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ASSESSMENT OF EXISTING "FEUDS" DATA BASE FOR IDENTIFICATION
OF POTENTIAL INDUSTRIAL WOOD USERS IN NORTH CAROLINA

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MASTER

David H. Gustashaw, SSEC

(Based on Report by NCSU)

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INTERNAL TECHNICAL MEMORANDUM:

ASSESSMENT OF EXISTING "FEUDS" DATA BASE FOR IDENTIFICATION
OF POTENTIAL INDUSTRIAL WOOD USERS IN NORTH CAROLINA

Under a contract with the Solar Energy Research Institute, Ultrasystems, Inc. had prepared an analysis related to potential industrial wood users for the states of Alabama, Georgia, and North Carolina. This analysis was based on the use of a data base maintained by Ultrasystems, Inc. identified as their Facility Energy Utilization Data System (FEUDS). This data base is an outgrowth of work conducted for the U. S. Department of Energy and is based on data from the Environmental Protection Agency (EPA) which is referred to as the National Emissions Data System.

Because of the prior work under the SERI contract, and the request by the DoE program manager that consideration be given to further use of the FEUDS data base, an in-depth analysis was made of that data base for the State of North Carolina. It should be emphasized that the data was evaluated from the standpoint of its application in identifying industrial situations outside of the forest products industry which might be candidates for the use of wood combustion systems.

It is concluded that the analysis prepared by Ultrasystems, Inc. using the FEUDS is not applicable for the purpose desired by SSEC. This conclusion is based on a review made by North Carolina State University under Subcontract SSEC 1201-C-430-0063. It should be noted that this is not intended to imply that the FEUDS technique is not applicable for other purposes.

The text of the report prepared by the Wood Assistance Team under subcontract to SSEC is attached. This group is located in the Industrial Extension Service of the School of Engineering at North Carolina State University.

David H. Gustashaw

DHG:mg

Attachment

Text of Report Prepared
by NCSU on March 6, 1981

PREFACE

This report was prepared at North Carolina State University (NCSU) by the Wood Assistance Team for the Southern Solar Energy Center as part of subcontract SSEC 1201-C-430-0063.

The Southern Solar Energy Center as part of its program to promote wood as an industrial fuel subcontracted North Carolina State University to form a Wood Assistance Team to provide technical assistance to potential users. This report evaluates Ultrasonics' methodology and data for identifying potential wood fuel users in North Carolina.

This report could not have been prepared without the combined efforts of all the Wood Assistance Team members and the support of their respective organizations. Valuable advice, data, help and support were received from others, including Program Manager - David H. Gustashaw, Southern Solar Energy Center, Project Administrators - Assistance Dean John R. Hart, NCSU School of Engineering and Thomas W. Stephenson, NCSU Industrial Extension Service; Project Advisors - Dr. Michael P. Levi, NCSU Extension Forest Resources and Larry B. McGee, North Carolina Department of Natural Resources and Community Development. Also, thanks to graphics designer, George Werth and typists Vicki Cudd, Sarah Furr, Shirley Haley, and Beth Richman for their efforts.

The Wood Assistance Team

Project Director	Ellen Pulaski - Wood Combustion Engineering Extension Specialist NCSU Industrial Extension Service
Combustion Specialist	Moustafa K. Karmous, PE - Wood Combustion Engineering Extension Specialist NCSU Industrial Extension Service
Resource Specialist	Larry G. Jahn - Specialist NCSU Extension Forest Resources
Environmental Specialist	Phyllis B. Wainwright, PE - Chemical Engineer N.C. Department of Natural Resources and Community Development
Special Advisor	J. D. Fowler - Energy Extension Specialist NCSU Industrial Extension Service

ABSTRACT

This report presents the North Carolina Wood Assistance Team's evaluation of the Ultrasystems' computerized methodology for identifying high potential wood conversion facilities. Increased wood fuel usage by industry would aid the national effort to decrease use of fossil fuel. The Solar Energy Research Institute indicates that commercialization of wood fuel would expand its use by industry.

Ultrasystems, Inc. was contracted by the Solar Energy Research Institute to do a computerized market analysis of three Southeastern states that would complement the Southern Solar Energy Center's Wood Assistance Team market development program. The Southern Solar Energy Center expected Ultrasystems to provide a list of many high potential wood conversion facilities in North Carolina to which the Wood Assistance Team could offer technical assistance.

After carefully checking, correcting, analyzing and evaluating Ultrasystems' report, the Wood Assistance Team's consensus is that the report does not meet its goal of identifying high wood conversion candidates. The premise of selecting and prioritizing facilities primarily by SIC codes is not sufficiently supported. Too few site-specific parameters were considered. The data is presented in a confusing format and is not a comprehensive listing of facilities. Data is missing and much of what is listed is out-of-date and inaccurate. The report is inconsistent, the results are limited and misleading, the rationale used is insufficiently defined or supported, resulting in a report that is invalid and unsuitable for the Wood Assistance Team's project.

NORTH CAROLINA STATE UNIVERSITY

WOOD ASSISTANCE TEAM

AN EVALUATION OF ULTRASYSTEMS' FEBRUARY 26, 1980 REPORT:
"POTENTIAL INDUSTRIAL WOOD USERS, A THREE STATE ANALYSIS"
(ALABAMA, GEORGIA AND NORTH CAROLINA)

I. INTRODUCTION

Ultrasystems, Inc. is a ten year old company with approximately 300 professional employees and specializes in a systems approach to energy, environmental and defense activities. In the energy field Ultrasystems uses their "Facility Energy Utilization Data System" (FEUDS) to do data base modeling. FEUDS is an outgrowth of work done by Ultrasystems for the Department of Energy, and is based primarily on the Environmental Protection Agency's (EPA) National Emissions Data System.

