OCA-T-600
Docket No. R97-1

DIRECT TESTIMONY OF

J. EDWARD SMITH, JR.

ON BEHALF OF

THE OFFICE OF THE CONSUMER ADVOCATE

December 30, 1997

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STATEMENT OF QUALIFICATIONS

My name is J. Edward Smith, Jr., and I am a consultant appearing on behalf of the Office of Consumer Advocate. I have held a variety of research, teaching, industry, and consulting positions and will briefly outline the most relevant areas of my experience. A more complete biography of my experience is provided as exhibit OCA 601. I received an A.B. in economics with honors from Hamilton College, and a Ph.D. in economics from Purdue University. As a Research Associate with the Logistics Management Institute and as a Manager in various General Electric businesses I gained experience in the structuring of work processes to achieve efficiency in factory operations. As Secretary and Director of Economics of the National Association of Regulatory Utility Commissioners I performed a variety of rate, rate structure, economics, and public policy studies, with a particular focus on relating the conclusions of economic theory to the regulatory framework. As the Director of Market Planning and Analysis for the Washington Gas Light Company, I performed numerous investment, economic, marginal cost/cost driver analyses, and a variety of marketing, planning, and rate studies for the Company. I presented testimony before the regulatory commissions in the three major jurisdictions in which the Company operates—the District of Columbia, Maryland, and Virginia—on rates, marketing, costing, pricing, and economics issues.

I. PURPOSE AND SCOPE OF TESTIMONY

The purpose of my testimony is to comment on the appropriateness, usefulness and applicability of the testimony of Postal Service witness Bradley. His proposed cost/volume methodology is used to develop the variability of mail processing labor hours as they relate to mail volume (total piece handlings (TPH)).[1] Because the determination of the cost of mail processing has a major impact on the rate levels, witness Bradley's work serves as a significant input to the rate-making process.

I have reviewed the economic theory, econometric equations, and variables in witness Bradley's testimony. I do not believe that his methodology is theoretically sound, analytically correct, or complete. Methodological changes and data improvements are necessary, and these changes are likely to result in major changes to his conclusions. I therefore conclude that witness Bradley's study does not establish a reliable indication of the degree of causal connection between labor hours and TPH, and, as a result, does not establish a proper foundation for mail processing cost attribution in this proceeding.

My comments on witness Bradley's testimony will focus on the following issues:

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[1] Witness Bradley's testimony appears in this docket in USPS-T-14.

- **The analytical framework underlying witness Bradley's study**. I believe that the economic framework of witness Bradley's study is incomplete in terms of the explanation and justification of his cost equations and in his failure to base his analysis on a production function; nor is there adequate consideration of capital, technological change, and time trends. He also focuses incorrectly on short-run costs without considering the longer term during which the rates will be in effect. Finally, the study is deficient in that it omits considerations of equipment characteristics, *e.g.*, capital investment, age of equipment, and layout of equipment. The analysis needs to incorporate additional variables to provide an improved understanding of the cost drivers.

- **Witness Bradley's use of a fixed effects regression model**. I believe that witness Bradley has focused excessively on short-run cost analysis and that his fixed effects model is inappropriate, because it models short-run costs. I conclude that a pooled regression approach is more consistent with the underlying form of the data and the longer-run time period over which the rates will be in effect.

- **Witness Bradley's analysis of the underlying data**. The analysis needs to incorporate additional variables to provide an improved understanding of cost drivers. Additional review of the data scrubbing process is needed. The application to non-MODS facilities of conclusions based on data from MODS facilities is unsubstantiated. Finally, a simple plotting of the scrubbed data in exhibit OCA 602

demonstrates that the underlying pattern of the data is at variance with his conclusions.

- **Established common sense regulatory standards**. Witness Bradley's conclusions fail to meet both the generally accepted, common sense regulatory standards and certain fundamental requirements of the Postal Reorganization Act which are to be considered when establishing rates

I sponsor the following exhibits: OCA 601, my qualifications; OCA 602, a series of data plots relating labor hours and total pieces handled (TPH); and OCA 603, a presentation of hours and TPH plots on a facility specific and total operations basis. I also sponsor library reference OCA-LR-8, the programs derived from witness Bradley's work used to produce exhibit OCA 602, and library reference OCA-LR-9, the programs derived from witness Bradley's work used to produce exhibit OCA 603.

II. WITNESS BRADLEY'S ANALYTICAL ECONOMIC FRAMEWORK IS NOT CONSISTENT WITH ACCEPTED ECONOMIC THEORY

Witness Bradley has made a variety of explicit and implicit economic assumptions. I will focus on the following major issues: the cost function, capital, technological change, time trend, and time period. Witness Bradley's cost equation for the mail processing activity does not explicitly model the total production process, but rather focuses on two major variables—TPH and hours. The results of this limited analysis have minimal explanatory power over the period the rates will be in effect. Although TPH is correlated in the accounting system to hours worked, it is not shown to be the only or even the major driver of costs. Other cost drivers, such as the types and age of equipment, arrangement of the production process, product demand, and types of processing activities could have a causal impact on the hours/TPH relationship. Significant issues not considered in the cost equation include: (1) the explicit treatment of the achievement of economic cost minimization; (2) the analysis of tradeoffs between capital and labor; (3) the choice of technologies; (4) scale economies as related to the production process; (5) the interplay of capital choices (for example, production relationships between activities); (6) age of equipment; and (7) type of equipment.

A. The Cost Equation Is Deficient, For It Lacks A Production Function Analysis

Witness Bradley's study relates labor hours and TPH with a cost equation. This cost equation is not sufficient for the task. Economic theory uses production functions in specifying cost functions. Economists specify production functions as representing the relationship between the inputs to the production process (*i.e.*, labor, capital, etc.) and the outputs (*i.e.*, the product). The theory of production functions requires that in order to properly relate, mathematically, inputs and outputs, an analysis is required of the properties of the functions, including capital/labor tradeoffs, expansion paths, and economies of scale. Cost functions are derived from the theory of production functions. As indicated by witness Bradley:

> A cost function is derived through an optimization process by which, using envelope theorem, there is an assumption that cost minimization is taking place.
>
> That's not always the case in production, and so, an alternative approach to measuring actual costs is to use what's known as a cost equation. In a cost equation, we're simply relating the cost, here labor hours, to the drivers that determine that cost, TPH and so forth. [2]

However, witness Bradley's cost equation does not consider adequately the important properties of production and cost functions, including capital/labor

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[2] Tr. 11/5544-45.

tradeoffs and joint production. Potential tradeoffs are especially important in view of the Postal Service's major automation and investment programs.

Witness Bradley performs the cost estimation using a translog cost equation:

> I therefore follow the standard econometric practice of using a flexible functional form to approximate the true, but unknown functional form.[3]

The translog cost form has been recommended by the Commission for the analysis of costs.[4] The use of the translog model is well defined in the economics literature. Examples include Utility and Production Functions by Chung and Intriligator's exposition in Econometric Models, Techniques, and Applications.[5] Other functions, such as the Constant Elasticity of Substitution (CES) or Cobb-Douglas, are in fact sub-cases, depending on the assumptions. As stated in a Commission opinion,

> ....the translog model lets the data and the econometrics mediate the issue of which terms are significant in explaining the cost behavior. In other words, the translog functional form does not force the estimated total cost curve to follow any predetermined linear or curvilinear pattern but, instead, it allows the estimated cost function to reflect the prevailing pattern in the data better than any other model presented on this record.[6]

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[3] USPS-T-14, at 36.

[4] PRC Op. R87-1, App. J, at 22.

[5] Jae Wan Chung, Utility and Production Functions, Cambridge, Blackwell, 1994. Michael D. Intriligator, Ronald G. Bodkin, Cheng Hsiao, Econometric Models, Techniques, and Applications, Upper Saddle River, New Jersey, Prentice Hall, Second Edition, 1996.

[6] PRC Op., R87-1, App. J, at 22.

In my opinion, witness Bradley's translog cost equation is insufficient, for he does not include capital as one of the cost factors. Witness Bradley needs to examine the underlying production function and the derivation of the cost function. He also needs to examine capital/labor substitutions, scale economies, and the interrelationships of activity processes in conjunction with his estimated cost equation. This will enable an understanding of the impact of changes in capital and technology on the cost in labor hours as TPH varies during mail processing.

Witness Bradley presents a cost equation that allegedly explains cost as a function of output based on data available from an operational field data collection system. However, he recognizes that his cost equation is not derived from a production function analysis:

> [T]he cost equation on page 36 [of my testimony] is more attuned to what's known as a variable cost equation, where it's looking at one of the components, that one being labor, and to be precise, this equation does not model or include capital.[7]

Since witness Bradley's cost equations for each activity are not fully derived and justified in terms of economic theory, the cost equations may provide a good data fit on an operational basis at a given facility. Nevertheless, the equations generally lack explanatory power for the purpose of cost allocation. Witness Bradley indicates:

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[7] Tr. 11/5546.

> I think that there is an underlying production function in the sense described by witness Panzer (sic) in terms of regular operating procedures and regular operating plan. I have not identified or investigated the nature of that production process.[8]

I do not doubt that the Postal Service has regular operating plans and procedures. They are prudent necessities of business operations. However, plans and procedures do not provide the analytical form or explanatory power found in a correctly specified translog production function as defined by economists. In addressing production cost estimation, witness Bradley agrees that economic theory indicates the inputs to a production function are both capital and labor. He also agrees that a production function considers tradeoffs between labor and capital. He cites a number of studies related to telephony, electricity, hospitals, trucking, etc.[9] Witness Bradley has indicated that capital could be a relevant variable.[10] Based on his statement and my knowledge of production and costing, I conclude that capital is a relevant input that should be considered in the analysis.

One of the major inputs to be considered as part of the modeling of production and cost is capital. Postal Service capital investment will be an increasingly important means of reducing mail processing costs and improving

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[8] Tr. 11/5545.

[9] Tr. 11/5546. *See also,* Tr. 5456.

[10] Tr. 11/5547.

productivity.[11] Additional funds have recently been allotted for large future capital investments.[12] Considerations of capital deployment are essential in analyzing capital/labor substitutions and choices, and in examining changes in production, changes in factor prices, choice of technology, and changes in technology.

Witness Bradley also needs to model joint production issues. He models a number of mail processing activities at a facility but treats the activities as independent of one another. This approach ignores key relationships among activities within the facility, *i.e.*, how demands for various types of postal products and usage of various activities interact to affect labor usage. Witness Bradley touches on the possible interaction of activities in his discussion of general support activities facilitating mail processing.[13] In a mail processing facility there are a number of processes that feed each other. For example, the dock feeds mail to the facility, facer/canceller machines and the optical character readers feed data to sorters, and ultimately mail is fed back to the dock area for transportation. The

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[11] See, for example, Explanation Of Cost Reductions And Other Programs, USPS-LR-H-10, referencing expanded Postal Service programs which will affect cost, productivity, and other operating factors.

[12] The Board of Governors has approved capital expenditures and improvements to achieve increased efficiency, such as plans to invest $17 billion over the next five years for capital improvements. *See* Board of Governors Monthly Meeting, October 7, 1997, at 62-64.

[13] USPS T-14, at 87-88.

arrangement of machines, types of machines, and management of the processes affect the overall level of productivity in the mail handling process. Although the mail processing activities are distinct, they do not operate on a "stand-alone" basis. Further examination of joint production issues is necessary in order to determine an appropriate cost equation.

In conclusion, witness Bradley's cost estimating equations are inadequate in their attempt to estimate the relationship between TPH (the exogenous variable) and hours (representing cost, the dependent variable) along with several other exogenous variables (*e.g.*, the time trends and manual ratio[14]). The absence of an underlying production function analysis renders the cost equation inadequate in considering the inputs to the production process and the potential interaction of activities.

B. The Treatment Of Technological Change Is Inadequate

Witness Bradley attempts to account for technological advances in his discussion of aggregate models of productivity and time trends.[15] He quotes Dr. William Greene, a noted econometrician, as stating that technological change can be measured with an autonomous time trend. However, I believe that witness

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[14] The manual ratio is the ratio of manual letters TPH to the sum of all manual letters TPH, mechanized letters TPH, and automated letters TPH.

[15] USPS-T-14, at 13-15.

Bradley's interpretation of Dr. Greene's comments is incorrect. The sentence immediately preceding the quotation states, "Macroeconomic models are often formulated with autonomous time trends."[16] Witness Bradley is not addressing a macroeconomic problem. Instead, on the microeconomic issue of technological change, witness Bradley needs to address the fundamental drivers of technological change impacting the mail handling process.

Furthermore, the economics literature does not provide a theoretical basis for witness Bradley's approach. In a two factor macroeconomic model, a generally accepted practice has been the use of a time variable to model "all other factor(s)," which are usually considered to be technological change. This is done in the absence of better data. In the context of macroeconomic analysis, the time trend can measure productivity changes; however, such a time trend is inappropriate on the microeconomic analysis level. An explicit modeling of capital related variables is required in order to explain technological change and other important microeconomic factors driving costs.

C. The Time Trends Analysis Yields Questionable, Inconsistent Results

Witness Bradley claims the autonomous time trend variable captures the effect on the dependent variable of all time-varying factors not otherwise included in

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[16] William H. Greene, Econometric Analysis, Upper Saddle River, New Jersey, Prentice Hall, 1993, at 239. This discussion also appears in the Third Edition published in 1997, at 391.

the model. He also indicates that the time trend variable could simultaneously measure "autonomous changes in the quality of the workforce, improved efficiency of the machinery, or more effective integration of the machinery into the operating system" as well as any other capital effects.[17] According to witness Bradley:

> ...the time variable includes the effects of technological change, but it also includes any other changes in the nature of the operation through time....
>
> So I wouldn't limit its interpretation solely to technological change, and in response to someone's interrogatory I tried to make clear it's really capturing any effects that are persistent through time in that operation.[18]

In my opinion, witness Bradley's use of the autonomous time trend variable lacks precision from an explanatory viewpoint. He estimates the cost equations using the time trend variable in current and lagged form—"Time Trend 1" and "Time Trend 2." In addition to theoretical problems with the use of time trend variables, witness Bradley also encounters estimating problems. The signs of the estimated coefficients of the time trend variables present questionable results. For example, for "Time Trend 1" some estimated coefficients are positive, and some are negative, depending on activity. In addition, in some cases the sign of the coefficient of "Time Trend 1" is different from the sign of "Time Trend 2." On lines 10 and 11 of witness

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[17] Tr. 11/5277.

[18] Tr. 11/5553.

Bradley's Table 7 (Econometric Results for MODS Sorting Activities),[19] the coefficient estimates for "Time Trend 1" for manual letters, OCR, BCS, LSM, and FSM have negative coefficients. However, for some other activities, SPBS, Manual Priority, Manual Parcels, and Canceling and Meter Preparation, the estimated coefficient is positive. In other cases, the coefficient is statistically insignificant, *e.g.*, manual flats, SPBS Priority. Apparently, whatever is being measured by the time trend can have a positive, inconsequential, or negative effect. Additional explanation is needed.

In addition, the estimated coefficient signs do not agree between "Time Trend 1" and "Time Trend 2"—even though "Time Trend 2" was previously "Time Trend 1." Whatever effect is measured by the time trend can be positive or negative, and not in any particular order. Witness Bradley's Table 8, which presents the Econometric Results for MODS Allied Activities (Opening Pref., Opening BBM, Platform, and Pouching),[20] appears to confirm this problem, as does his Table 9, Econometric Results for BMC Sorting Activities (Mechanized Sack Sorting, Mechanized Primary Parcel Sorting, NMOs, BBM Sack Opening, Irregular Parcel Post).[21] To quote witness Bradley:

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[19] USPS-T-14, at 54.

[20] USPS-T14, at 63.

[21] USPS-T14, at 65.

> The differentials in the signs would reflect different autonomous trends in time, and what I mean by that is in any activity there's going to be nonvolume effects which are causing that activity's productivity or hours to go up and down through time, and what the time trends capture and attempt to control for are those external or autonomous effects on the cost equation, as we were saying before, the shifting in the cost equation. So the reason that these would be different would be that different individual operations are subject to different external events through time.[22]

Accordingly, I conclude that witness Bradley believes that one or more external effects can affect a mail processing activity positively or negatively. However, from an explanatory point of view, witness Bradley has not delineated the external effects or why they are positive or negative. I am unable to conclude what the external effects measure or how or why they affect an activity. Also, I am unable to confirm that the signs are consistent with a correct methodology. At a minimum, additional explanation is required, and it may also be the case that additional analysis is necessary.

D. The Study Focuses On The Very Short Run: Longer-Run Analysis Is Needed

The time period under analysis for the cost function estimation is not adequately defined for the cost equation. The data span at least 39 time periods; however, most of witness Bradley's comments and analysis suggest that he is

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[22] Tr. 11/5554.

looking at essentially "monthly" or, more precisely, four-week periods.[23] Given the short-run four week time frames he nevertheless intermingles short-run and longer-run considerations.

The reason that short-run/longer-run issues are so important is that estimates of cost incidence will be different, depending on which type of cost (short-run or longer-run) one is attempting to measure. It is generally recognized that most production processes will permit a slight increase or decrease with proportionately lower amounts of capital and labor. However, the appropriate mail processing cost to measure as volumes increase or decrease is the longer-run cost--which witness Bradley has not measured. Witness Bradley states that:

> ...economists define the long-run as a situation in which all inputs are flexible and can be adjusted. The short-run would exist when any of those inputs would not be perfectly adjusted.[24]

In commenting on the longer-run/short-run issue, witness Bradley indicated:

> I am informed that once an automated machine has been accepted from the manufacturer, it will typically only take one or two accounting periods to reach the minimum threshold for normal operations. [25]

Based on witness Bradley's comments, it appears that the longer-run for the mail processing activities under consideration is approximately a year, given the

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[23] There are thirteen time periods in a year, so data are close to, but not exactly, monthly.

[24] Tr. 11/5547.

[25] Tr. 11/5356.

