRODUCT

TCHE....(OUTPUT) TOTAL COST OF RESIN PER CUBIC FOOT OF CUT PANEL PRODUCT

TCW....(OUTPUT) TOTAL COST OF WAX PER CUBIC FOOT OF CUT PANEL PRODUCT

TM..(SUB1) TOTAL HEAT LOSS PERCENT OF AVAILABLE HEAT

TITL....(INPUT-OUTPUT) AN ALPHANUMERIC ARRAY FOR THE PRINTED OUTPUT TITLE WHICH MAY BE SPECIFIED IN THE DATA DECK

TMG....(INTERNAL) POUNDS OF TRIMS GENERATED PER CUBIC FOOT OF CUT PANEL PRODUCT

TNV..(OUTPUT) THE GROSS VARIABLE COST OF ENERGY AND RAW MATERIALS FOR THE PRODUCTION PROCESS PER CUBIC FOOT OF CUT PANEL PRODUCT

TRES....(OUTPUT) TOTAL WEIGHT OF RESIN REQUIRED PER CUBIC FOOT OF CUT PANEL PRODUCT

TRMS....(INTERNAL) SQUARE INCHES OF TRIM LOSS PER PANEL

TWAX....(OUTPUT) TOTAL WEIGHT OF WAX REQUIRED PER CUBIC FOOT OF CUT PANEL PRODUCT

V(I,J)....(OUTPUT) TWO DIMENSIONAL ARRAY FOR STORAGE OF OUTPUT VARIABLES AND CONVERSION TO MBF AND CUBIC METER BASIS

WMC....(INPUT) THE MOISTURE CONTENT OF THE BARK (PERCENT OVEN DRY BASIS)

WOR....(OUTPUT) WEIGHT OF RESINS IN THE PANELS (IN POUNDS PER CUBIC FOOT OF PRESSED PANEL)

WOW....(OUTPUT) WEIGHT OF WATER IN THE PANELS (IN POUNDS PER CUBIC FOOT OF PRESSED PANEL)

WDF....(SUB1) WEIGHT OF DRY FUEL PER POUND OF GREEN OR WET WOOD UN BARK FUEL

WTW..(INTERNAL) POUNDS OF WET WOOD RESIDUES GENERATED PER CUBIC FOOT CUT PANEL PRODUCT

WXW....(OUTPUT) WEIGHT OF WAX IN THE PANELS (IN POUNDS PER CUBIC FOOT OF PRESSED PANEL)
IF(IFOP .LE. 3 , AND, NAXF .EQ. 3) AUXIMAUX # TBR * (ETG = 1.0)

C *** B.T.U.S SUPPLIED BY AUXILIARY FUEL PER CU, FT. CUT PANEL

IF(NAXF .EQ. 1) BAUXAUXI # ETAO

C *** CALCULATE COST OF AUXILIARY FUEL PER CU, FT. CUT PANEL

IF(NAXF .EQ. 1) CAUXAUXI # ETAO

C *** TOTAL COST OF PURCHASED FUEL PER CU, FT. CUT PANEL

TCFAUX = TBR * TCFAUX

C *** COST OF ROUNDWOOD/CU. FT. CUT PANELS

RPOIL = CRAUX + CCF

C *** COST OF ELECTRICITY

TCM = CRATM + CEKM

C *** TOTAL NET VARIABLE COST/CU. FT. CUT PANELS

TNVC = TCFAUX + TCFAUX + TCFAUX + TCFAUX + TCFAUX + TCFAUX

C *** PROFIT CONTRIBUTION AND RATIO TO SALES VALUE

PCON = TNVC

C *** ANALYSIS OF SENSITIVITY OF NET VARIABLE COST TO THE COST, ON AN

IF(IFOP .LE. 3 , AND, NAXF .EQ. 3) AUXIMAUX = TBR * (ETG = 1.0)

C *** INPUT BASIS, OF ROUNDWOOD, RESIN, L.A, ELECTRIC POWER, AND FUEL

C *** SENSITIVITY TO ROUNDWOOD COST (ROUNDWOOD COST/CU, FT., = X )

C *** TNVC = (CFCM * (CFCM * TCFAUX + TCFAUX + TCFAUX + TCFAUX + TCFAUX + TCFAUX)

C *** SENSITIVITY TO RESIN COST (RESIN COST/LB. = X )

C *** SENSITIVITY TO WAX COST (WAX COST/LB. = X )

C *** SENSITIVITY TO ELECTRIC POWER COST (COST/KWH = Y )

C *** SENSITIVITY TO ELECTRIC POWER COST (COST/KWH = Y )

C *** SENSITIVITY TO ELECTRIC POWER COST (COST/KWH = Y )

C *** SENSITIVITY TO FUEL COST (PRICE OF FUEL/FUEL UNIT = X )

IF(IFOP .EQ. 0) BSSTNV = FUEL * POIL

IF(IFOP .EQ. 1) BSSTNV = FUEL * POL

IF(IFOP .EQ. 2) BSSTNV = FUEL * PGAS

IF(IFOP .EQ. 3) BSSTNV = FUEL * PWO

A$FUEL = A$FUEL

A$STNV = A$STNV

A$STNV = A$STNV

IF(IFOP .EQ. 0 , OR, IFOP .EQ. 2) A$STNV = A$STNV

IF(IFOP .EQ. 0 , OR, IFOP .EQ. 2) B$STNV = B$STNV

C *** DETERMINE OUTPUT VARIABLES

DO 65 N = 1, 37

-21-
C *** FURNACE MALFUNCTION OCCURS AT GREAD T.6.C. GREATER THAN 68 PERCENT
    IF(GMCT .GT. 0.68) EFPR=0.0
C *** AVAILABLE HEAT PER POUND
    AVHMTU=MTHTV
C *** EFFECTIVE HTHU'S PER POUND
    HTHU=AVHMTU
    IF (HTHU .LT. 0.0) HTHU=0.0
C *** MILLION EFFECTIVE HTHU'S PER POUND OF FUEL
    MTHU=HTHU/10.0
    RETURN
SUBROUTINE SUB2(RTHU,HTEF,IFOP)
C *** THIS SUBROUTINE CALCULATES THE EFFECTIVE HEATING VALUE OF THE
C *** VARIOUS FUELS ON THE BASIS OF A SIMPLE PERCENT EFFICIENCY LOSS
    IF (IFOP .EQ. 0) HTEF=RTHU,0.0
    IF (IFOP .EQ. 1) HTEF=RTHU,AVDTHU
    IF (IFOP .EQ. 2) HTEF=RTHU,0.75THU
    IF (IFOP .EQ. 3) HTEF=RTHU,0.5THU
    RETURN
END
<table>
<thead>
<tr>
<th>U.S. Forest Products Laboratory.</th>
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<tbody>
<tr>
<td>PARVCOST, a FORTRAN program, is presented to calculate wood costs and requirements and chemicals and energy per unit of finished particleboard products.</td>
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<td><strong>KEYWORDS</strong>: PARVCOST, particleboard, program, variable costs, products, profit contribution ratio, energy.</td>
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