As part of the national effort to decrease use of imported fossil fuel, the Solar Energy Research Institute (SERI) in Golden, Colorado, is developing programs to increase the commercialization of solar and renewable resources, such as wood. SERI has placed early emphasis on increased usage of wood because the credibility of the supply (harvesting) and demand (direct combustion) technologies of wood fuel are well established. Also, the forest products industry is proving the economic feasibility of wood fuel by using it to become increasingly energy self-sufficient.

One way to accelerate wood energy commercialization is through market identification. A computerized data base of facilities which contains parameters that can be analyzed and used to prioritize those facilities with potential to convert from fossil to wood fuel would be helpful.

Ultrasonics stated that FEUDS is such a data base and that it could be used to identify and prioritize facilities. As a pilot project, SERI contracted with Ultrasonics to perform a wood fuel market analysis of three Southeastern states. The results of that contract are contained in the Ultrasonics' report that is being evaluated here.

Since most of the Southern Solar Energy Center's (SSEC) 17 state region has abundant supplies of wood economically available for fuel, SSEC expects a wood fuel market development program would increase wood fuel usage and lessen the region's use of imported fossil fuel. Such a program would also provide local economic benefits. The states chosen by SERI for Ultrasonics' analysis were selected to complement SSEC's development program. Georgia and North Carolina were selected because they have already undertaken efforts to increase usage of wood for fuel, and Alabama because it is planning to do the same.

Many different industries in the Southeastern states use process steam, but only the forest products industry is using wood combustion to any extent to generate steam. To expand the use of wood for fuel SSEC is directing its initial wood fuel market development program toward those non-forest products industries where it is most likely to be technically feasible to burn wood for fuel. Generally wood fuel must be available within 50 miles to be economically feasible. Therefore, SSEC supports a pilot project to provide site-specific technical assistance to industrial facilities in North Carolina identified as having potential to convert from fossil to wood fuel. The facility identification and technical assistance are being provided by a Wood Assistance Team (WAT) at N.C. State University (NCSU). The team includes a wood resources specialist, a wood combustion specialist, and an environmental specialist and is led by an engineering director. This is a report of the WAT evaluation of Ultrasonics' methodology and results in identifying facilities in North Carolina with high wood conversion potential.

II. ULTRASYSTEMS' METHODOLOGY

Representatives from SERI, SSEC and NCSU met with representatives from Ultrasystems and discussed the site-specific parameters that needed to be analyzed and weighed to accurately identify and prioritize facilities with high potential for conversion to wood fuel. It was agreed that current and accurate data on the facility's equipment and operation, wood fuel availability, environmental constraints, and financial feasibility were required. Ultrasystems stated that many of these data elements are currently available in FEUDS and that their market analysis methodology would utilize most of them as selection parameters. However, only upon inquiry after receipt of the first Ultrasystems' data was it revealed that the selection methodology used is based almost entirely on identifying facilities with the same 4-digit Standard Industrial Classification (SIC) codes as those known to have at least one wood burning boiler.

Ultrasystems' report indicates that the listings in Appendix A of their report result from passing the data on the over 238,000 boilers contained in FEUDS through only three screens: (1) size (2) energy process and (3) geographical. Their rationale for using only these three screens is that: (a) "...this effort was accomplished on a small contract;" (b) their proposal was to "...prioritize market segments based primarily upon facility similarities between current wood fuel users and potential users;" and (c) they were limited by "...the availability of appropriate data elements against which to screen."

The Size screen is for boilers less than 250 MM BTU/HR. Ultrasystems states "the largest size feasible is governed by two primary factors, the bulky nature of the fuel and the dispersed nature of the resource." A 250 MM BTU/HR boiler would require about two trailer loads of wood fuel per hour. Such fuel quantities would require a very large wood storage and handling system and could exceed the wood fuel supply available within a 50 mile radius. Thus wood fuel is generally not

economically feasible for boilers greater than 250 MM BTU/HR. No minimum size screen is used because the smallest emission point source identified in FEUDS is 1 MM BTU/HR.

Ultrasystems' second screening criteria is based on the logic that facilities with the same SIC code have similar processes and energy needs. They state that "Specific industries and institutions which do use wood fuels are good examples of the potential applications of wood fuels."

The Geographical screen is for locations with significant wood resources but was used only down to the state level. The 3 states chosen (Alabama, Georgia and North Carolina) by SERI have abundant wood resources throughout.

Another screen, environmental compliance, was considered but not used. Wood is less polluting than coal and generally pollution control equipment for wood is less expensive than for coal. Therefore, if a facility is having an environmental compliance problem, particularly with SO_x , conversion to wood fuel might be beneficial. Ultrasystems analyzed the environmental status of 1609 boilers in North Carolina and found only 70 out of compliance. Of those 70, only 5 did not have a variance, and only 19 boilers were out of compliance due to SO_x emissions. Because Ultrasystems' data indicated that so few boilers in North Carolina had compliance problems, Ultrasystems did not use environmental data as a selection factor.