Postal Service's extensive ongoing capital programs. The longer-run might not even involve immediate capital investments but might simply involve the permanent addition of personnel to use existing investment more intensively. Witness Bradley quotes Dr. William J. Baumol's comments in Docket No. R87-1:

> A final matter to be touched on briefly here is the choice of marginal costs upon which the rates should properly be based. Should these marginal costs be short run or long run in nature? As I will show, the answer is that they should be the actual marginal costs, whichever of those that may be. When an output of a service is increased (or decreased), there is only one amount of cost actually added (or saved), not two or three. The actual marginal costs are normally closest to what economists call short run marginal costs (SRMC). But it must be emphasized that these actual marginal costs do include cost consequences of a current volume change that may occur in future periods. (Emphasis in original.) [26]

Witness Bradley indicates that the concept of marginal costing is applicable in the current case:

> One should attempt to base prices on the marginal costs that will actually be incurred by the firm to serve a sustained increase in volume over the time period during which the prices will be in effect. Taken literally, this would require that some version of short run marginal costs should be used. [27]

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[26] Tr. 11/5417.

[27] Tr. 11/5417 (Response to P.O. Information Request No. 4, question 1a.)

Based on the above comments, witness Bradley appears to indicate that he is estimating short-run costs. He explains drivers of the cost/volume relationship in the following terms:

> The first reason is the existence of relatively fixed functions within the activity. Certain functions, like setting up mail processing equipment or tying down a manual case are done for each sorting scheme and are not sensitive to the amount of volume sorted. As volume rises, the hours in these functions do not rise much, if at all.[28]

I conclude that witness Bradley has focused on short-run cost analysis. Consideration of longer-run costs, over the time period that the rates will be in effect, is necessary. In the following section I demonstrate graphically the flaw of focusing on short-run analysis.

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[28] USPS T-14, at 55-6.

III. ECONOMETRIC ISSUES

A. Witness Bradley Should Have Used The Pooled Regression Model In Place Of The Fixed Effects Model

The choice of model is crucial in determining the outcome of witness Bradley's study. Responses to the P.O.'s Information Request No. 4 highlight the importance of model choice.[29] The computed variabilities using witness Bradley's data for mail processing activities are generally in the neighborhood of 100 percent for pooled data; they are substantially lower for the fixed effects cases. Accordingly, a key question is which econometric method is best for estimating the relationship between hours of labor incurred and the exogenous causal variables.

Witness Bradley states that he considered three choices for the modeling of the panel data: a pooled model, a fixed effects model, and a random effects model. A pooled model analyses the panel data set as being homogeneous across facilities. There will be one intercept with the axis of the dependent variable. For the fixed effects model, a vector "alpha sub i" allows for site specific effects to take into account differences between facilities. This results in multiple heterogeneous intercepts for the dependent variable axis but homogenous slopes for the independent variable. For the random effects model, facility specific characteristics are modeled as stochastic variables. Witness Bradley rejects this approach.

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[29] Tr. 11/5427-9.

Witness Bradley testifies that he opted for a fixed effects model in order to allow for site-specific effects, accounting for significant non-volume variations across facilities. In his fixed effects estimate, witness Bradley relies on the work of Dr. Hsiao; witness Bradley's approach is that of Case 1 on page 6, in Dr. Hsiao's book.[30] This case hypothesizes regression lines based on panel data with multiple alpha intercepts—one for each site location. That is, the alpha intercepts of the regression lines are heterogeneous but the slopes are homogeneous across locations. Each alpha sub i, the intersection with the y axis in two dimensional space, is associated with a specific regression; the regressions have common slopes but differing y intercepts.

I am not disputing the accuracy of Dr. Hsiao's work. As a monograph published by the Econometric Society, the work is definitive. Rather, I want to make clear that I disagree with witness Bradley's decision to apply the fixed effects approach to the specific case under consideration in estimating the hours/TPH relationship. I conclude that each of the "alpha sub i" in witness Bradley's method relates to a short-run, "monthly" facility specific cost relationship. In specifying his underlying theoretical framework, witness Bradley has discussed short term changes. Based on the model chosen from Dr. Hsiao, as well as witness Bradley's

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[30] Cheng Hsiao, Analysis of Panel Data, New York, Cambridge University Press, 1986, at 6.

testimony, I believe that witness Bradley has presented a set of short term cost equations that are inappropriate for measuring the variability of mail processing costs in this proceeding.

The nature of short-run changes in production is that incremental output can usually be obtained with relatively minimal increases in resources. However, the measurement of changes in labor with short-run changes in output is irrelevant for the purposes of this proceeding. The relevant measurement of cost incidence should focus on the expansion path reflecting expansion or contraction of the scale of the facility in the foreseeable future, as incremental labor is altered or additional capital equipment installed as a result of the Postal Service's ongoing capital expansion. Based on the information in witness Bradley's testimony, it is clear that significant expansion of capacity at a facility can occur in a period ranging from several months to possibly a year. Accordingly, the longer-run time frame under discussion is well within the period during which these rates are likely to be in effect.

A visual inspection of plots of the underlying data substantiates my comments that the pooled regression approach is a better modeling of the data and that the data do not substantiate the fixed effects approach. In my exhibit OCA 602, one observes a variety of data plots for a number of the mail processing activities. For a selection of activities, hours and TPH were plotted on a combined basis for all years and for all facilities. The plots for a given activity are based on all of the data which

were inputs to witness Bradley's equations. The data plots drawn from witness Bradley's data suggest a variability approaching 100 percent for many of the activities.

For purposes of exposition, Diagram 1, below, presents four facility specific short term equations represented by the lines on the diagram (labeled A, B, C, and D). These equations are hypothesized for a common activity at four different sites. Accordingly, each equation relates hours and TPH at a different facility for an activity. The cost equations are of the form and nature estimated by witness Bradley. Moving along one of the lines (A,B,C, and D) for a given facility, on a short-run monthly basis, labor is not 100 percent proportional to TPH.[31]

For the hypothesized case under consideration, at a point in time each of the four sites has a design capacity for a given activity. Each activity at a specific facility has an optimum level of output for the activity. This hypothesized optimum level of operation is denoted by a specific point, a "p" on each of the lines A,B,C, and D of the diagram. The longer-run expansion path is the way in which changes in TPH affect the need for labor hours over a longer time period. The optimum capacity of a facility would be changed in adapting to longer term changes in TPH. This could occur over a period of months, the time during which the rates would be in effect.

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[31] This is implicit because the regression lines A through D have a slope which causes them to intersect the y axis well away from the origin.

The expansion path is denoted by the connection of the points "p" and defines line E on the graph.[32] The equation of this longer-run expansion path should be estimated in determining cost/volume variability. The set of points denoted "p", therefore, delineates a somewhat longer-run cost relationship corresponding to line E in the diagram. On an empirical basis, the plotted data in exhibit OCA 602 suggest that such a line could be computed. The pooled regression equation has already been furnished in a response to the Presiding Officer's request[33] and is a first approximation to the equation represented as line E. The equation is based on limited data, insofar as it does not consider the facility specific variables previously mentioned.

Dr. Hsiao's Case 1 diagram presents a situation of heterogeneous intercepts with a homogeneous slope. His diagram is essentially identical to Diagram 1 in this testimony. Witness Bradley has estimated lines A,B,C, and D as the fixed effects

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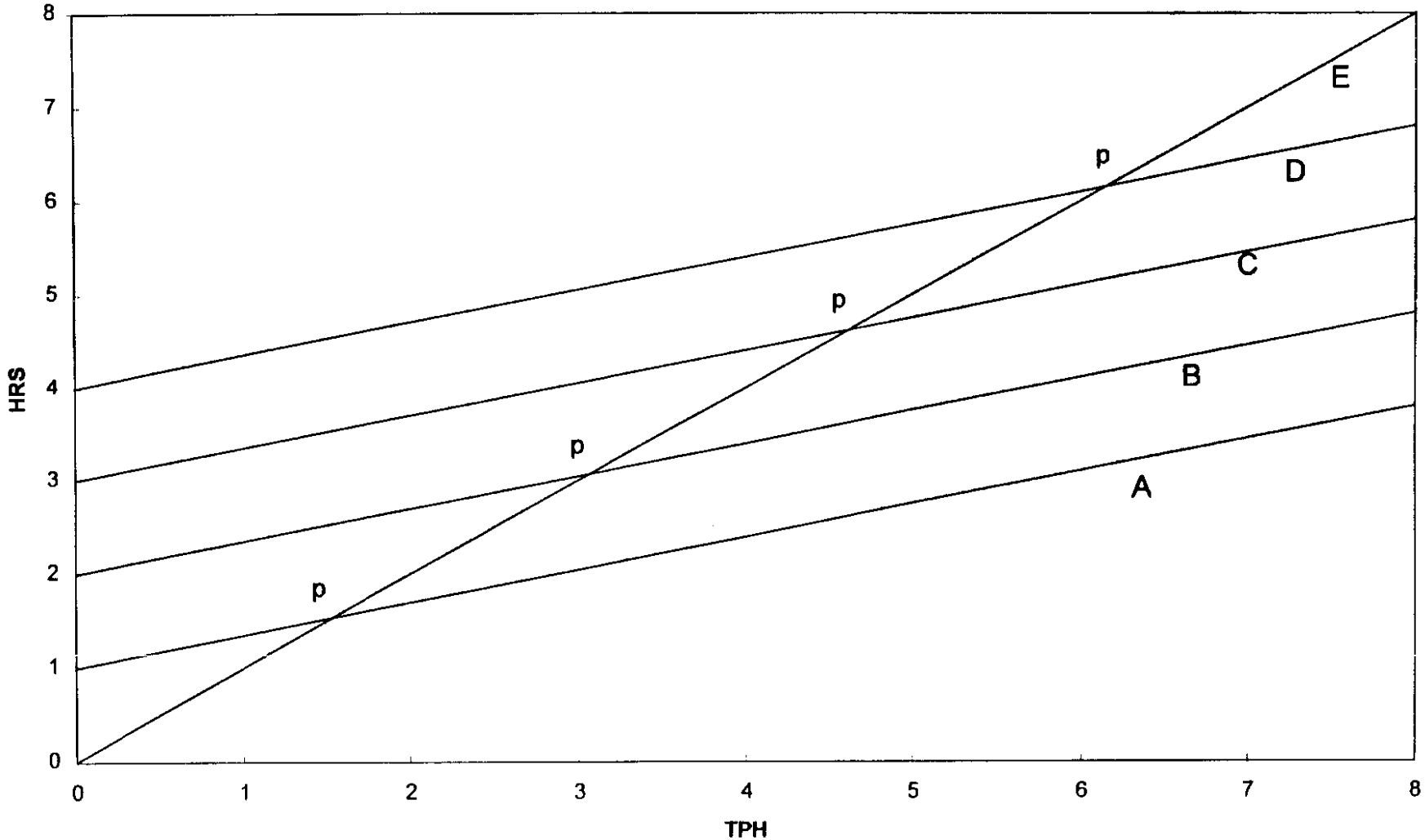
[32] It should be noted that all lines are drawn for purposes of exposition, and that real world presentations frequently involve data plots that are less precise and ordered in their presentation.

[33] Tr. 11/5427-29 (P.O. Information Request No. 4, question 3.)

1 regression equations. However, it would be Line E in Diagram 1, a line which also
2 appears in Dr. Hsiao's diagram, figure 1.1,[34] that represents the relevant equation.

[34] Hsaio, *op. cit.*, at 7.

Diagram 1: Potential Cost Relationships



I conclude that line E of Diagram 1 is the correct line for purposes of measuring the relationship between hours and TPH. Lines A, B, C, and D are short term relationships between labor hours and TPH. One moves along the hypothetical expansion path E by varying the size of the facility in terms of employment, investment, or both.

By relying on factory floor data and by fitting factory floor data to a short-run fixed-effects model, witness Bradley has guaranteed that he will obtain short term results. This is why the pooled model, discussed in the previously mentioned Presiding Officer's Information Request No. 4, is more relevant.

Witness Bradley's data are consistent with the data plot presented by the Presiding Officer.[35] In response to questions about the data plot witness Bradley indicated:

> It looks to me like a blob of data with many, many data points, and one's eye would be tempted to draw a straight line through it, but I think that would be a mistaken inference, because the actual straight line should come from an econometric regression. My experience has been that when looking at simple plots they can be misleading. So I'd be hesitant to say so. [36]

He continued:

> What these data plots would seem to imply are results which are similar to my response to POIR 4 – I believe it is Question 4, it's

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[35] Tr. 11/5580.

[36] Tr. 11/5581.

Question 3 or 4, where I produced econometric results for what is known as a pooled model.

Econometric results for the pooled model give you a variability of one, or in most cases a little bit greater than one, which could be consistent with this plot. [37]

The plots of the underlying data tend to substantiate the conclusion that the pooled approach is correct.

B. The Actual Data Plots By Facility Also Are Visually Compelling, Leading To A Pooled Regression Model Conclusion

I have previously pointed out that the data presented in exhibit OCA 602 are visually compelling in demonstrating a proportionality between labor hours and mail volume. In order to assess empirically witness Bradley's selection of a regression line, I performed additional data analyses on the activities and facilities. I chose the activities Manual Flats, Manual Letters, OCR, and LSM. I first plotted the data on a site specific basis. This resulted in hundreds of plots, *i.e.*, one for each location denoted by an IDNUM (site location) for each type of activity. A selection of the plots is presented in exhibit OCA 603. All plots are presented in library reference OCA-LR-9. There are three types of plots. The first type of plot substantiates the A/B/C/D equation form in Diagram 1. This array of plots would be expected in the short term for specific facilities. The second type of plot corresponds to the line E in

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[37] Tr. 11/5581-82.

Diagram 1. If witness Bradley's theory were correct, this array of plots would not be expected.[38] Finally, some plots resemble a random "blob" of data. These "blob" plots do not substantiate either a fixed effects model or a pooled model.[39]

Since I have plotted actual data rather than having computed regressions, the conclusions are visually compelling but not precise. It is clear, however, that the underlying data plotted on a site by site basis substantiate both fixed effects regressions and pooled regressions.[40]

Exhibit OCA 603 also includes plots denoted as IDNUM 9999 for each activity. IDNUM 9999 is not a specific location. Rather, each point in IDNUM 9999 for a specific activity represents a summation of all of the logs of the hours and TPH data for a given location. Accordingly, a point on the IDNUM 9999 plot for a specific activity is representative of the total hours and total TPH at a given site. The plotting of all of the points together is representative of hours as a function of TPH, across sites for a given activity. Assuming that a specific facility may operate either below or above capacity, then total data for a site should be representative of overall operations at the site. The plot of the summed data shows that the expansion path

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[38] Such plots substantiate proportionality between hours and TPH and would lead one to conclude that a pooled equation is appropriate.

[39] A model can be forced through such plots, but such an exercise does not necessarily establish a relationship.

[40] In each case where I have summarized the form of a data plot, I have used informed judgment as to its shape.

for a specific activity appears to be of a pooled nature. In performing additional analysis of the hours/TPH relationship witness Bradley should consider the design capacity for each facility as one of the exogenous drivers of hours, examining the impact on the hours/TPH relationship as facility size changes.

IV. DATA ASSUMPTIONS ARE NOT SUFFICIENT

A. Additional Variables Are Required

A number of additional variables besides the time trend variable should have been investigated for interaction with mail processing labor. As already noted, labor usage does not stand alone. It is interdependent with a variety of technology, capital, equipment, and management choices.

As part of a pooled regression effort, one could add additional explanatory variables. Witness Bradley has agreed that this would be desirable:

> More generally, if one would have a variable which was a facility-specific characteristic that was non-volume—let's say age of the facility—one could, if one had that data, enter a variable such as age—as age of the facility as another (sic)—let's call it z variable—and estimate its own coefficient in place of the alpha I, yes.[41]

Witness Bradley has used the alpha vector to model facility specific events. However, I believe that the additional variables should be explicitly modeled. Witness Bradley actually performed such an analysis with some of the variables he considered, *i.e.*, the manual ratio and time variables. I believe that his analysis needs to be extended.

By not analyzing additional variables across the facilities and over time for their potential interaction with labor usage, witness Bradley's analysis is limited. It fails to explain potentially major causal factors over the period during which the rates

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[41] Tr. 11/5549-50.

will be in effect. Witness Bradley needs to investigate additional variables affecting mail processing labor expense. These variables include the age of the facility, the magnitude of the facility support costs, the size of the facility (square feet of space and/or number of people employed), the space utilization, the number of processing activities, the types of mail processing equipment, the value of the equipment located within a facility, and the quality of the work force. Some of these variables are mentioned in witness Bradley's testimony and, separately, in his published article "Performance in a Multiproduct Firm."[42]

I have experience in the analysis of work processes. At General Electric's Large Transformer Operation, I worked in a business which completely restructured the factory and marketing processes. At the Logistics Management Institute, I performed studies of the electronics and airframe businesses, with particular emphasis on the organization of work flows for improved productivity. My work with the Washington Gas Light Company involved the restructuring of major work processes in information systems and marketing to achieve stated goals. In all of this work I have observed that factors such as the flow of the production process, the quality of the management, the types of activities performed near a given activity, as well as the types, amounts, age, and utilization of capital equipment can

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[42] USPS-T-14, at 40-41. Michael D. Bradley, Donald M. Baron, "Measuring Performance in a Multiproduct Firm: An Application to the U.S. Postal Service," Operations Research, Vol. 41, No. 3, May-June, 1993, at 455.

will be in effect. Witness Bradley needs to investigate additional variables affecting mail processing labor expense. These variables include the age of the facility, the magnitude of the facility support costs, the size of the facility (square feet of space and/or number of people employed), the space utilization, the number of processing activities, the types of mail processing equipment, the value of the equipment located within a facility, and the quality of the work force. Some of these variables are mentioned in witness Bradley's testimony and, separately, in his published article "Performance in a Multiproduct Firm."[42]

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[42] USPS-T-14, at 40-41. Michael D. Bradley, Donald M. Baron, "Measuring Performance in a Multiproduct Firm: An Application to the U.S. Postal Service," Operations Research, Vol. 41, No. 3, May-June, 1993, at 455.

have a large impact on a given work activity. Witness Bradley's analysis does not study these factors and needs to add variables taking these factors into consideration.