Although WAT expected other parameters such as boiler age, steam load, and operating hours, that are available in FEUDS, to be used in the selection process, they are not. Other parameters such as conversion technology and financial feasibility are not included because the contract with SERI was time and money limited. Ultrasystems states that the contract did not allow "...a rigorous application of the general market analysis methodology or interactive analysis for the selected screening parameters."

Ultrasystems was to not only identify facilities with high potential for conversion to wood fuel but also to prioritize them by that potential.

It was expected that some type of algorithm weighing all the various site-specific selection parameters would be used to assign a priority to each facility.

Instead, Figure 2-2 of Ultrasystems' report indicates an extension of their selection methodology, which is based primarily on screening by SIC codes, would be used for prioritization. Operational and geographic parameters were apparently also to be considered, but they are not defined.

Actually, the prioritization used in their report is based on only two criteria: SIC code and "...the perceived ease of switching fuel consumption..." Facilities where fuel switching is perceived easiest get first priority. The rationale of prioritization is based on three factors: (a) access to wood fuels, (b) degree of modification required, and (c) industry precedent. Based on those factors three priority levels are defined as follows:

- First - any facility with "unused capacity to burn wood,"
- Second - forest product industries "which burn fossil fuels," and
- Third - "...other than forest product industries not burning wood but for which there is a precedent for burning wood."

Neither of the above methodologies prioritizes facilities based on site-specific data, but rather groups them by some general facility characteristic such as SIC code. The facilities are not prioritized within the group.

III. ULTRASYSTEMS' DATA

WAT is not familiar with, nor does it have access to facilities in Alabama or Georgia, therefore this evaluation is limited to North Carolina data. This is sufficient however, since Ultrasystems' selection methodology and data base is the same for each state.

Ultrasystems' report states on page 7 that certain site-specific data would be listed for each facility and two different data sets provided -- a report set and a "Limited Official Use" (LOU) set that includes coupled sensitive information.

However, on page 30 the report states that a special data form was developed for Appendix A which lists somewhat different data. The report further states that three different sets of this data would be provided -- Appendix A data, and LOU data in two different formats. WAT requested copies of the LOU data from SERI but received only one set of LOU data in Combustion Long Form format. That format lists every emissions point source at a facility, not just boilers, plus much emissions data and is very confusing. For example: a single dual-fuel boiler is listed twice, once for each fuel. Such multi-fuel listings are supposed to be connected by brackets, but were not.

A. Priority 3 Data

Priority 3 data are for non-forest products industries which are WAT's first priority and therefore were examined first. The following data are listed as priority 3 for converting to wood fuel in Appendix A:

1. Plant name and address -

42 facilities are listed, but 30 have no local address and 4 have no town listed.

2. Four-digit SIC codes -

Each of the 42 facilities has an SIC code listed.

3. Ownership -

For 41 of the facilities, type of ownership is listed.

4., Boiler Identification -

82 emissions point sources are listed for the 42 facilities, however,

15 dual-fuel boilers are each listed twice (-15),
12 boilers listed are groups (more than one boiler
per point source) (+35), and

1 boiler listed is 4 diesel units (-1).

Result: 101 boilers are actually listed.

5. Fuel Type -

82 emission point sources have fuel type listed.

Note: For the 47 individual boilers making up the 12 boiler groups, fuel type and design capacity are listed only for the boiler group, not the individual boiler.

6. Design Capacity -

82 emissions point sources have design capacity in MM BTU/HR listed.

All the Appendix A priority 3 data described above, whether listed or missing, is repeated in the LOU priority 3 data. The LOU data is an expanded data set for the 42 facilities listed in Appendix A. It contains data on 25 additional parameters (mostly emissions data) for each facility and lists all their emissions point sources (257). All that data makes it confusing and difficult to locate the data relevant to evaluating a facility's wood conversion potential. Only 104 (40%) of the emissions point sources listed in the LOU data are for boilers -- 22 additional to those listed in Appendix A and corresponding to 18 additional boilers. Two of the boilers are grouped boilers and 1 is not a boiler. The resultant total is 121 boilers at 42 facilities listed in the LOU priority 3 data. Of the 20 additional boilers listed, 9 are larger than 250 MM BTU/HR and 1 is a wood burning boiler. These 10 should not have been listed in Appendix A. But, the remaining 10 boilers should have been listed in Appendix A. Fuel type and design capacity are listed for the 104 emissions point sources.

The following data items of interest are listed in the LOU priority 3 data.

1. Boiler installation year is listed for 63 boilers at 27 facilities, but none is listed for 58 boilers at 15 other facilities.
2. Annual fuel consumption is listed for all except 1 dual-fuel boiler.
3. Although it was indicated that data on seasonality of boiler use was to be listed, none was shown in the LOU data received from SERI. However, operating schedules for 88 boilers at 35 facilities are listed.
4. Compliance status is listed for all boilers -- 102 boilers at 40 facilities are IN compliance, 8 boilers (7 coal fired, of which 5 are larger than 250 MM BTU/HR) at 2 facilities are OUT of compliance with a variance, and 11 boilers at 5 facilities have compliance status unknown.

For the 42 facilities and 121 emissions point sources listed in the priority 3 LOU data, 10% of the data mentioned above is missing. The accuracy of the listed data will be evaluated in Section IV.