B. The Mail Processing Analysis Confirms The Need For Additional Variables

A review of the mail processing operation substantiates the need for consideration of additional data. Recently at the Merrifield, Virginia, Sectional Center Facility (SCF), I observed the mail processing. It is my understanding that the Merrifield SCF may be more technologically advanced than some of the other mail processing facilities, but that the facility is, in general, representative. It is clear that a variety of automated, technologically sophisticated activities are interwoven to support the timely processing of mail. None of the activities truly stand alone in terms of processing, labor requirements, investment characteristics, or efficiency. Data to measure the impact of those variables on mail processing needs to be evaluated.

Data for many of the variables which witness Bradley has discussed in his article and which I have discussed should be available at the facility level. I would expect that some of the data should also be available at the activity level. Where data are lacking at the activity level, it would be appropriate to perform an analysis to determine if facility level data are adequate. Alternatively, it may be necessary to gather additional data.

C. The Data Scrubbing Effort Needs Additional Analysis To Check The Reliability Of The Procedures

Data scrubbing is another area in which witness Bradley's work needs additional research. Table 1 of USPS library reference LR-H-148 presents witness Bradley's analysis of data used. A number of observations were eliminated for many sites.[43] An additional analysis of scrubbed variables would be desirable to answer the following types of questions: Was there inappropriate dropping of data? Is an inordinate amount of data unreliable? If an inordinate amount of data is unreliable, how reliable is the remaining data? By eliminating a number of outliers, were the most efficient or important data eliminated, particularly in view of major investment and automation efforts? In eliminating sites with fewer than 40 observations, were sites with major automation efforts eliminated? In addition, there needs to be a discussion and statistical justification of the relevant number of observations per site.

[43] USPS-LR-H-148, at 7.

D. The Absence Of Non-MODS Data Potentially Biases The Conclusions

Associated with the issue of data reliability is the absence of non-MODS data. Witness Bradley uses data from MODS facilities and has presented no data from non-MODS facilities. However, his conclusions are applied to mail processing at non-MODS facilities which differ from MODS facilities. Witness Moden recognizes there are many differences between MODS and non-MODS facilities and testifies that non-MODS facilities are characterized by simpler sorting schemes, a smaller workroom floor, clerks with greater personal knowledge of the local delivery area, and a possibility of a steadier work flow.[44] He further recognizes that the factors affecting volume variability include equipment, mail flows, performance of individual clerks, and work-room floor size.[45] Nevertheless, witness Moden, in spite of his agreement about the differences in characteristics between MODS and non-MODs facilities, maintains that there are similarities in the work in terms of equipment and work flows. He indicates, however, that he knows of no studies comparing mail processing flows between MODS and non-MODS facilities.[46] Although there may be similarities between MODS and non-MODS facilities, there are obviously

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[44] USPS-T-4 at 22.

[45] Tr. 11/6052.

[46] Tr. 11/6053.

significant differences as well, and the impact of those differences on mail processing is not presented.

Witness Degen testifies for FY 1996 that non-MODS offices accounted for 96,447 out of 386,617 employees in certain classifications.[47] Accordingly, non-MODS offices appear to account for approximately 25% of the employment in certain classifications, a very significant percentage that has been ignored in the data collection process and consequently in the data analysis. There is agreement that non-MODS offices are smaller; but there does not appear to be agreement whether they are representative—opinions abound; studies are absent. Given witness Moden's testimony, it is reasonable to question whether MODS facilities are in fact representative of non-MODS facilities.

[47] Tr.12/6354 (OCA/USPS-T12-64).

V. COST ALLOCATION STANDARDS

A. The Study Does Not Meet Traditional Regulatory Standards

In Principles of Public Utility Rates, Dr. James C. Bonbright articulated the standards which a regulatory study should meet.[48] He identified eight evaluation criteria. The criteria are applicable to witness Bradley's costing study, for the study serves as a major input to the rate making process. Five of the eight criteria are immediately relevant. In one form or another, Dr. Bonbright's criteria have been widely applied by commissions—explicitly or implicitly—in the evaluation of regulatory studies.

First, Dr. Bonbright advocated the "practical" attributes of simplicity, understandability, public acceptability, and feasibility of application. Although the econometrics and underlying modeling techniques in witness Bradley's testimony are complex, the real issue from an understandability point of view is whether witness Bradley's study is complete—*i.e.*, whether all of the modeling alternatives have been adequately considered. It is important that the methodology employed is understandable to informed individuals, particularly where, as here, the results are contrary to past practice. One of my criticisms of the study is that the conclusions are not consistent with the data. In fact, a simple plotting of the data of labor hours

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[48] James C. Bonbright, Principles of Public Utility Rates, New York, Columbia University Press, 1961, at 291.

and total pieces handled (TPH) as presented in exhibit OCA 602 is at variance with witness Bradley's major conclusions. Witness Bradley's testimony does not meet the standards of simplicity, understandability, public acceptability, and feasibility because it is incomplete.

Second, Dr. Bonbright advocated that proper interpretation of a study be free of controversy. Witness Bradley's study does not meet this requirement. For example, the data plot presented by the Presiding Officer indicated that a simple "eyeballing" of the data suggests that costs are proportional to output.[49] Common sense, based on a review of the data plot, suggests that the elasticity appears to be approximately 1, which in the past has been the generally accepted estimate. I have presented plots of the data in exhibit OCA 602 which are at odds with witness Bradley's conclusions.

A third criterion for consideration is the stability of the rates, which are based to a significant degree on the underlying costing studies. Witness Bradley's study results in a reallocation of costs, and this could result in very different rates—not necessarily in this case but quite possibly in future cases. Some types of activities and classes of service would ultimately have decreased costs, and others would have increased costs. Before the stability of the current rate structure is significantly altered, it would be appropriate to verify that witness Bradley's study correctly

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[49] Tr.11/5580.

attributes costs. The study does not reliably predict the correct causal connection between hours and TPH and so does not provide adequate justification for changes in costing methodologies.

A fourth criterion outlined by Dr. Bonbright is fairness in the apportionment of total costs of service among the different consumers. Again, the incomplete and inadequate methodology presented by witness Bradley renders the study inappropriate for implementation because it probably apportions costs incorrectly. If costs are not properly attributed to the classes or services responsible for those costs then the rates derived from that attribution may cause some classes or services to bear more than their fair share of the cost of the service.

A final basis for the evaluation of proposed methodologies is that rates should promote efficiency by discouraging the wasteful use of services while promoting all justified types and amounts of use. The economic theory of regulation generally indicates that in reviewing and setting rates one of the goals is cost-based rates to promote economic efficiency, defined as the correct allocation of scarce resources. This is the objective of cost-based rates—to arrive at the proper pricing of products. However, witness Bradley's study is incomplete and thus fails to provide a proper foundation for cost-based rates. Accordingly, I do not believe that witness Bradley's work meets the regulatory standards outlined by Dr. Bonbright. The data plots in OCA 602 suggest that witness Bradley's conclusions are at

variance with the underlying data. The econometric applications need more work in terms of theoretical analysis, choice of variables, and choice of estimation procedures.

B. Application Of The Study's Conclusions Would Be Contrary To Requirements Of The Postal Reorganization Act

Witness Bradley's study does not meet certain criteria set forth in the Postal Reorganization Act which are similar to those I have just discussed with respect to Dr. Bonbright. The Act provides that recommended postal rates and fees for each class of mail or type of service must be in accord with the policies of the Act. These policies include, among other things, that the rate schedule established and maintained is fair and equitable,[50] and that each class or type of mail bear the direct and indirect postal costs attributable to that class or type of mail.[51]

For all of the reasons previously stated concerning the deficiencies of witness Bradley's study and its failure to quantify reliably the analysis of the causal connection between labor hours and TPH, I believe the study apportions mail processing costs incorrectly. If costs are not correctly attributed to the mail classes and services, unfair and inequitable schedules could result. Also, the provision of the Act requiring that each class or type of mail bear the direct and indirect postal

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[50] 39 U.S.C § 3622(b)(1).

[51] 39 U.S.C. § 3622(b)(3).

costs attributable to that class or type of mail would not be met. If witness Bradley's methodology results in a failure to attribute correctly the direct and indirect costs to the appropriate class or type of mail, then there would be no compliance with that provision of the Act.

VI. CONCLUSIONS

I do not believe that witness Bradley has substantiated his conclusions concerning volume variability. I conclude that a pooled regression approach with additional data and economic analysis are needed. In addition to analyzing labor hours, some consideration of investment costs is necessary. Such consideration is important in view of the Postal Service's investment plans. I have also described additional variables that should be considered in the study. Witness Bradley's focus on monthly short-term costing needs to be extended to a longer term. In my view a properly designed analysis would substantially alter witness Bradley's conclusions. Furthermore, the absence of non-MODS data from the analysis may bias the conclusions. Therefore it is premature to use his analysis as a basis for establishing the attribution levels of mail processing labor costs.

QUALIFICATIONS

J. EDWARD SMITH, JR.
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Economist: Experienced in applied microeconomics, investment project evaluation, marketing, planning, business analysis, computer applications, statistics, and government/business regulatory interface. Successful expert witness, consulting, and project management skills.

CONSULTANT, 1997. Practice is focused on regulatory analysis, marketing, and utilities. For example, for a major client conducted study on opportunities from deregulation.

CUSTOMER SERVICE IMPROVEMENTS: For Price Waterhouse managed a study focused on telephone call centers.

DIRECTOR, MARKET PLANNING AND ANALYSIS, WASHINGTON GAS, 1987-97.

FINANCIAL/INVESTMENT ANALYSIS: Increased return from 8% to 11-14% on $100 million investment budget by instituting financial and economic marketing reviews to upgrade profitability.

PRICING AND MARKET ANALYSIS: Achieved a 30% improvement in costing and pricing of electricity rates by developing improved marginal cost, supply, and demand models for two major electric utilities, permitting the analysis of power pool and stand alone operations.

COST/BENEFIT BUDGET ANALYSIS: Eliminated fifteen percent over-run surprises in the total Marketing Budget by developing procedures for tying expenditures to results.

PLANNING: Increased Company's market share from 35% to 70% in supplying natural gas to the new home construction market by developing a planning process that generated accurate forecasts of market potential and built cross-functional commitment and teamwork to achieve higher marketing goals.

EXPERT WITNESS: Retained over $25 million of yearly profits by developing an economics/market research and pricing capability able to establish credibility before regulatory agencies and to win twelve rate proceedings in contesting the rate structures of major competitors. Also managed the preparation and appearances of other witnesses.

CUSTOMER SEGMENTATION/MARKET RESEARCH: Added $5 million of new business income each year by developing a geographic information database that segmented customers by demographics, preferences, and lifestyles.

COMPUTER PROCEDURES: Achieved 80% reduction in the backlog of requests on mainframe legacy systems by developing new operating procedures.

COMPUTERS: Computerized and networked competitive databases to provide immediate access to competitive information, reducing decision making times. Computer skills include SAS, Excel, Lotus, RBASE, Word, Word Perfect, and others.

SALES: Added over $46 million of profit at a cost of $13 million, improved the Company's competitive edge, and enhanced trade relationships by creating the Integrated Resource Planning Operation--which pioneered new marketing approaches to target incremental gas sales, and which promoted the installation of higher efficiency gas equipment.

HUMAN RESOURCES DEVELOPMENT: Became the major internal supplier of new management talent for the Company by motivating and training new marketing personnel--resulting in the achievement of a promotion rate three times that of other areas of the Company.

FINANCIAL/ECONOMIC ANALYSIS: Designed a strategic model of corporate operations to forecast the impact of marketing and customer service decisions on earnings per share, rates of return, and market position. Used the model to achieve penetration of new markets with up to a doubling of profits in some products.

PUBLIC POLICY AND REGULATORY INTERFACE: Defused a poisonous regulatory climate with important government stakeholders while representing the Company before regulatory panels, committees, and working groups.

COMPETITIVE ANALYSIS: Collection of competitive data obtained a competitive advantage against six major competitors.

MANAGER, POWER SYSTEMS BUSINESS, GENERAL ELECTRIC, 1976-87.

SALES TURNAROUND/COST REDUCTION: Improved profits by $3 million by developing the first reliable market forecasts which were used to balance the factory production schedule, cut costs, and to implement the first price increase in three years.

COMPUTERS: Saved $500,000 per year at a one time equipment cost of $50,000 by migrating the mainframe customer database--used as the basis for all market pricing and strategy--to PC applications.

COST/BENEFIT ANALYSIS: Forestalled potentially disastrous cost increases of up to 40% in a $2 Billion consumer appliance market by developing low-cost alternatives to proposed product requirements necessitated by government regulations.

BUSINESS DEVELOPMENT: Demonstrated to management the advantages of entering a new $5 Billion market in electric utility power plant life extension by showing that the development of a plant retrofit program could counterbalance the sales decline in new electric utility construction.

STRATEGIC CHANGE: "Alternative U.S. Energy Futures" project showed the need for major changes in business product mix, resulting in the development of new and successful sales thrusts to offset low sales growth in existing products.

DIRECTOR OF ECONOMICS, NATIONAL ASSOCIATION OF REGULATORY UTILITY COMMISSIONERS, 1974-76.

PRODUCTIVITY IMPROVEMENT: Initiated studies of utility rates, cost performance, and investment trends. The studies received extensive coverage in the press.

RESEARCH ASSOCIATE, LOGISTICS MANAGEMENT INSTITUTE, 1972-74.

COMPETITIVE ANALYSIS: Identified achievable savings of 15% in prices for high technology equipment through increased competition, second sourcing, and Design-to-Cost.

EFFICIENCY ANALYSIS: Study of the aircraft industry for the Department of Defense identified achievable savings of over $1 billion per year through improved plant consolidation.

ASSISTANT PROFESSOR, UNION COLLEGE, 1969-72. Taught statistics and managerial economics at the undergraduate level and in the Master of Science in Industrial Administration program, targeted at mid-career professionals.

EDUCATION: Manager Development Course, GE, Crotonville, 1980.
Ph.D., Economics, Purdue University, 1969. A.B., Economics, Hamilton College, 1965.

PRESENTATIONS.

Least Cost Planning and Gas Utilities: Balancing the Theories and Realities, seminar, 1989

Eastern Utilities Group, Eastern Regional Business and Economics Utilities Conference, "Competition between Natural Gas and Electricity," April 11, 1990.

AGA/SGA Market Research Seminar, "Overview of Applied Market Research," Nashville, Tennessee, May 3, 1990.

"Conservation and Load Management: The Promise of Tomorrow," National Regulatory Conference at Marshall-Wythe School of Law, May 14, 1992.

National Petroleum Council, Natural Gas Study, November 1992. Major contributor to demand analysis for mid Atlantic Region and National Analysis for Residential and Commercial Customers.

"Painting the Electric and Gas Picture," Presentation to the 19th Annual Rate and Regulatory Symposium on Resource Planning, Incentives and Pricing, University of Missouri Extension Conference Office, Westin Crown Center, Kansas City, Missouri, April 27, 1993.

"Integrated Resource Planning," Presentation on IRP, Fuel Switching, and Demand Side Management, DOE/NARUC National Conference on Natural Gas Use, New Orleans, Louisiana, April 26, 1993.

"Least Cost Planning," Southern Gas Association Corporate Telelink Network, Integrated Resource Planning Broadcast, October 21, 1993.

American Gas Association, "IRP: The Road to Buy-In," Presentation to AGA Seminar on Integrated Resource Planning, Arlington, Virginia December 8, 1993.

Associated Gas Distributors Operating Committee, Presentation on IRP: "Solving the conservation Puzzle," February 8, 1994, Washington, D.C.

"The Business Economist at Work: Washington Gas," in Business Economics, July 1996, Volume XXXI, Number 3.

"Forecasting and Risk Management," EPRI Conference on Forecasting in a Competitive Electricity Market, November 11, 1997.

TESTIMONY AND CASES
DISTRICT OF COLUMBIA

F.C. No. 834, Phase II: Case that established Integrated Resource Planning as a requirement, with conservation goals, efficiency criteria, and extensive data and study requirements. Resulted in a variety of programs, analyses, and working group efforts.

F.C. No 834, Phase II, Integrated Least Cost Plan, Fifteen Volumes, 1990

F.C. No. 870, 1988. Rate Case.

F.C. No 834, Phase III, Integrated Least Cost Plan, Twelve Volumes, 1992.

F.C. No 889, 1990; testimony focused on marginal costs, rate structures, and summer/winter differentials .

F.C. No. 905, 1991; focused on rating periods, marginal costs, and rate structures.

F.C. No. 917, 1992; review of PEPCO Least Cost Plan; Focused on power pools as related to electric marginal costs.

F.C. No. 921, Integrated Least Cost Plan, Seven Volumes, 1994. Review of programs, modeling efforts, and plans.

F.C. No. 921, Integrated Least Cost Plan, 1996. Two Volumes.

F.C. No. 922, Washington Gas Base Rate Proceedings, 1992.

F.C. No. 934, Before the Public Service Commission of the District of Columbia, 1994

MARYLAND

Case No.. 8284, In the Matter of the Complain, Potomac Electric Power Company vs. Maryland Natural Gas, 1990.

Washington Gas, Case No. 8251, 1990. Focus on electric utility rates, marginal costs, power pools, and summer/winter differentials.

Washington Gas, Case No. 8315, 1991. Issues in Case 8251 further litigated in view of changing cost structures.

Washington Gas, Maryland Division, Integrated Resource Planning Status Report, 1994.

Washington Gas, Maryland Division, Conservation Status Report, 1994, 1995.

Washington Gas, Maryland Division, Case No. 8720, In the Matter of the Cost-Effectiveness of Washington Gas Light Company's Demand-Side Management Programs

Pepco Complaint against Maryland Natural Gas. Case 8284, 1990. Complaint over issues related to block rates, connection fees, gas supply costs. Complaint dismissed.

VIRGINIA

Washington Gas, Virginia Division, Status Report of Washington Gas CLM Activities, 1995

Washington Gas, Virginia Division, Status Report of Washington Gas CLM Activities, 1996.

Washington Gas, Virginia Division, Case No.. PUE920041, 1993.

NVNG Protest, Energy Saver Home Tariff. 1990. Filed comments in opposition to program.

NVNG Protest, Heat pump promotional Program; 1990

NVNG Protest, Co-op Advertising Program; 1991.

NVNG Protest, Service Connection Policy Revisions, 1992.

Potomac Edison Case No. PUE900009, Electric Add on Heat Pumps.

Virginia Case No. PUE900070, Conservation and load Management Case. 1992.

WEST VIRGINIA

Potomac Edison, Case 90-046-E-PC, Potomac Edison filing for electric add-on heat pumps. Developed testimony for Washington Gas witness.

PLOTS OF WITNESS BRADLEY'S DATA

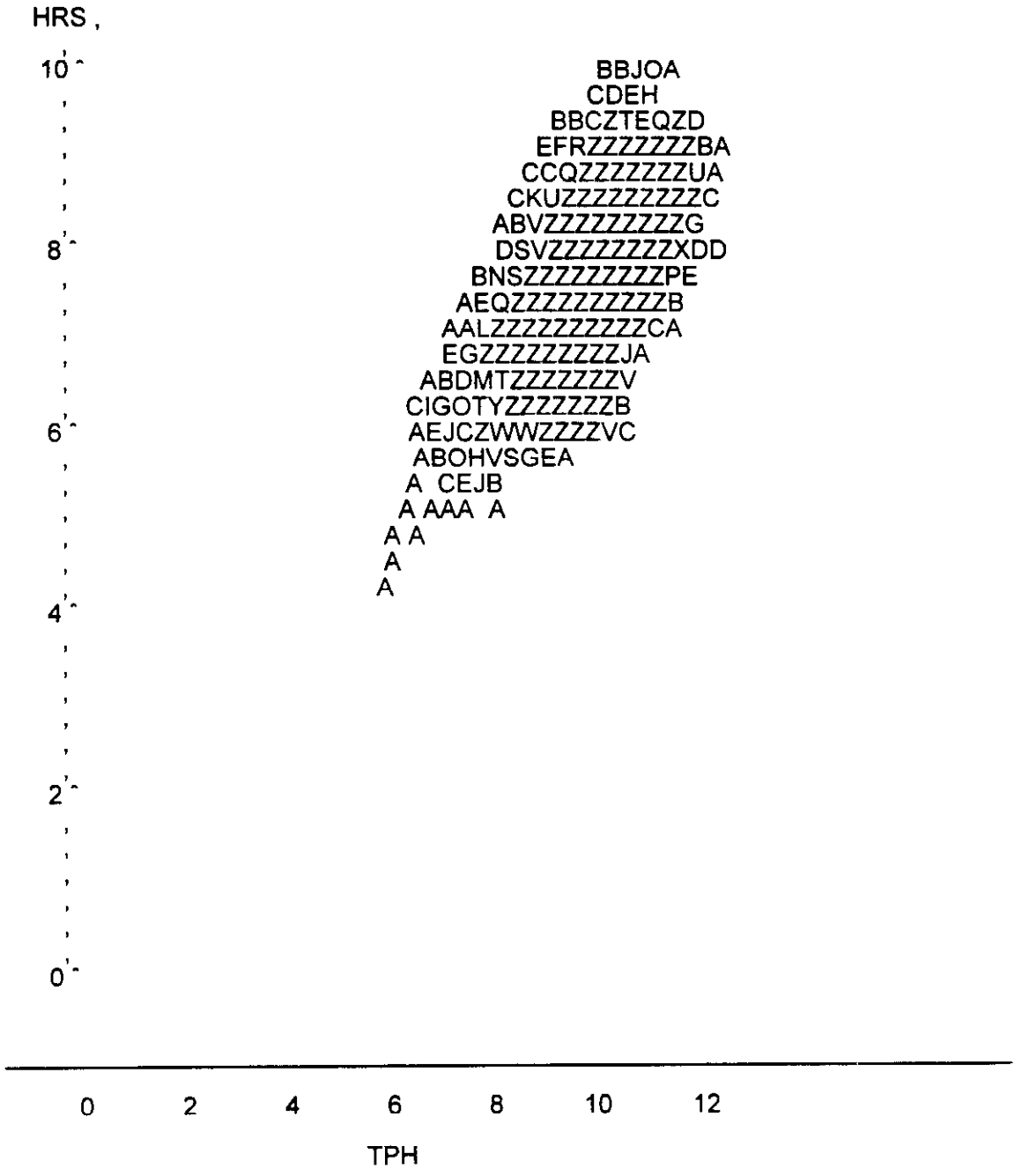
This exhibit presents plots in log form of labor hours and total pieces handled (TPH). The data were generated using witness Bradley's computer programs and data, found in library references USPS-LR-H-148 and LR-H-149. In order to generate the data, the programs in the library reference USPS-LR-H-149 were slightly modified, for purposes of running them on personal computers and for purposes of generating plots. The modified programs and data output for this exhibit are contained in OCA-LR-8.

Plots for the following activities were generated: OCR, BCS, LSM, Manual Letters, Manual Flats, SPBS Non-Priority, and Manual Priority. Due to time constraints a limited number of activities based on witness Bradley's data were plotted.

The plots which have been developed up to this point indicate the need to reexamine the estimating procedures in witness Bradley's study. A simple plotting of the data demonstrates the data are not consistent with witness Bradley's conclusions. In general, the plots are consistent with a cost elasticity of one. They are also consistent with the pooled data analysis, discussed in the testimony. Therefore, adoption of witness Bradley's conclusions would be inappropriate at this time.

OCR OPERATIONS
DATA IN LOGS

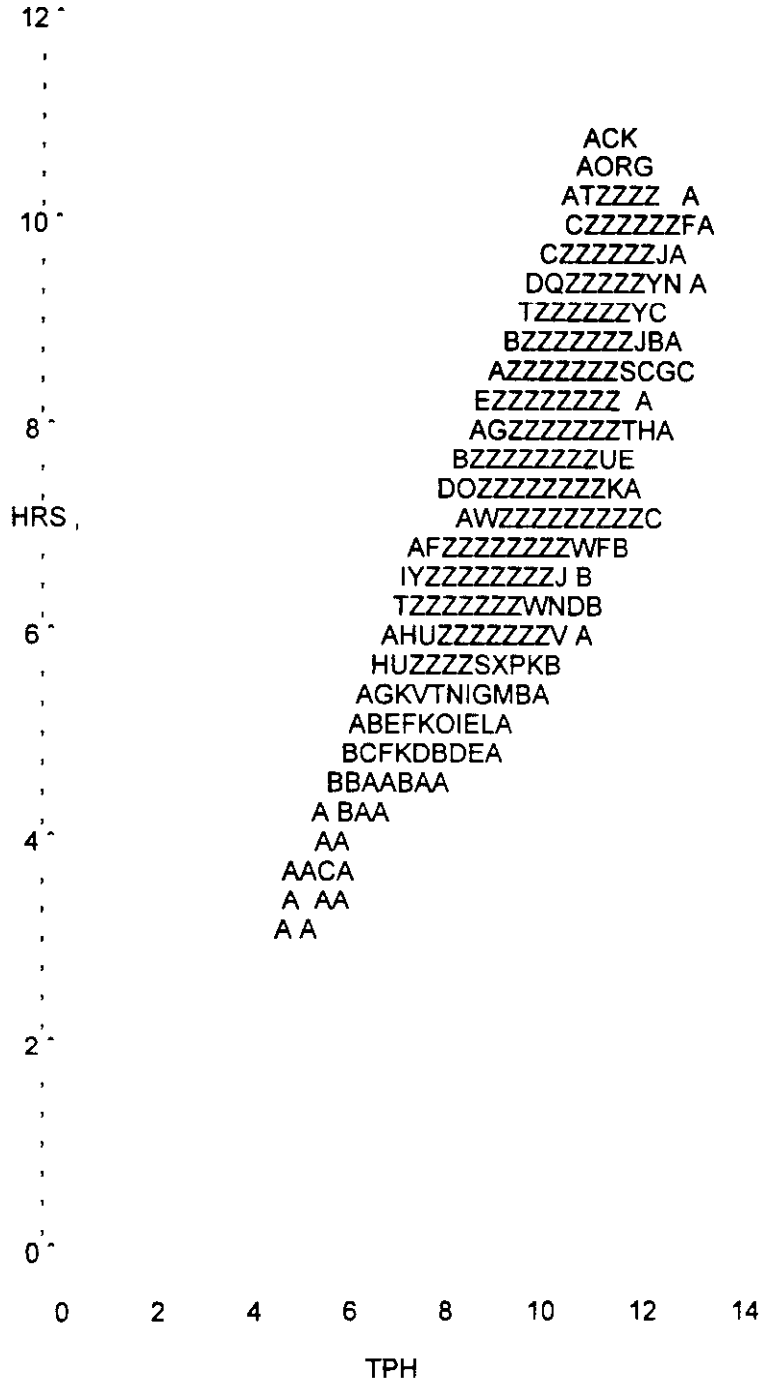
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 15131 obs hidden.

BCS OPERATIONS
DATA ARE IN LOGS

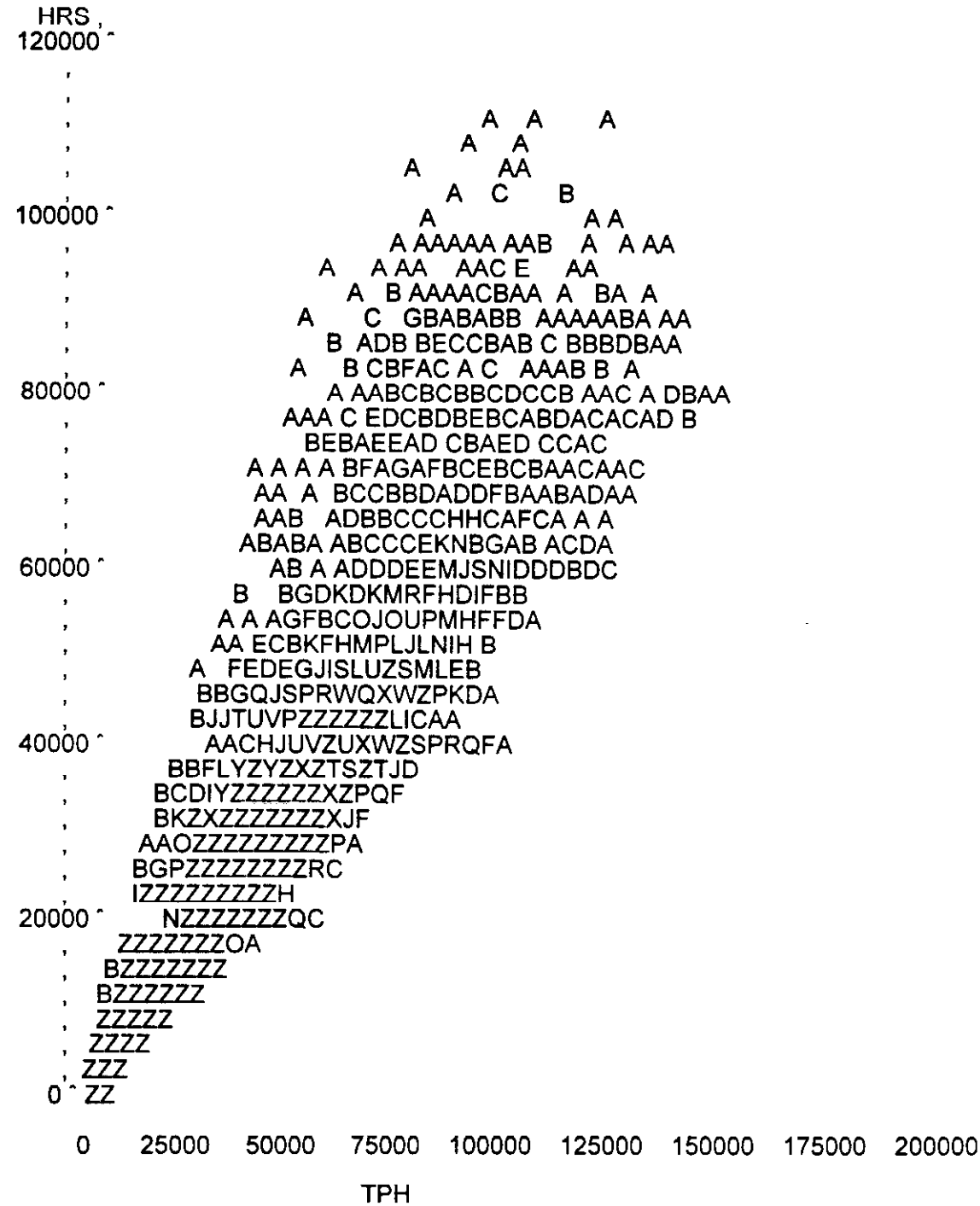
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 18818 obs hidden.

LSM OPERATIONS
DATA IN LOGS

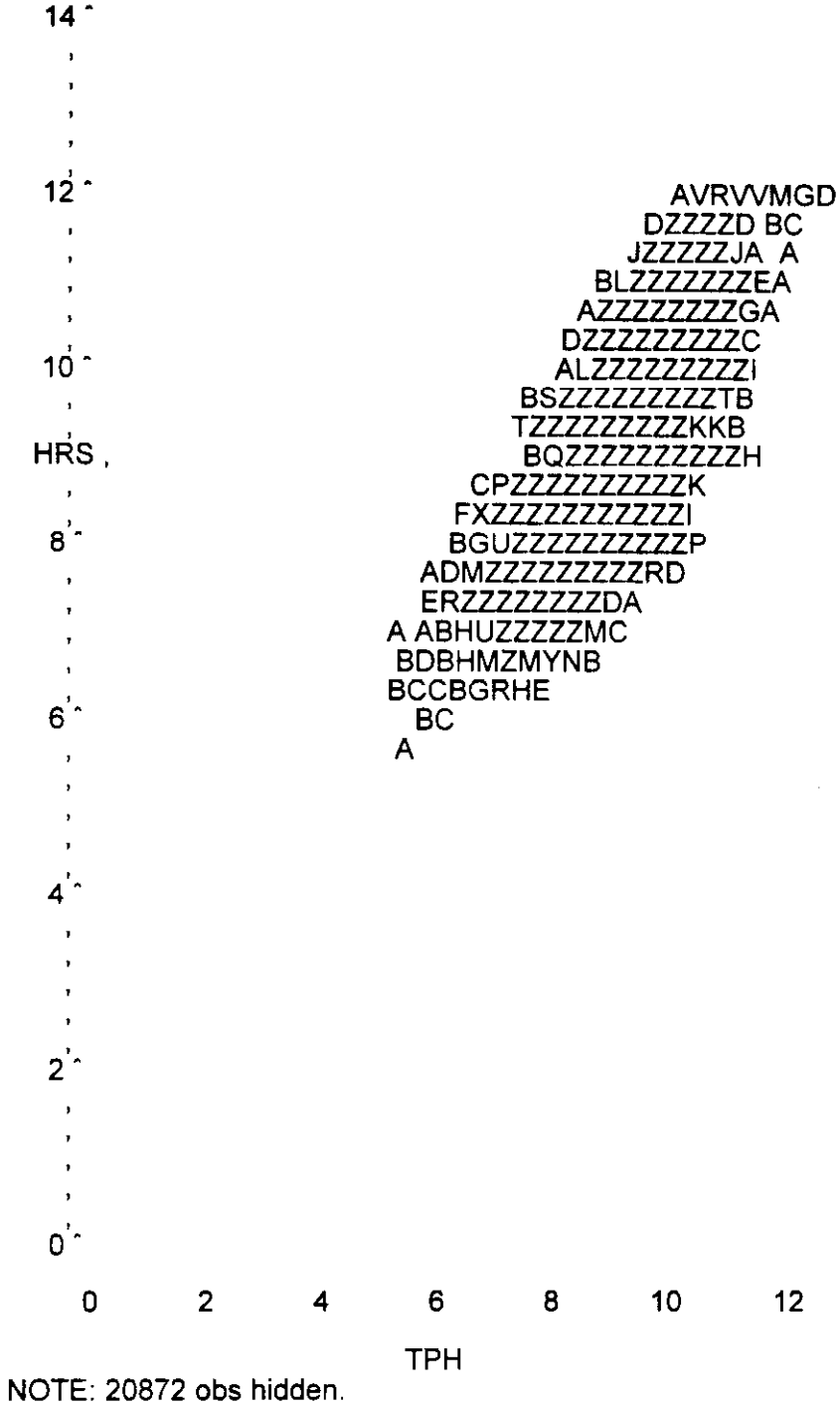
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 14996 obs hidden.