B. Priority 2 Data

Priority 2 is for forest-products industries (SIC 24, 25 and 26). The following data are listed as priority 2 for converting to wood fuel in Appendix A:

1. Plant name and address -
140 facilities are listed, but 50 have no local address and 8 have no town listed.
2. Four-digit SIC codes -
Each of the 140 facilities has an SIC code listed, but 3 are not SIC 24, 25 or 26.
3. Ownership -
For 137 of the facilities, type of ownership is listed.
4. Boiler Identification -
215 emissions point sources are listed for the 140 facilities, however,
7 dual-fuel boilers are each listed twice (-7),
1 tri-fuel boiler is listed 3 times (-2),
5 boilers listed are groups (more than 1 boiler per point source) (+6).
Result: 212 boilers are actually listed.
5. Fuel Type -
215 emission point sources have fuel type listed.
Note: For the 11 individual boilers making up the 5 boiler groups, fuel type and design capacity are listed for the boiler group, not the individual boilers.
6. Design Capacity -
215 emission point sources have design capacity in MM BTU/HR listed, however, the design capacity for 1 boiler is listed as zero.

All the Appendix A priority 2 data as described above, whether listed or missing, is repeated in the LOU priority 2 data. The LOU data is an expanded set for the 140 priority 2 facilities listed in Appendix A. It contains data on additional parameters for each facility and lists all their emission point sources (914). Only 357 (39%) of the emission point sources listed are for boilers -- 142 additional to those listed in Appendix A priority 2, and corresponding to 48 additional boilers. Most of the additional point sources are for the wood burning of the co-fired and multi-fuel boilers. Seven of the boilers are grouped boilers and 1 is not a boiler. The resultant total is 260 boilers at 140 facilities listed in the LOU priority 2 data. Of the 48 additional boilers listed, 6 are larger than 250 MM BTU/HR and 37 are wood burning boilers that should not have been listed in Appendix A anyway. But, the remaining 5 boilers should have been listed in Appendix A. Fuel type is listed for 357 emissions point sources and design capacity for 353 of them.

The following items of interest are listed in the LOU priority 2 data.

1. Boiler installation year is listed for 258 boilers at 140 facilities.
2. Annual fuel consumption is listed for 247 boilers and design firing rate for 244 boilers.
3. Operating schedules for 240 boilers at 135 facilities are listed.
4. Compliance status is listed for all boilers -- 230 boilers at 118 facilities are IN compliance, 10 boilers at 7 facilities are OUT of compliance with a variance, 2 boilers at 2 facilities are OUT of compliance without a variance, and 18 boilers at 14 facilities have compliance status unknown.

For the 140 facilities and 357 emission point sources listed in the priority 2 LOU data, 4% of the data mentioned above is missing. The accuracy of the listed data will be evaluated in the following section.

IV. EVALUATION OF ULTRASYSTEMS' REPORT

Each member of the WAT was given a copy of Ultrasystems' report and access to the corresponding LOU data and requested to evaluate Ultrasystems' selection methodology and list of potential wood conversion candidates. From their prospective and using their expertise each team member made an independent written evaluation of the report. The consensus of their findings and opinions is contained in this evaluation report.

It was planned for WAT to use the list of non-forest products industries identified and prioritized by Ultrasystems for conversion from fossil to wood fuel as a basis for developing a list of facilities with high wood conversion potential to whom WAT would provide site-specific technical assistance. WAT's consensus is that Ultrasystems did not meet the objective of providing a suitable list of non-forest products facilities. WAT disagrees with Ultrasystems' statement that the primary wood energy market yet to be developed is "...the acceleration of forest products industry conversions..." and the resulting assignment of priorities 1 and 2 to current wood fuel users and forest products industries.

Facilities outside the forest products industry were assigned a priority 3, however, for the WAT project they are number 1 priority. The main thrust of SSEC's WAT project is to extend the knowledge, technical credibility and economic feasibility of using wood for fuel developed by the forest products industry to those outside the industry.

A. Data

Since all the data in Appendix A, listed or missing, is repeated in the LOU data, WAT's evaluation concentrated on the LOU data. However, any problems associated with the first 6 data items are equally applicable to the Appendix A and LOU data. Also since WAT's first priority is non-forest products industries, WAT first checked on the priority 3 data. Later checks on the priority 2 data revealed similar omissions and problems.

1. Priority 3 Data

The purpose of Ultrasystems' report is to identify facilities with wood conversion potential, not for statistical analysis, but so WAT can contact and visit them to offer technical assistance. The list of 42 priority 3 facilities in Appendix A provided no easy means of contacting the facilities and is very incomplete in identifying them fully and giving their actual location. No telephone numbers or contact persons are listed for any facility and only 6 have any type of street address listed. It was apparent that before WAT could make any use of the list it would have to be completed and corrected. To check the accuracy and provide the additional information needed, the names, addresses and SIC codes of the 42 facilities listed were checked against the 1979-80 N.C. Directory of Manufacturing Firms (which lists almost 7,000 firms) and similar publications. Verification or information to resolve discrepancies was obtained by telephone. No facility had a completely correct name, street address, town and ZIP code listed. Only 11 had names and addresses complete enough that they could be identified, and many of those were colleges. For the remainder, even with directory information it was difficult to identify a particular facility because in many towns companies have several plants, and the exact plant on Ultrasystems' list is seldom identified.

After much effort at name and address completion and correction which included 7 names, 22 street and mailing addresses, 5 towns and 29 ZIP codes, 34 identifiable facilities resulted. Further calls to parent companies, Chambers of Commerce and real estate agencies revealed that the 8 remaining facilities were out-of-business and had been for several years. In several instances information was very difficult to obtain because the facility had been sold and a new business started which had also gone out-of-business and some people did not remember the previous business name that Ultrasystems listed.