MANUAL LETTERS
DATA IN LOGS

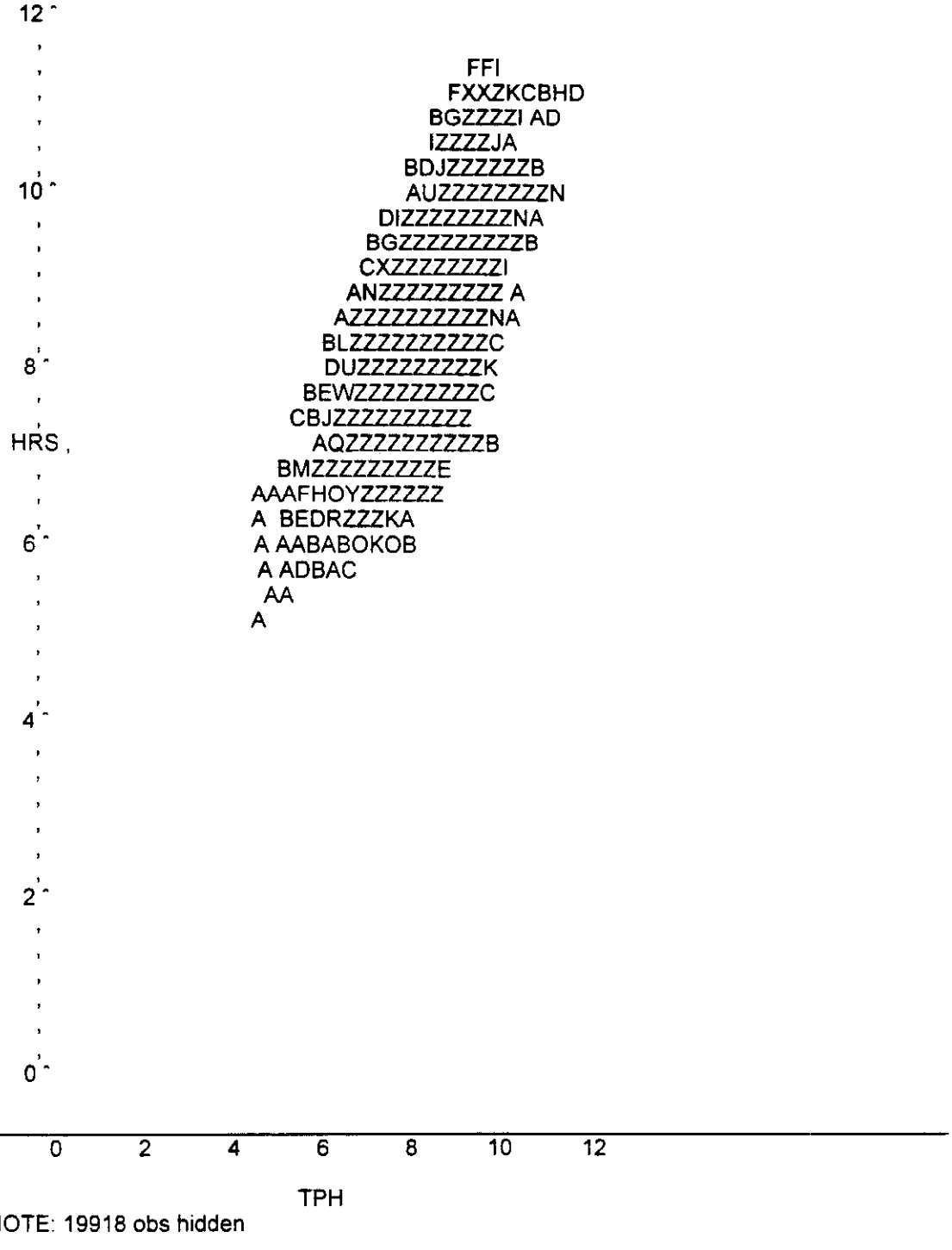
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 20872 obs hidden.

MANUAL FLATS
DATA IN LOGS

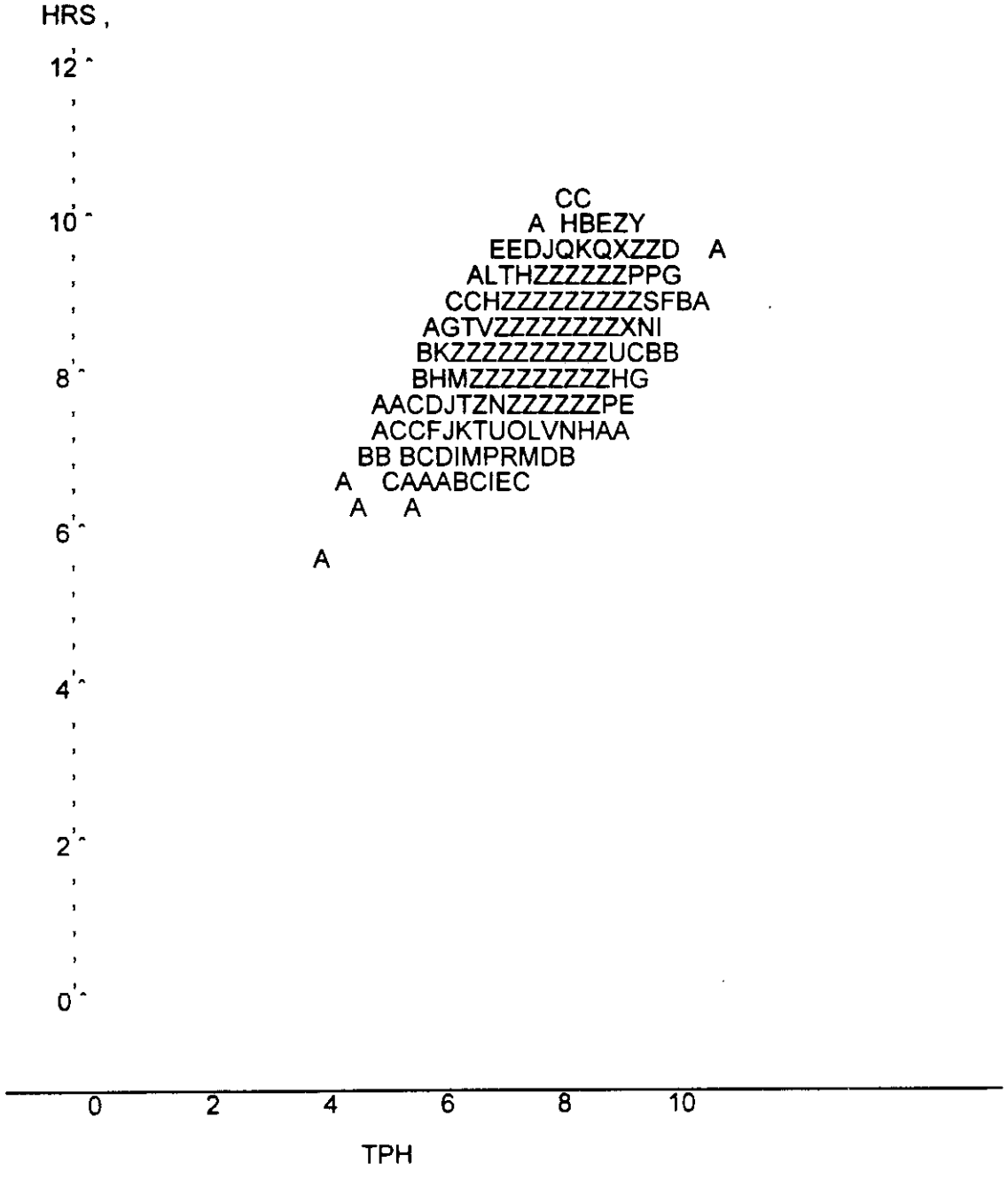
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 19918 obs hidden

SPBS NON-PRIORITY
DATA IN LOGS

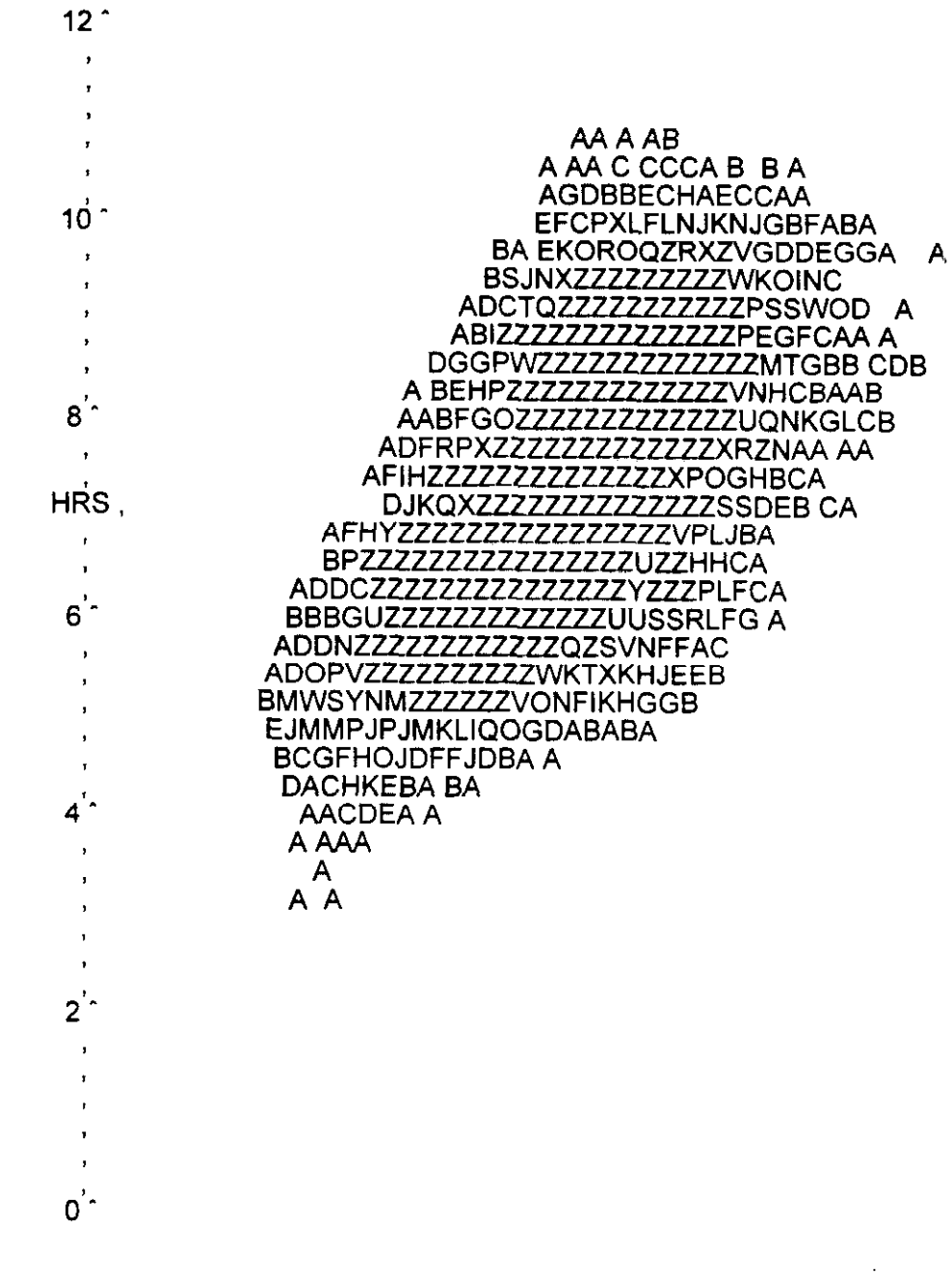
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 2522 obs hidden.

PLOTTED DATA ARE IN LOG FORM
MANUAL PRIORITY; DATA IN LOGS

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 7604 obs hidden.

REPRESENTATIVE ACTIVITY PLOTS BY SITE AND BY TOTAL

This exhibit consists of plots of data for four mail processing activities.[1] Time constraints limited the number of activities considered. Witness Bradley has computed the following cost elasticities for each of the types of plotted activities:

Manual Letters: .7718

Manual Flats: .7479

OCR: .6281

LSM: .8687

Traditionally there has been an assumption of a cost elasticity value of one; accordingly, witness Bradley's conclusions represent a proposed departure from previously accepted practices.

Based on witness Bradley's data and programs, presented in USPS-LR-H-148 and USPS-LR-H-149, I developed a number of plots on an activity basis relating hours and TPH at each site in order to explore how the underlying data seem to relate to witness Bradley's conclusions. Econometric procedures develop precise relationships with a dependent variable as a function of one or more independent variables. Whether such a relationship is accurate depends on whether the assumed relationship exists and is in the form hypothesized. Accordingly, a plotting of the data verifies to some degree the relationship between two variables, other things being equal.

A plotting of data points which ultimately has a positive intercept on the dependent variable, the hours-axis, is consistent with witness Bradley's fixed effects conclusions. A plotting of data points which result in a blob of data is not indicative that the fixed effects (or any other approach) is consistent with witness Bradley's conclusions. Finally, a plotting of data points essentially through the origin is consistent with the pooled case. In each of the three cases, absent a computed regression line, the analyst uses judgment in determining the appearance of the data plots.

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[1] Witness Bradley considered a total of twenty five activities: MODS Sorting—eleven activities; MODS Allied Activities—four activities; BMC Sorting—six activities; BMC Allied Activities—two activities; and Remote Encoding and Registry—two activities.

Each computer program run for an activity resulted in hundreds of graphs—one for each of the sites. For each activity I present four of the graphs generated by the computer program. I selected representative graphs. All graphs generated for an activity along with the relevant computer programs for this exhibit are presented in OCA-LR-9, permitting a full review of the work performed.

For each of the four types of activities presented in this exhibit the basis for the selection of the four graphs is as follows. Three of the graphs for each activity are for specific locations and illustrate that a variety of data patterns form the underlying data used in the study. Graphs were chosen based on their appearances for illustrative purposes; accordingly, different mail handling locations were chosen across activities. The three types of plots by location include,

- a plot that is in good agreement with a fixed effects regression;
- a "blob" type of plot, indicating that for the location under consideration there does not appear to be a clear data relationship; and
- a plot that is in good agreement with a pooled effects regression.

A summary of the three types plots mentioned above follows:

Manual Letters

Plot for IDNUM=8195: Consistent with Fixed Effects.

Plot for IDNUM=3361: Consistent with Blob.

Plot for IDNUM=242: Consistent with Pooled Effects.

Manual Flats

Plot for IDNUM=1374: Consistent with Fixed Effects.

Plot for IDNUM=3593: Consistent with Blob.

Plot for IDNUM=5255: Consistent with Pooled Effects.

OCR

Plot for IDNUM=9961: Consistent with Fixed Effects.

Plot for IDNUM=2467: Consistent with Blob.

Plot for IDNUM=621: Consistent with Pooled Effects.

LSM

Plot for IDNUM=7346: Consistent with Fixed Effects.

Plot for IDNUM=4347: Consistent with Blob.

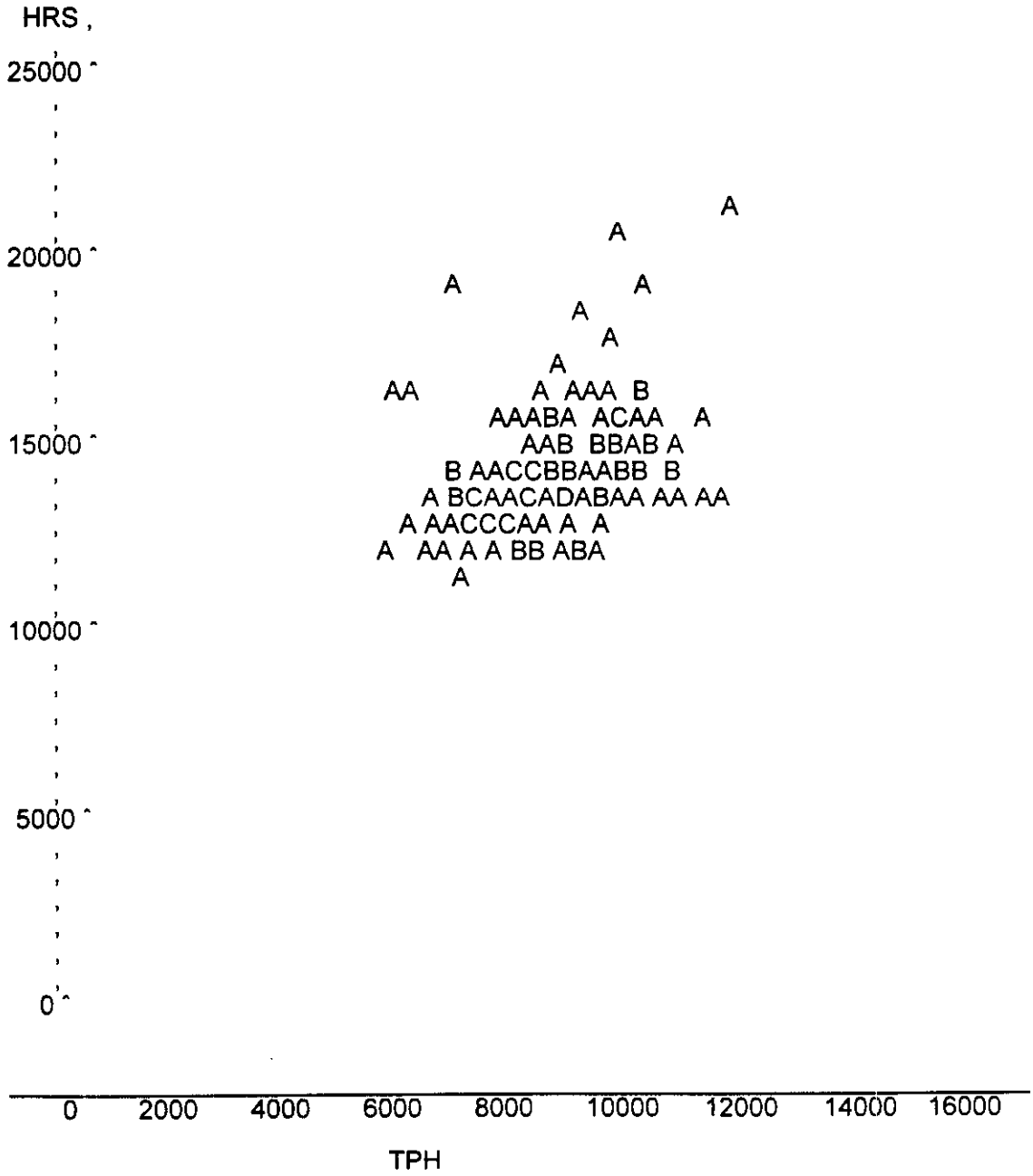
Plot for IDNUM=2375: Consistent with Pooled Effects.

The fourth graph for each activity is designated as IDNUM 9999. One graph of this type has been printed for each activity. There is, however, no location cited for IDNUM 9999. Rather, IDNUM 9999 is a computed set of data. The plot for IDNUM 9999 has a number of points. Each point summarizes the summation of the logs of total hours of mail processing labor and the total TPH at a specific site. All of the data points—one per site—are then plotted. The data plotted in the graph of IDNUM 9999 are therefore based on all of the sites for a specific activity data set, with the logs of hours and TPH summed for each site.

MANUAL LETTER OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

---------- IDNUM=242 ----------

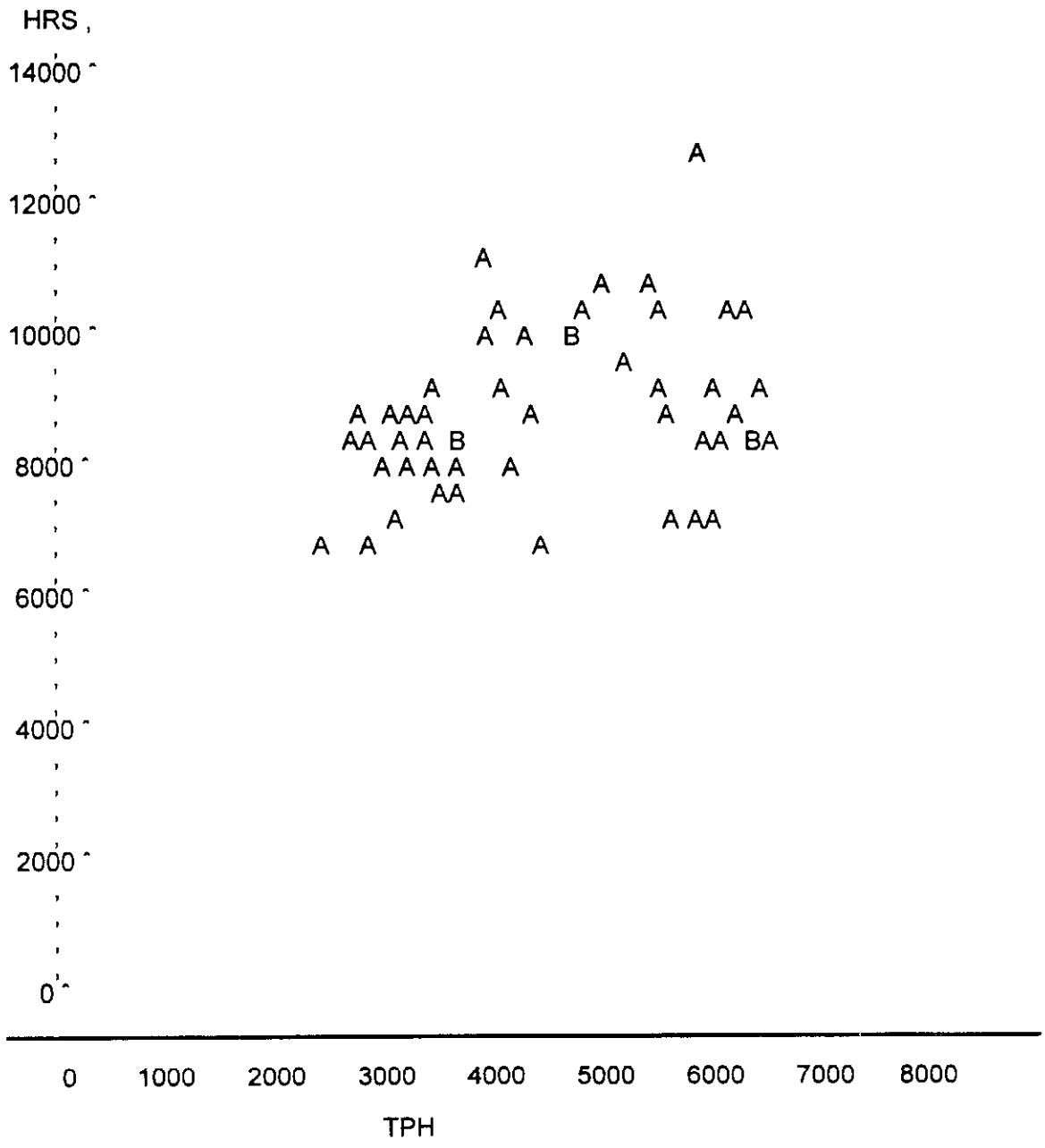
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL LETTER OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

---------- IDNUM=3361 ----------

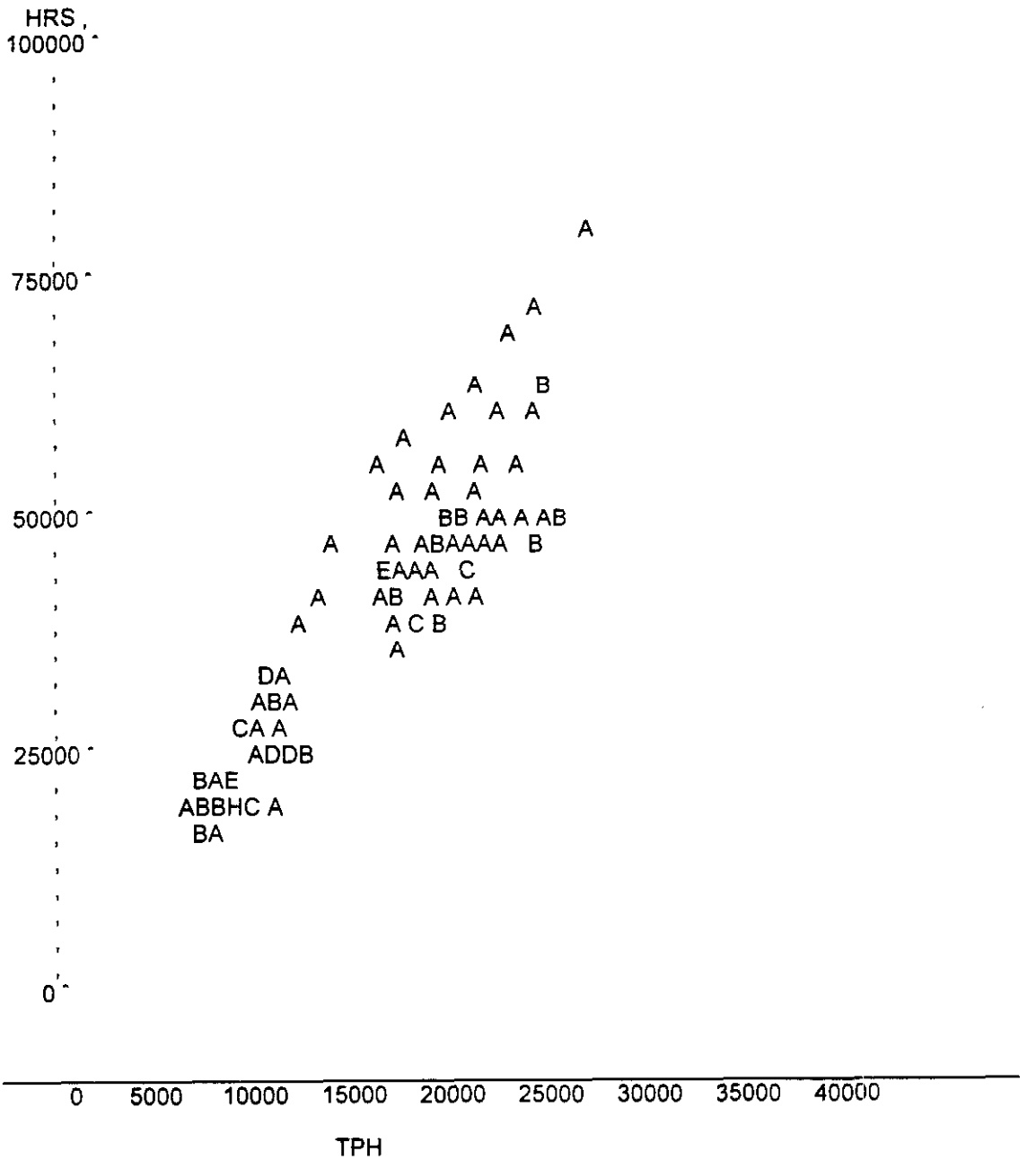
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL LETTER OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

IDNUM=8195

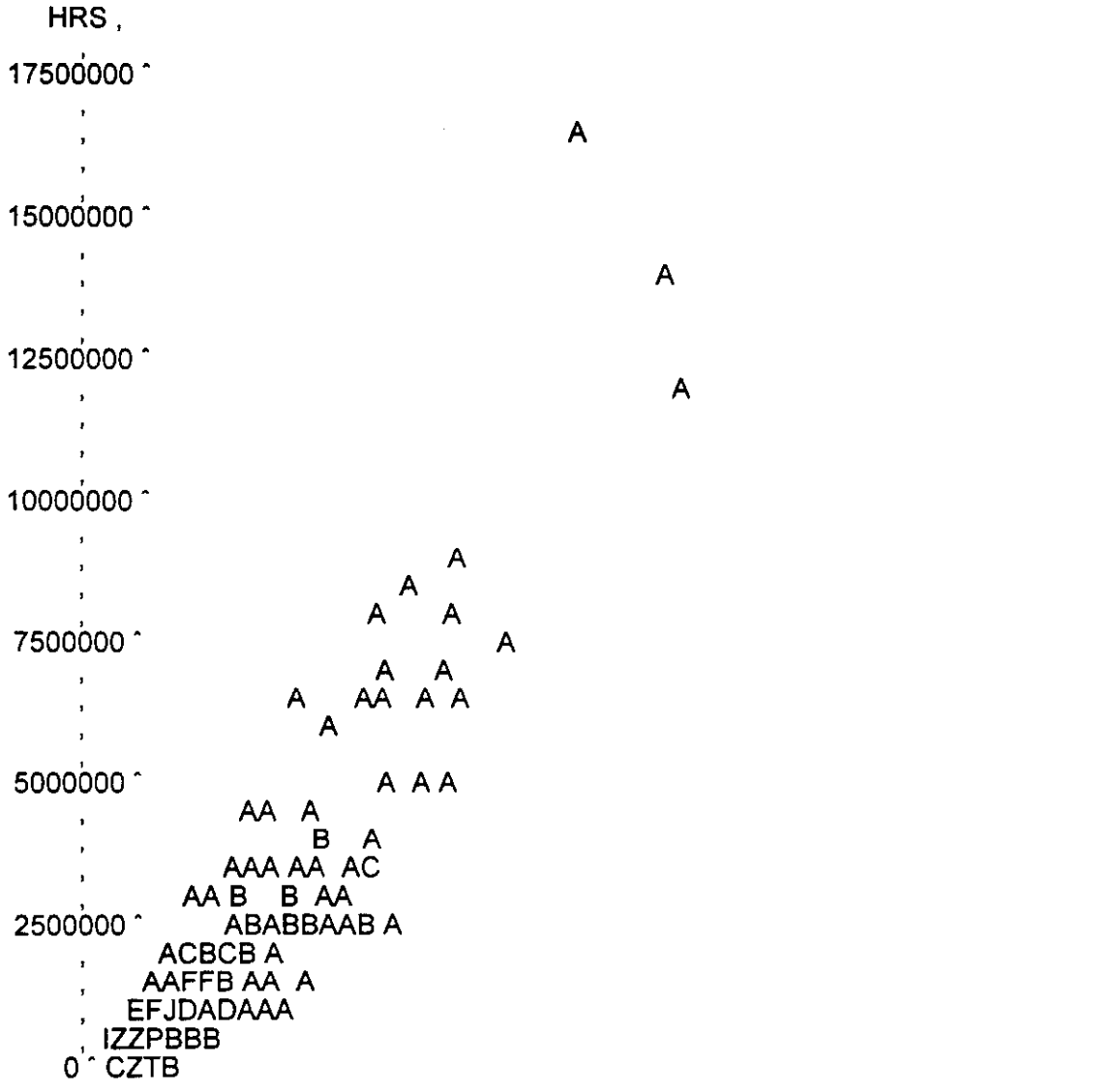
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL LETTER OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

---------- IDNUM=9999 ----------

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.

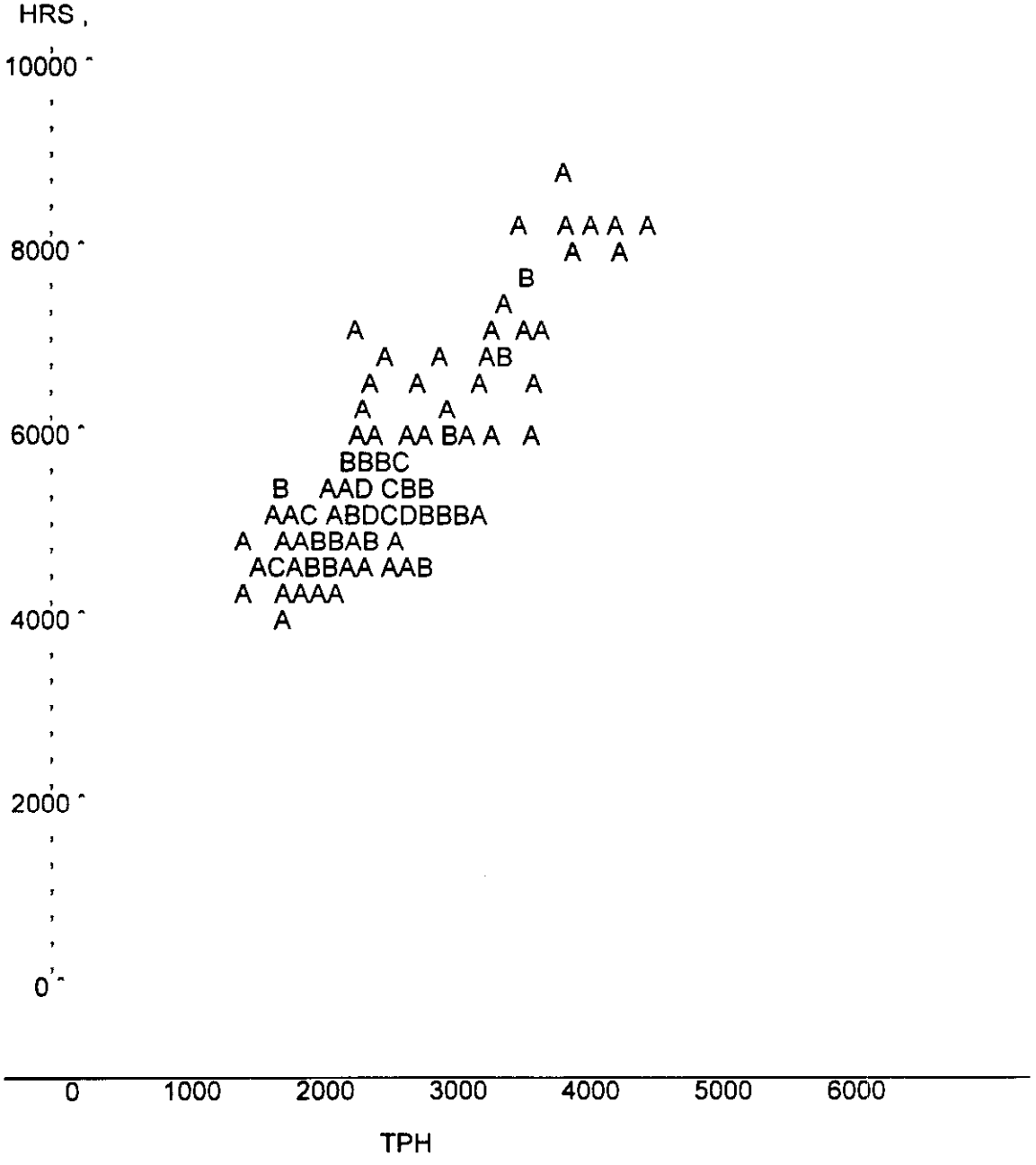


NOTE: 56 obs hidden.

MANUAL FLAT OPERATIONS
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

---------- IDNUM=1374 ----------

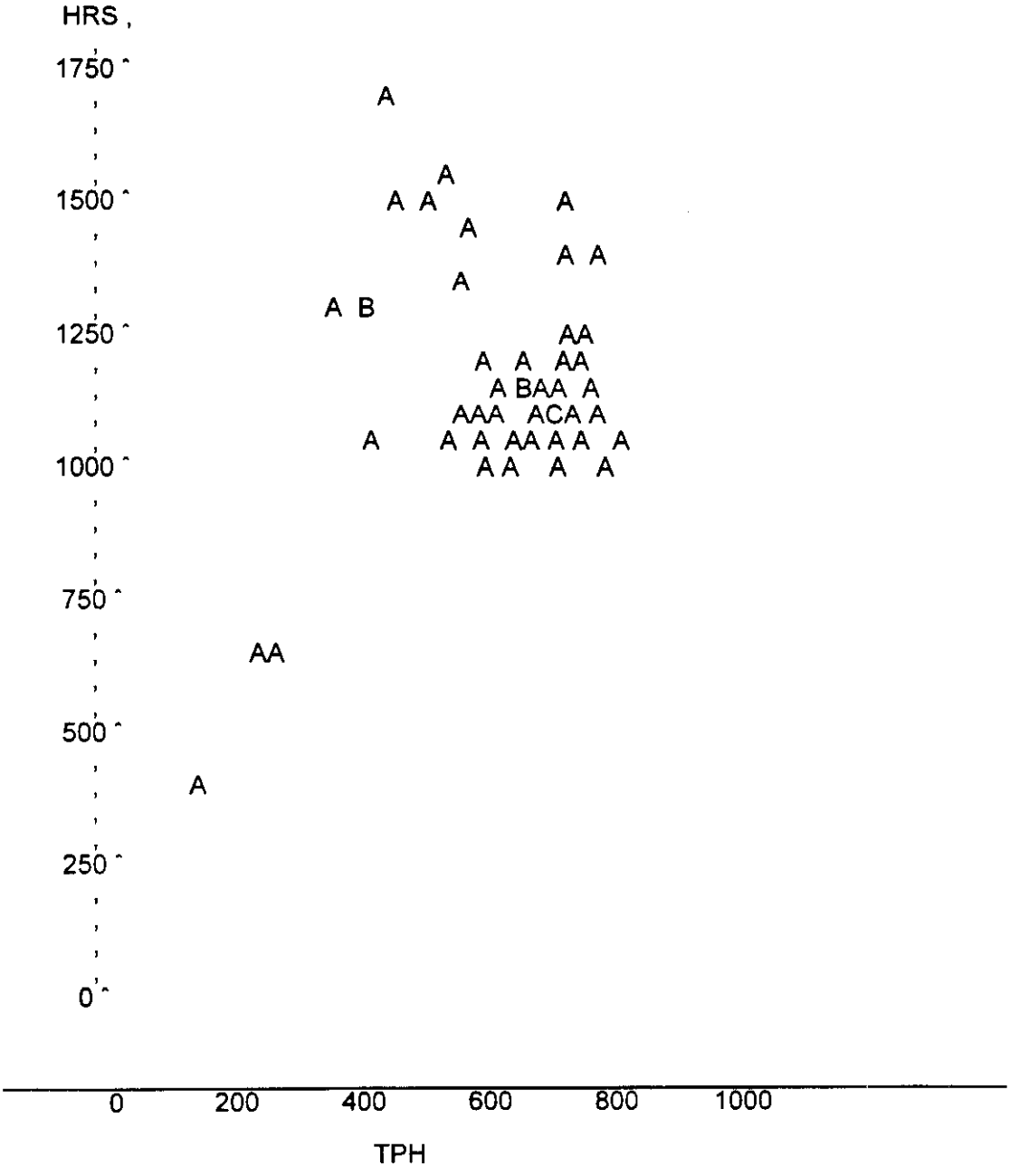
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL FLAT OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Site