All 42 facilities have SIC codes listed but only 22 were correct, mostly colleges. Two facilities have SIC 25 codes and are therefore priority 2. Ultrasystems lists only 1 textile SIC code as using wood fuel - SIC 2299, and all 15 textile facilities were listed as SIC 2299. However, 1 facility is SIC 25 and another SIC 28, and while the rest are in the SIC 22 group, none is SIC 2299. After these corrections only 23 priority 3 facilities with 86 boilers remain listed in the same SIC codes as known wood burning facilities.

The missing ownership listing for 1 college was provided and 10 boilers listed in the LOU data should have been listed in the Appendix A data. All boilers listed in both Appendix A and the LOU data are identified and have fuel type and design capacity listed. However, 11 boilers listed in Appendix A plus 2 additional ones in the LOU data are really groups, and it is assumed that the fuel type is the same for each of the boilers. Additionally the design capacity listed is for the boiler group and no individual design capacity is listed for the 44 and 49 boilers listed as groups in Appendix A and LOU data respectively. Also 1 facility has 2 boilers listed which are not boilers, and the balance are larger than 250 MM BTU/HR. Five of the boilers at another facility are larger than 250 MM BTU/HR.

After correcting the six data items discussed in Section III only 22 of the original 42 facilities can be classified as priority 3 wood burning candidates. Of those, only 6 facilities with 9 boilers are non-forest products industry manufacturing firms.

The information on 4 other data items discussed in Section III was checked for completeness and some of it appears questionable.

(a) Boiler installation years ranging between 1952 and 1975 are listed for 63 boilers to 27 facilities. According to the data, boilers were only installed in 10 of those years and 51% were installed in 1963.

(b) Fuel consumption is listed for all but 1 dual-fuel boiler. However, at many multi-boiler facilities the fuel consumption of an individual boiler is the exact pro-rata portion (based on boiler size) of the facility's total fuel consumption. In addition the fuel consumption listed for some boilers is such that a boiler of the listed capacity would have to operate continuously at over 100% load.

(c) No operating schedule is listed for 7 facilities with 33 boilers.

(d) The compliance status for 11 boilers at 5 facilities is listed as unknown. It is unknown as to whether that means Ultrasonics doesn't know the compliance status or that the compliance status has not been determined. In addition the emission data listed for many boilers are in exact pro-rate proportion to their size. Further checking revealed much of the data in question was inaccurate.

The LOU data does contain additional information that is relevant to identifying facilities with wood fuel conversion potential but the data format obfuscates much of that data and includes much emission data that is not relevant to identifying wood conversion candidates. To check the accuracy of the data on fuel type, boiler capacity, annual fuel consumption, operating schedule, boiler installation year, and emission compliance status; a cross-section of 12 facilities was selected as a sample and further checks were made on each by telephone or visit.

Six of the facilities checked have more boilers than are listed in the report and most of the boilers not listed have been installed for at least 5 years. Seven facilities have incorrect boiler sizes listed, 4 have the wrong fuel listed, 3 have incorrect operating schedules listed and all fuel consumption data is out-of-date. The data listed is not completely correct for any single facility checked.

At several facilities the data listed in the report is so different from the data being received from the operating personnel that it is difficult to correlate. For example: at one facility there is no correlation whatever, and the plant engineer finally realized that the data listed in the report is for an old section of the plant which has been closed five years. Conversely data was received from him for a section of the plant that has been in operation since at least 1960, yet no data is listed in the report for it.

Many of the inaccuracies in the data can be attributed to being out-of-date. Ultrasonics states the FEUDS is based on "...EPA's National Emissions Data System which is updated by EPA on an annual basis with new input data received from semi-annual surveys. Any fluctuation in the configuration of the plant which affects an emission point source will be recorded by FEUDS." Yet for their report written in 1979, none of the data is more current than 1977, and over 60% is over 5 years old. In the rapidly changing energy field that is too old.

Therefore, while some of the facilities identified may have some conversion potential, they cannot be properly evaluated from the information listed. WAT's consensus is that the data base relevant to non-forest products industries facilities checked is incomplete and contains inaccuracies and much emissions data of limited usefulness. There is no reason to believe the balance of the data base is different or would produce better results.

2. Priority 2 Data

The priority 2 data was next checked by WAT in a manner similar to that used on priority 3 data. WAT does not believe the priority 2 forest products industries facilities have the potential for expanded wood fuel usage that the priority 3

facilities do. Therefore, WAT did not expend as much time and effort on verifying, correcting and evaluating the priority 2 data that it expended on the priority 3 data.

As in the priority 3 data, no telephone or contact persons are listed for any facility, and street addresses for only 42 of them, making it difficult to contact or visit them without obtaining additional information. The 1979-80 N.C. Directory of Manufacturing Firms was again used to obtain some of the missing information and check the accuracy of the names, addresses and SIC codes of the 140 priority 2 facilities listed. No facility has a complete name, street address, town and ZIP code listed. However, 50 have names and addresses complete enough to identify them initially. Fifty-seven more facilities were identified after their names and/or addresses were corrected, but 33 facilities can still not be identified. WAT believes many of the unidentified priority 2 facilities have problems similar to the priority 3 unidentified facilities. Consequently, the additional effort required to verify that conclusion is not warranted.