IDNUM=3593

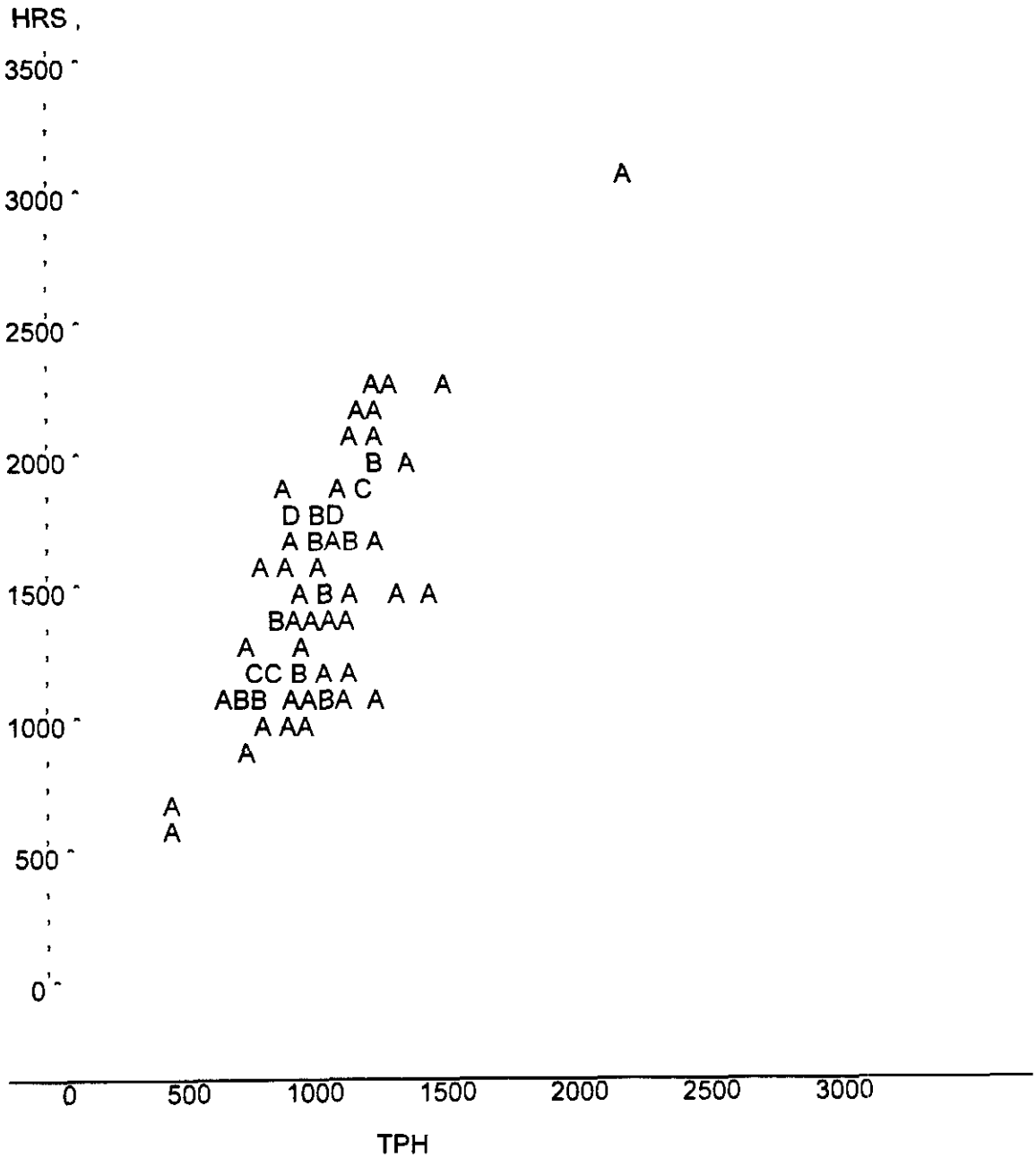
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL FLAT OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Location

---------- IDNUM=5255 ----------

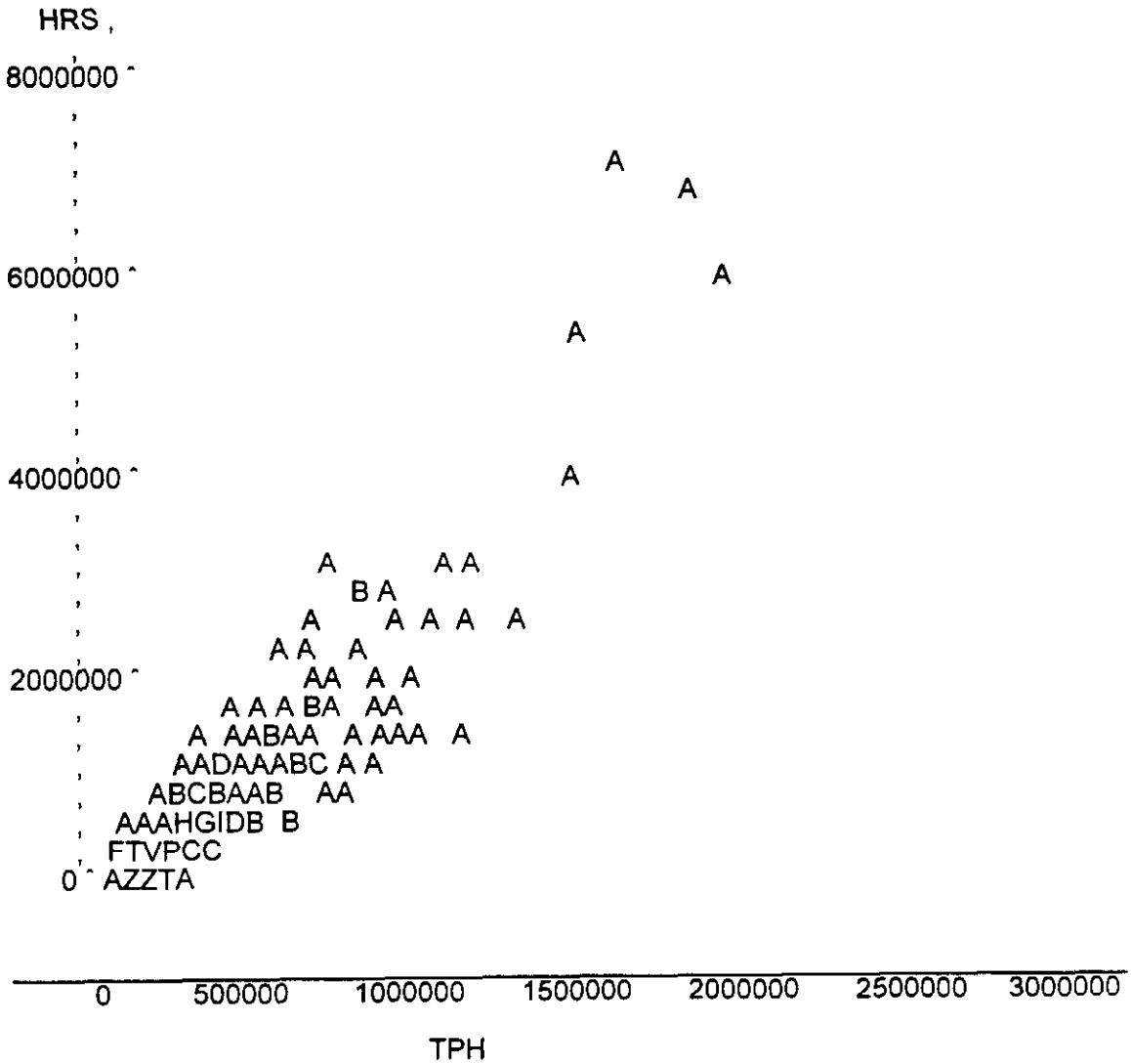
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



MANUAL FLAT OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOGS, Plotted by Location

---------- IDNUM=9999 ----------

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 48 obs hidden

OCR OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

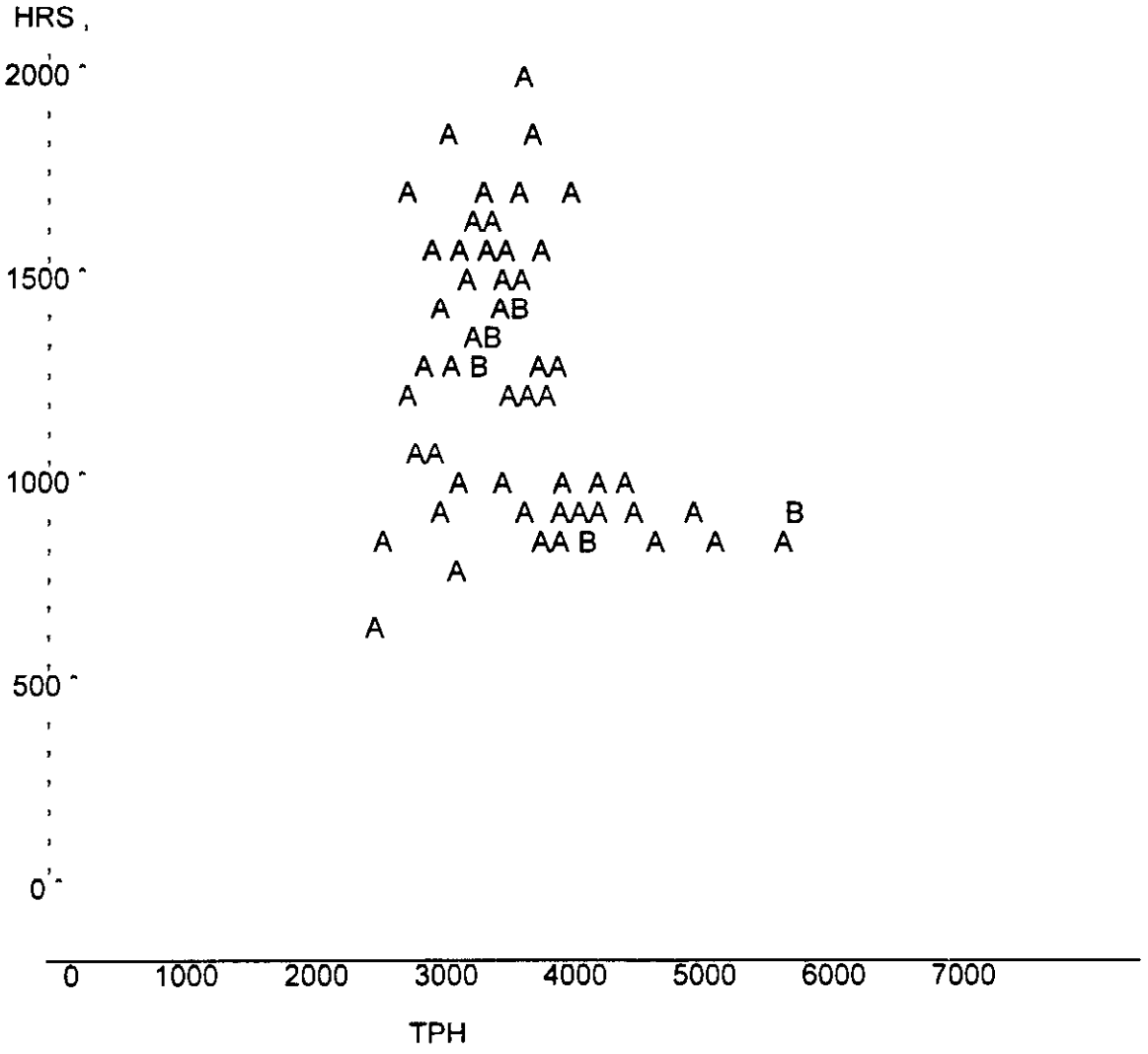
IDNUM=621

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.

OCR OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

---------- IDNUM=2467 ----------

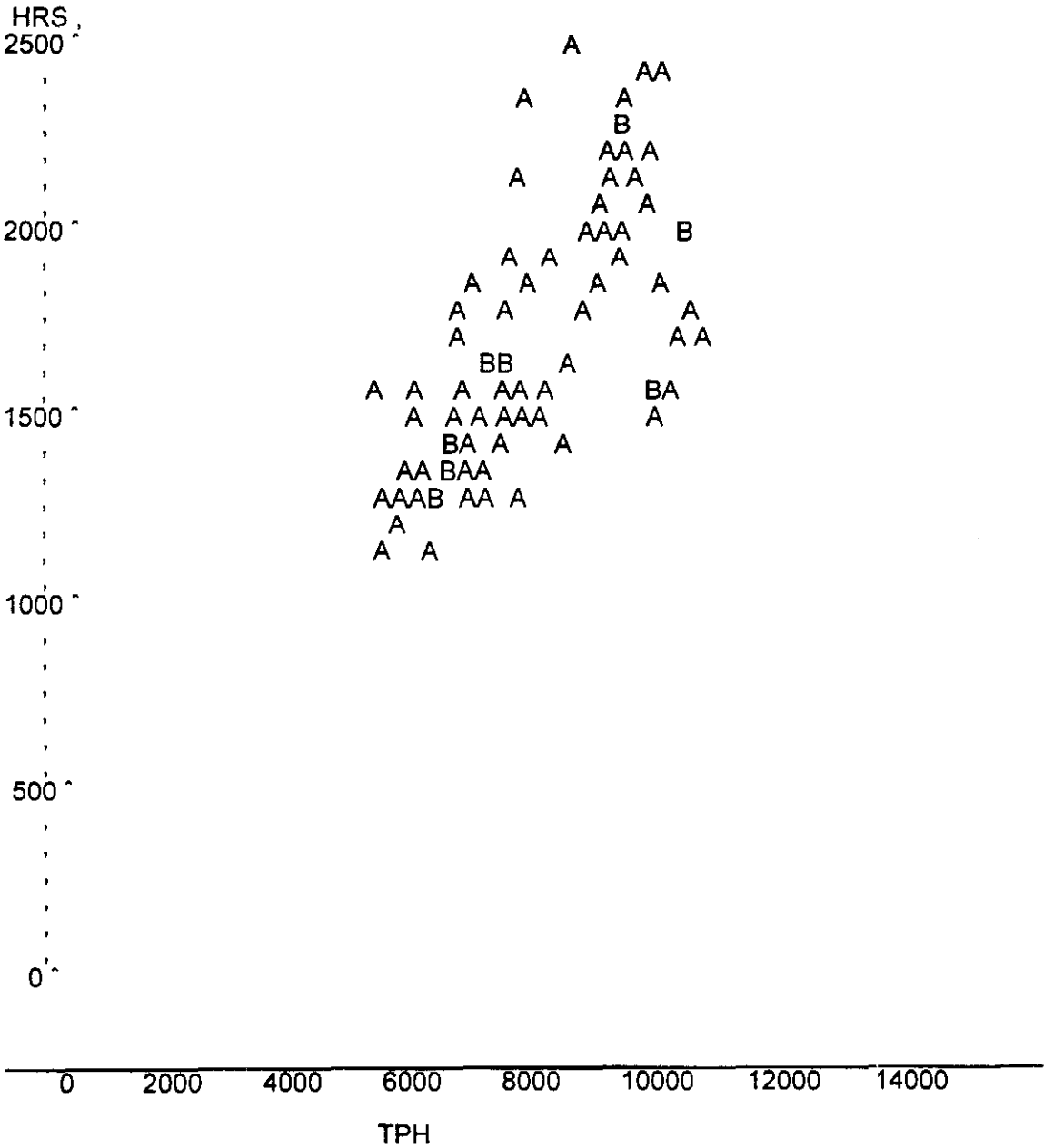
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



OCR OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

---------- IDNUM=9961 ----------

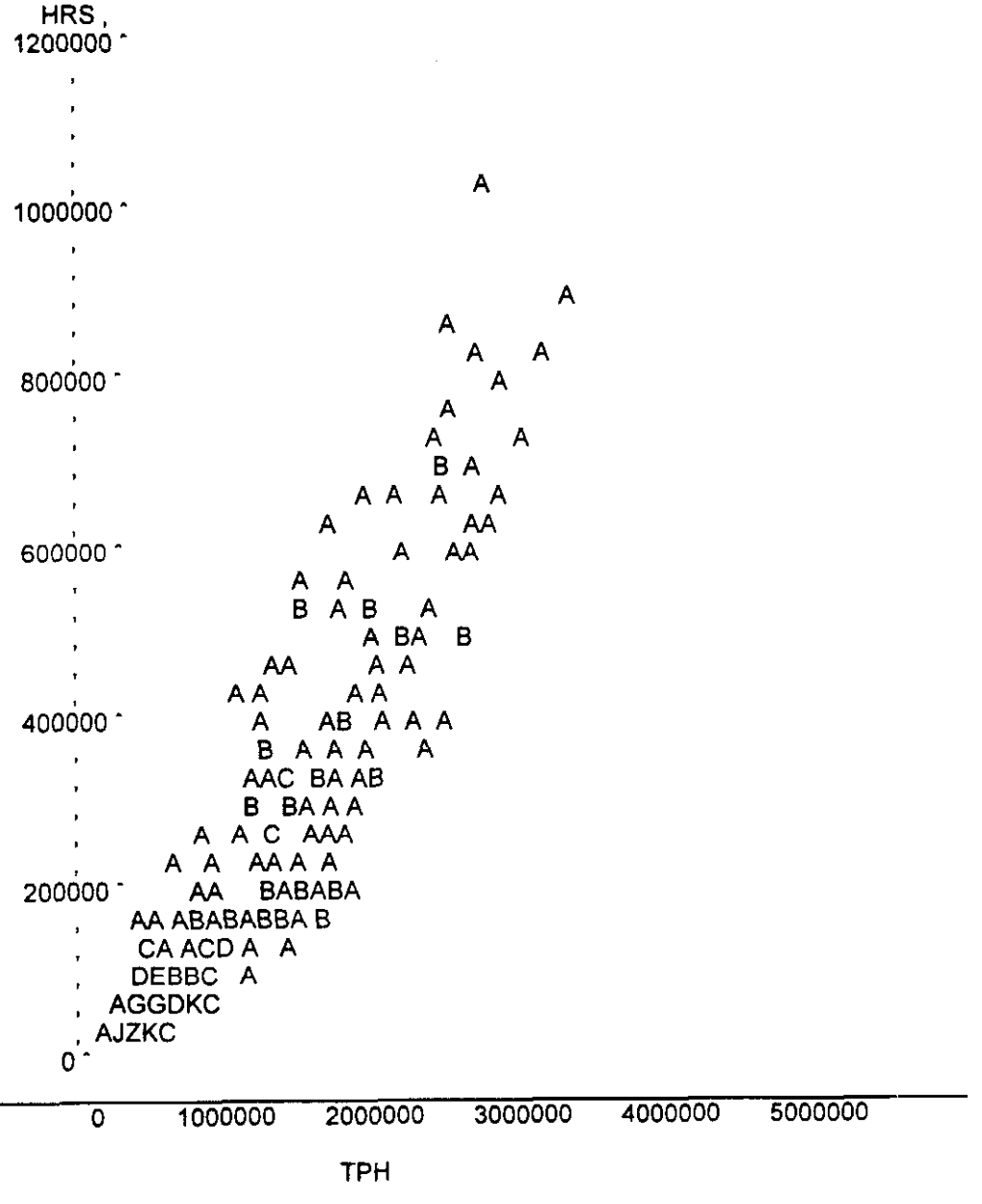
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



OCR OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

IDNUM=9999

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.