All 140 priority 2 facilities have SIC codes listed but 36 were incorrect. After correction 1 facility has a priority 3 SIC code and 2 facilities have SIC codes not burning wood. Therefore, after correcting names, addresses and SIC codes, 104 facilities with 207 boilers are accurately listed in priority 2. However, only 50 facilities with 66 boilers are not already burning wood, and 54 of those boilers are smaller than 250 MM BTU/HR. Therefore, only 10 facilities with 12 boilers listed in priority 2 have high potential to convert to wood fuel.

Much of the additional data, though not fully checked, is questionable:

- (a) At 33 facilities with 49 boilers, all boilers listed are burning some wood and it appears they are being co-fired, and therefore should be priority 1, not priority 2.

(b) In priority 3, 51% of the boilers have 1963 listed as the installation year, but checking revealed that to be incorrect, similarly 69% of the boilers in priority 2 have 1963 listed as the installation year.

(c) As in priority 3, the fuel consumption and emission of a boiler at a multi-boiler facility is often listed as the exact pro-rata proportion (based on boiler size) of a facility's total fuel consumption and emissions.

Other data, similar to that which was proved inaccurate in priority 3, have patterns that appear questionable. WAT's consensus is that the priority 2 data have problems similar to the priority 3 data, as would be expected since both come from the same data base; therefore, further checking would not be productive. Furthermore, since the results and problems of the priority 2 and priority 3 data are similar, the balance of this evaluation report will be limited to priority 3 data which is WAT's first priority, and which was most thoroughly checked.

B. Methodology

WAT's consensus is that Ultrasystems' identification and prioritization methodology are inadequate and mis-directed. The selection methodology is inadequate in that it is based on only 3 parameters:

1. boiler size - greater than 250 MM BTU/HR ^{is not consistent} (less than)
2. process energy - only facilities having the same 4-digit SIC code as those currently using wood fuel, and
3. geographic location - Alabama, Georgia, and North Carolina.

The whole premise is mis-directed. It depends on comparison with facilities now burning wood, however, 94% of them are forest products industries. The priorities are similarly mis-directed and inadequate. Priority 1 is for current wood users and priority 2 is for forest products industries. Thus priority assessment is based on membership in a group rather than weighing site-specific parameters for individual facilities.

1. Boiler Size

As discussed above, because of economics and fuel supply restrictions, boilers greater than 250 MM BTU/HR are not generally good wood conversion candidates and Ultrasystems uses that upper limit on boiler size screening. WAT believes that may be too large. WAT is primarily interested in non-forest products industries facilities and they generally do not have large boilers, so WAT believes initially 200 MM BTU/HR should be the upper size limit as that covers over 98% of the boilers in North Carolina.

On the other end of the boiler size scale, Ultrasystems states that economics do not justify burning wood in small boilers because the fuel handling equipment is disproportionally costly versus the resultant fuel savings. However, as shown in Figure 2-3 of their report 745 or 51% of all the wood burning boilers they have identified in the U.S. are smaller than 20 MM BTU/HR. And since 50% of all the boilers listed by Ultrasystems in North Carolina (Appendix C) are smaller than 20 MM BTU/HR, no lower boiler size screen was used. (Actually 1 MM BTU/HR is the lower limit since nothing smaller is listed in FEUDS.) Of the 745 wood burning boilers listed smaller than 20 MM BTU/HR, 694 or 93% are at forest product industry facilities. They are generally burning wood waste which is available at little cost as a by-product of their operation. Most of the boilers were not installed originally as wood energy systems and have no fuel handling systems. Most were originally installed as incinerators, and some may be old coal boilers. Therefore, most are special situations and not applicable to non-forest products industries facilities.

Outside the forest products industries small wood energy systems are not economically feasible because of their long pay back period. Therefore, it is WAT's consensus opinion that facilities with boilers or steam loads smaller than 20 MM BTU/HR are not prime conversion candidates. Fuel cost savings resulting from converting to wood from fossil fuel are

approximately linearly related to boiler size. However, wood is a bulky fuel and a wood energy system requires a fuel handling and storage system whose cost is not linearly related to boiler size. Therefore, it may take longer to pay back the investment in a small wood energy system from fuel cost savings than most industries will accept.

Therefore WAT believes that only facilities with boilers between 20 and 200 MM BTU/HR have high wood conversion potential. If that restriction is applied to the boilers still listed in the priority 3 LOU data, 31 boilers smaller than 20 MM BTU/HR and 4 boilers larger than 200 MM BTU/HR would be deleted. There would remain 8 boilers at 3 facilities between 20 and 200 MM BTU/HR, plus 35 small boilers at 8 other facilities with total steam loads greater than 20 MM BTU/HR. One of those facilities is an oil terminal with 2 small boilers and really should not be included. However, the 10 remaining facilities with 41 boilers can still be considered to have some wood conversion potential, but other limitations discussed below will reduce the number further.

2. Process Energy

Ultrasystems' "process energy" is their primary selection parameter. Their premise is to identify all the wood burning combustors in the U.S. and presume that any facility with the same SIC code as one burning wood is a prime candidate to convert to wood fuel. WAT contends that there is no foundation to support this premise. This logic eliminates from consideration the expansion of wood fuel to other industries. It also causes an entire industry to be selected if just one firm in the U.S. in that SIC code is burning wood.

Outside the forest products industries (SIC 24, 25, and 26) only 94 (.04%) of the 238,000 combustors in the FEUD's data base are burning wood. Of the 18 2-digit SIC codes where wood is being burned 13 have less than 5 boilers using wood for fuel.

Of these 4 different 2-digit SIC codes have just one boiler each burning wood. The number of wood burning boilers in many of these SIC codes is just too few upon which to base industry wide projections. Unusual conditions that may have caused a firm to convert to wood fuel are not taken into account thus causing all firms with the same SIC codes to be classified as prime candidates.

There is some question about how many wood burning combustors there are and their respective facility SIC codes. Figure 2-3 of Ultrasonics report lists 1465 wood burning combustors, but Figure 2-4 indicates there might be 2389. However, in Appendix F of their report only 806 wood burning combustors are listed plus 428 more burning wood and other fuels. In Figure 2-3 the 1465 wood burning combustors are grouped under 21 different 2-digit SIC codes, however, in Appendix D the 21 SIC codes are broken down into seven 2-digit codes and 34 4-digit codes.

Under 7 of the 2-digit SIC codes in Appendix D no 4-digit codes are listed. There are 145 possible 4-digit SIC codes under those 7 2-digit SIC codes, but only 16 wood burning boilers listed under those 7 2-digit SIC codes. Process energy comparison is defined as being between 4-digit SIC code facilities. Therefore, to which of the 145 possible 4-digit SIC codes do the 16 wood burning boilers belong? This is confusing, but even if the data was clear the premise is too restrictive, non-definitive and insufficient.

The premise is too restrictive in that there may be facilities in other SIC codes whose energy needs could also be met by wood fuel. It would be better to identify those industrial processes whose energy needs can feasibly be met by wood fuel and then screen for facilities using those processes in any SIC code.

The premise is non-definitive in that while the processes and energy needs of some facilities with the same SIC code are similar, many are very different particularly across a 2-digit SIC

group. Energy profiles for facilities where wood fuel is feasible could be developed and would be of use in identifying facilities with conversion potential.

The premise is also insufficient in that every facility with an SIC code where wood fuel is used cannot feasibly use wood fuel. For example: 4 oil terminals are listed in priority 3 as potential conversion sites because somewhere in the U.S. there are 2 boilers at oil terminals burning wood. However, WAT does not believe that qualifies all oil terminals as potential wood fuel users.

3. Geographic Location

As stated, for wood fuel to be economically feasible it generally has to be available within 50 miles of the facilities at which it is to be used. Therefore, any facility identified as a potential wood fuel user must be within 50 miles of an adequate wood fuel supply. However, in the facility selection methodology used for the Ultrasystems' report the only geographic screen used was for whole states, and no consideration was given to available fuel supply. It was stated that for the 3 states selected, abundant fuel supplies were available throughout, but that does not assure that wood fuel will be available at any given facility. When applied to other states a much more limited geographic screen based on wood fuel availability would be needed.

Therefore, as stated the selection methodology that uses only 3 parameters is inadequate.

(a) Boiler size - 1 to 250 MM BTU/HR includes over 98% of all boilers and is therefore almost meaningless.

(b) Process energy - selecting only facilities with 4-digit SIC codes matching those of current wood burning facilities is too restrictive. It eliminates many facilities whose energy needs and processes could be satisfied by wood fuel.

(c) Geographic location - selecting a whole state is not restrictive enough to define the availability of significant wood resources.

4. Other Parameters

Although the above three were the only parameters used by Ultrasystems, WAT believes other parameters must be considered to properly identify facilities with high wood fuel potential. For example: Wood fueled boilers do not respond as quickly to rapid steam load changes and take longer to start and shut-down than fossil fueled boilers. Therefore, a steady steam load and infrequent starts and stops are required for a facility to have high wood fuel potential. Due to the high capital investment necessary for wood burning equipment a boiler should also be operated a minimum of 6000 hours per year to be considered a prime conversion candidate.

Other parameters needing to be considered include boiler age and utilization factor, compliance status, fuel storage space available, availability and cost of wood fuel, financial feasibility and expansion plans. Most of the data elements required are supposed to already be in Ultrasystems' data base.

C. Prioritization

Ultrasystems' priority methodology is an extension of their selection methodology and is based primarily on SIC codes. Priorities 1 and 2 are for wood users and forest products industries respectively, while priority 3 is for non-forest products industries. WAT and SSEC believe priority 3 should be the first priority because they are convinced that a major new market for wood fuel usage is in the non-forest products industries. Current wood fuel users and forest products industries familiar with and having access to wood fuel will increase their usage without outside assistance as the price of fossil fuel increases and/or its availability decreases. However, non-forest products industries may not undertake wood fuel usage

because of lack of knowledge about wood fuel's economic and technical feasibility without the information and technical assistance WAT will provide.

Also no prioritization is given to facilities within the groups. WAT recommends an algorithm be developed to weigh the various parameters at each facility, and prioritization, like identification, should be on a site-specific basis. Individual consideration must be given to a number of the site-specific parameters discussed above. A weighing of those parameters, especially by computer, would provide the individual facility prioritization needed.