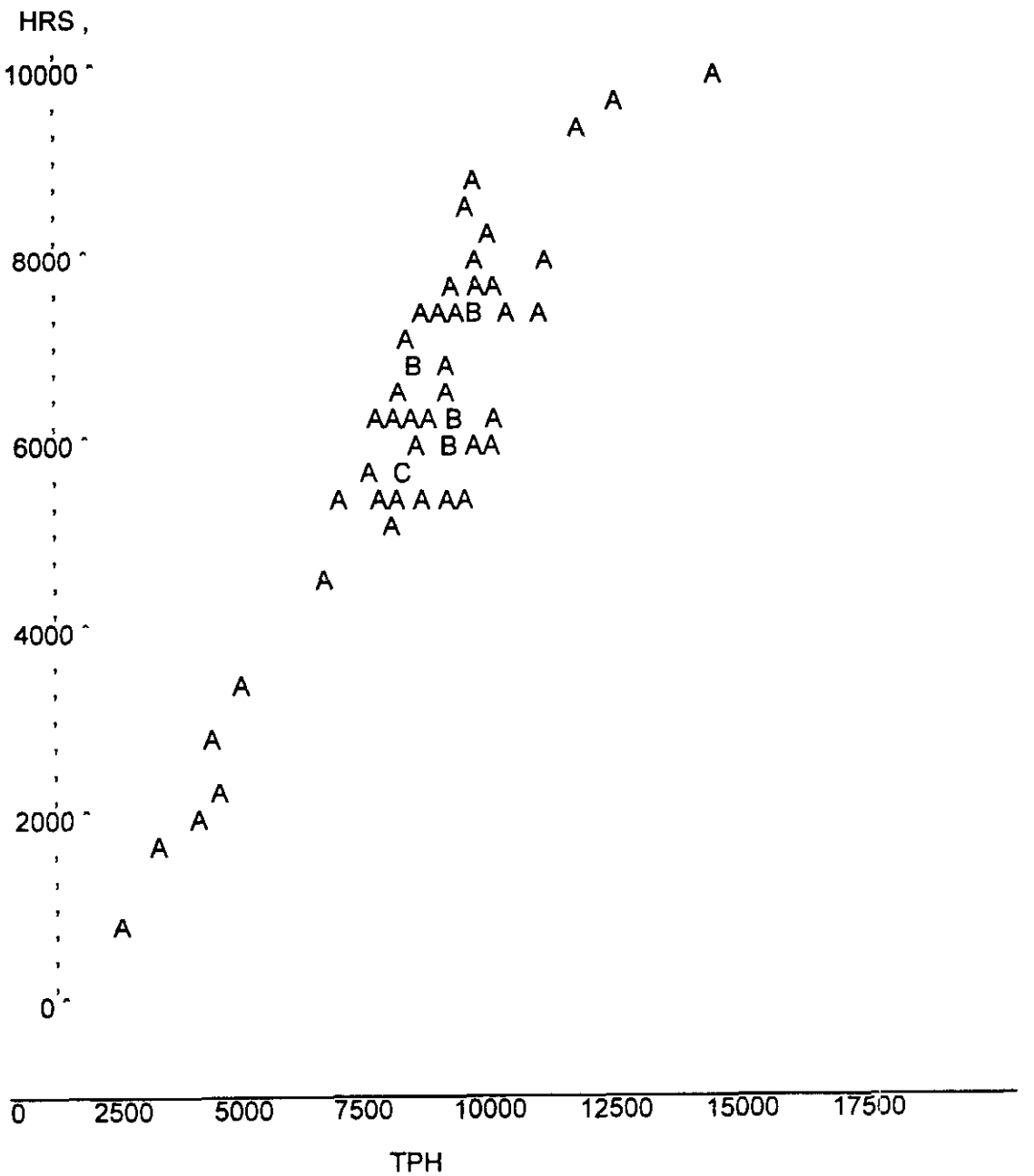


NOTE: 3 obs hidden.

LSM OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

IDNUM=2375

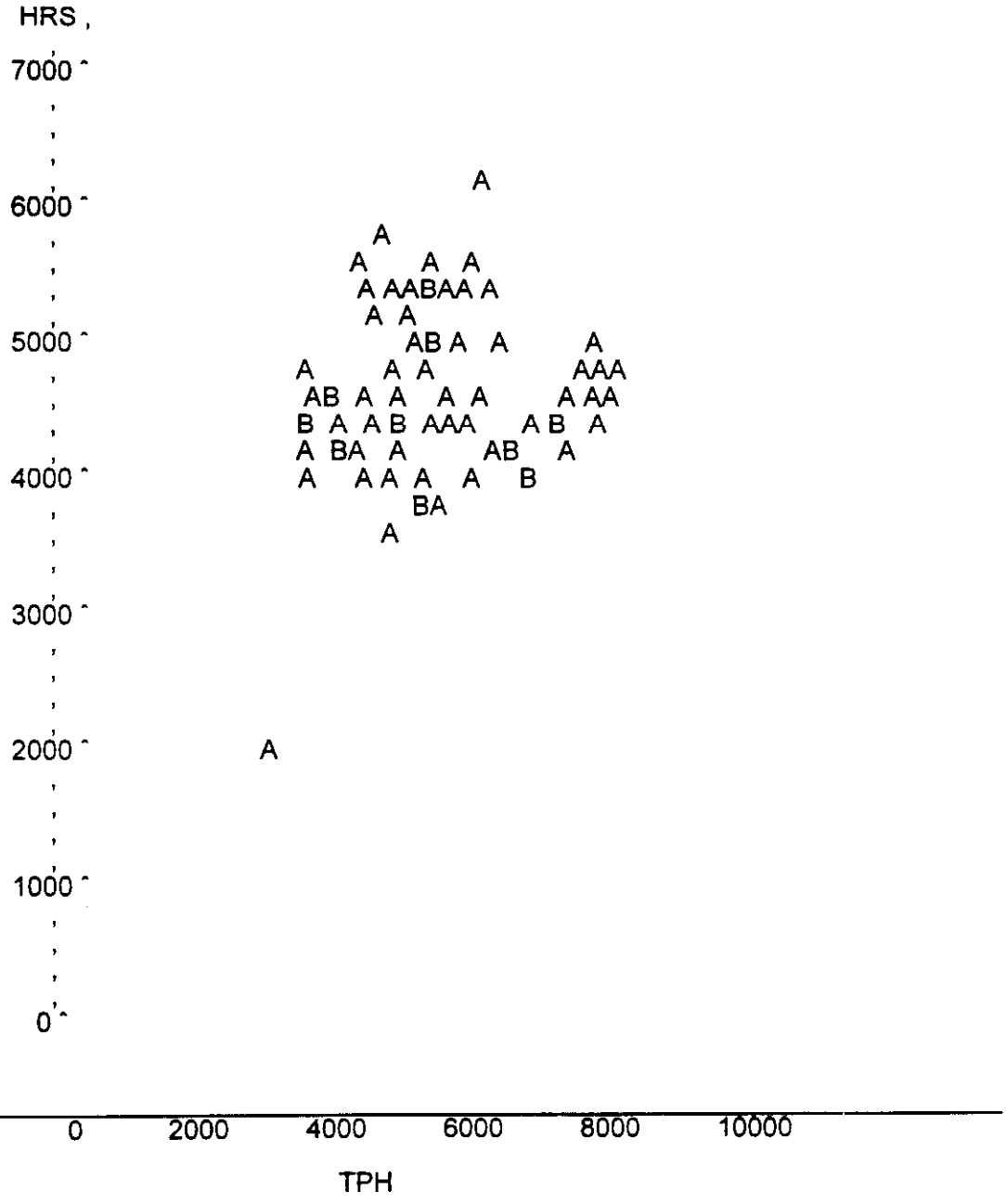
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



LSM OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

IDNUM=4347

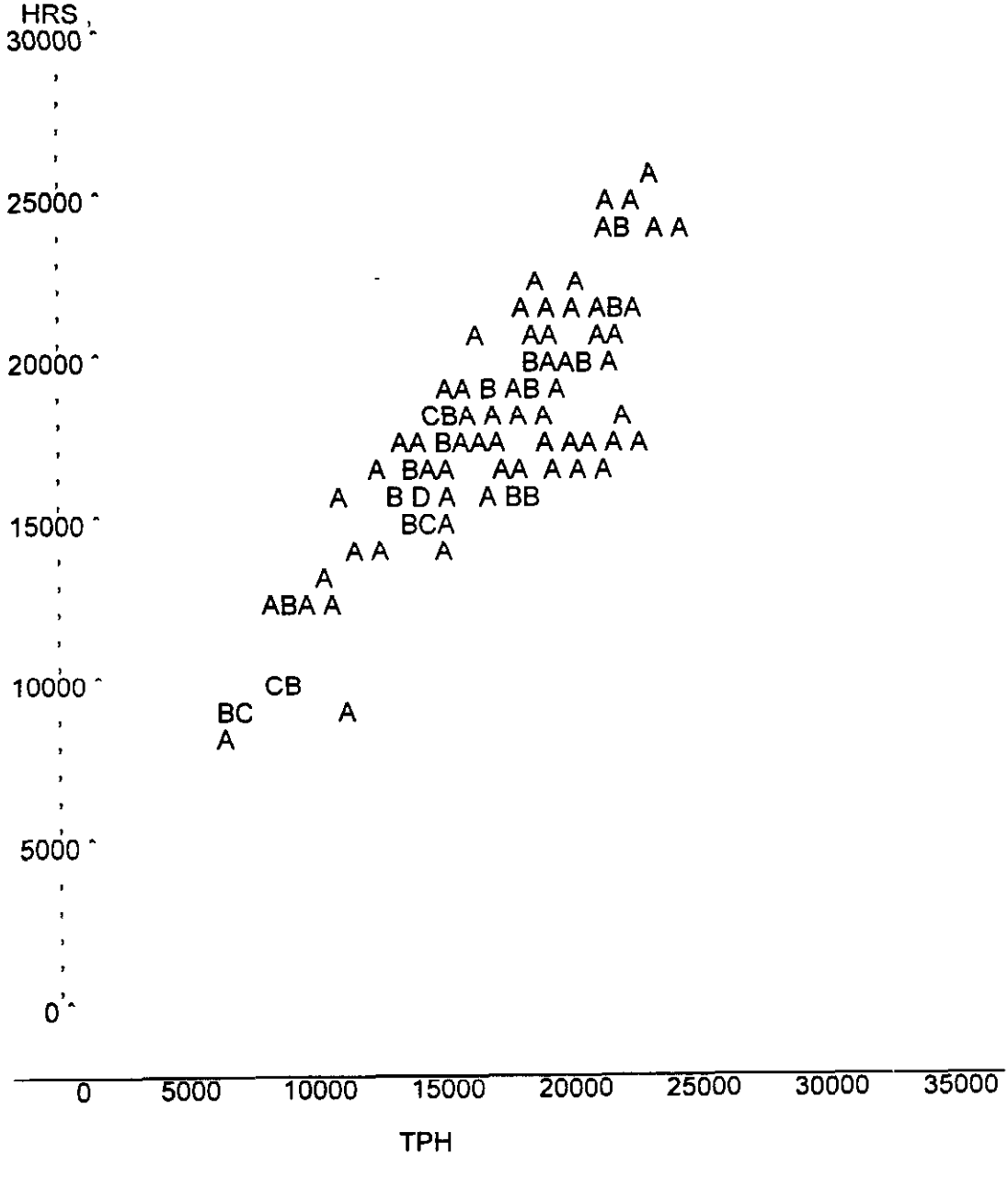
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



LSM OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

---------- IDNUM=7346 ----------

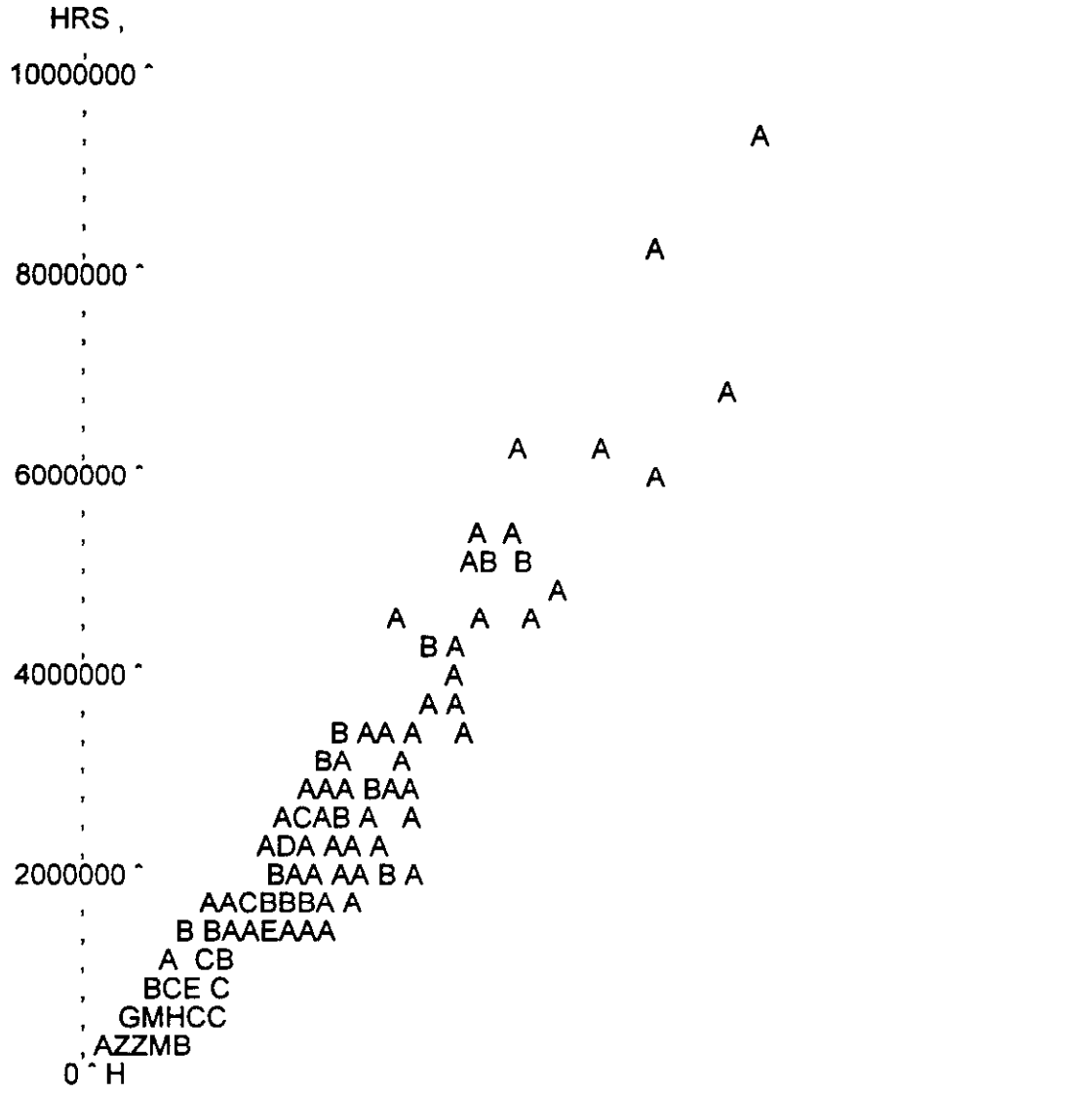
Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



LSM OPERATIONS/ HOURS ON TPH
USING ONLY CONTINUOUS DATA FROM 8801-9613
INCLUDING OFFICES @ LEAST 39 OBS/LAG MODEL
DATA ARE IN LOG FORM, Plotted by Location

---------- IDNUM=9999 ----------

Plot of HRS*TPH. Legend: A = 1 obs, B = 2 obs, etc.



NOTE: 16 obs hidden.