D. Data Limitations

Ultrasystems' selection methodology is rather open ended in that it was to select any facility in North Carolina with any one of 41 SIC codes and a boiler between 1 and 250 MM BTU/HR. There are many more facilities in North Carolina with boilers in this size category than were identified by Ultrasystems. There WAT contends that many North Carolina boilers are not included in Ultrasystems' data. The following analysis supports that conclusion:

1. The Boiler Inspection Division of the North Carolina Department of Labor states there are over 70,000 pressure vessels in North Carolina and at least 5000 of them are boilers between 1 and 250 MM BTU/HR. Yet in Appendix C Ultrasystems states it analyzed for compliance all the boilers in North Carolina for which it has data -- only 1609.
2. In Appendix D Ultrasystems lists 13 SIC codes of non-forest products manufacturing facilities using wood fuel. North Carolina Department of Commerce figures for 1981 indicate there are 1640 facilities in North Carolina in those SIC codes. Based on responses from facilities with those 13 SIC codes to WAT's boiler survey, WAT projects there are at least 135 such facilities in North Carolina with 290 boilers between 1 and 250 MM BTU/HR. Ultrasystems listed only 15 such manufacturing facilities with 24 boilers, or about 10% of them.

3. No high priority wood conversion facilities in North Carolina were selected by Ultrasystems from 5 of those 13 SIC codes. North Carolina Department of Commerce figures lists 1347 facilities in North Carolina in those 5 SIC codes. Based on responses from facilities with those 5 SIC codes, WAT projects there are at least 25 such facilities in North Carolina with 55 boilers between 1 and 250 MM BTU/HR.
4. In Appendix C Ultrasystems identifies 198 boilers between 1 and 250 MM BTU/HR at facilities with the same SIC codes as those burning wood. Assuming the same ratio of multi fuel boilers, grouped boilers and boilers to facilities as are in the report, Ultrasystems should have identified 80 facilities with 162 boilers in the LOU data as having wood conversion potential. However only 42 facilities with 85 boilers are identified in the LOU data, or about 50%.

The above examples indicate that Ultrasystems' data base does not contain many of the priority 3 facilities in North Carolina. WAT estimates that at best less than one-half of the priority 3 facilities are listed and it appears that Ultrasystems' selection methodology can only identify about one-half of those. When the realistic boiler size and operating hours discussed previously are applied to the 22 facilities and 78 boilers that remained after corrections, only 2 facilities with 3 boilers can be identified as having high potential for conversion to wood, and neither of them is a manufacturing firm. Therefore Ultrasystems' data and selection methodology indicates they could only identify less than 10 facilities in North Carolina with high wood conversion potential.

By comparison, WAT's selection methodology identified 102 facilities with high wood conversion potential in North Carolina, and 22 of those are in the same SIC codes as those shown by Ultrasystems to burn wood. WAT projects that there are at least twice that many facilities with high wood conversion potential in North Carolina. Another survey limited to

manufacturing firms in a 20 county area identified 9 facilities in the same SIC codes as those known to burn wood with conversion potential, whereas Ultrasystems listed only 4 for that area. Therefore, it appears that selection methodologies such as WAT's and others identify more facilities with wood conversion potential than Ultrasystems' selection methodology does.

V. CONCLUSIONS

After a thorough evaluation of the Ultrasystems' report, the North Carolina Wood Assistance Team concluded that the Ultrasystems' data base and methodology are of little value in selecting facilities with a high potential for converting to wood for fuel. The data used is incomplete, inconsistent, out-of-date, and inaccurate. The selection methodology utilizes too few site-specific parameters and is based on some unsupported assumptions.

Ultrasystems' selection procedure produced a list of 42 high potential wood conversion (priority 3) facilities in North Carolina. However, after WAT corrected their data and reapplied their selection methodology, only 22 of the facilities listed could still be considered candidates. Twenty of these 22 facilities were eliminated because they had small boilers and/or operated too few hours to be economically considered candidates for converting to wood fuel. Therefore, only 2 or 5% of the 42 facilities selected by Ultrasystems have a high potential for burning wood for fuel. There are several problems with the selection methodology that caused the poor results.

WAT's consensus is that Ultrasystems' selection methodology considers too few parameters. (1) Boiler size - 1 to 250 MM BTU/HR identifies too many small boilers for which wood fuel is not economically feasible. (2) Process energy - Selecting only facilities with the same 4-digit SIC codes as those currently using wood fuel is too restrictive and eliminates many facilities whose energy needs could be met by wood fuel. The assumption to choose facilities like

those already using wood is based on only 94 non-forest products facilities in the U.S. Most of the time the use of wood fuel by only one or two facilities caused an entire industry group to be selected irregardless of their reason for burning wood. (3) Geographic location - Selecting a whole state because it has abundant wood resources is insufficient to assure that every facility selected within that state will have access to a wood fuel supply.

Those 3 parameters alone are not adequate to properly identify facilities with high wood conversion potential. Site-specific parameters such as steam load variations, operating schedule, boiler age, space availability, environmental compliance status and local wood availability should also be incorporated into the selection methodology.

Based on the data for the facilities selected, the FEUDS data base used by Ultrasystems is incomplete and inaccurate. Not a single one of the 42 facilities selected has complete and accurate data listed. The latest data listed is for 1977, and 60% of it is more than 5 years old. In some cases where a facility has more than one boiler, the fuel consumption and emissions data listed were just pro-rated among the boilers based on size. For some facilities, emissions point sources listed under boilers are not really boilers, but diesel units, furnaces, turbines, etc. In addition to these and other drawbacks the data format is very confusing and contains far more emissions data than is necessary to identify potential wood conversion facilities.

After a thorough and detailed evaluation WAT concludes that the Ultrasystems' report does not meet its goal of identifying high potential wood conversion facilities. The selection and prioritization methodologies do not consider enough site-specific parameters. The data base used does not include all facilities with boilers and contains much out-of-date and inaccurate data. In summary the report is inconsistent, the results are limited and